A Critical Review of Risk Factors of the Gaming Industry in Macau

Prof. Xing Wen Xiang
Dr. L. C. Koo
Dr. Eva Y.W. Khong

Abstract:

Macau has a thriving gaming industry which is crucial to the economic success currently. However, the global economy is inevitably affected by the European debt crisis and a fragile U.S. economy. In addition, with the Mainland economy showing signs of a slowdown, in the face of uncertainties around in Macau, it is a point in time to critically review the factors that may adversely affect the long term, healthy, and harmonious development of the entire gaming industry. We need to be vigilant in peace time through developing and maintaining an effective risk management mechanism to ensure the sustained development of the gaming industry. The operational definition of risk in the industry is explored in this study. This research adopts the Hierarchical Holographic Modeling (HHM) approach to structurally and systematically identify, filter, rank, and evaluate the risks and crises for the gaming industry in Macau. Through a series of focus group meetings supplemented by four rounds of Delphi questionnaires, 18 risk factors are identified. The MDS together with the correlation coefficients among the18 risks produce a Risks Interconnection Map (RIM) to clearly depict the relative positions and association among the 18 risk factors. The research findings would provide a useful reference for the stakeholders in the industry.

Key words: Hierarchical Holographic Modeling (HHM); Delphi questionnaires; Multi-Dimensional Scaling (MDS); Risks Interconnection Map (RIM)

Development of the Gaming Industry in Macau

The gaming tax has been the principal income of Macau since licensed gaming began in 1847. First monopoly on casino was granted to Tai Hing Company in 1934. The casino monopoly franchise was changed to STDM in 1962 until 2001. In 2001, the Macau government terminated the monopolistic environment and planned to give out three licenses to increase competition. Twenty-one bids were received and, in February 2002, three were granted the gaming concession, namely the Sociedade de Jogos de Macau (SJM), Galaxy Casino (Galaxy) and Wynn Resorts Macau (Wynn). SJM signed an 18-

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year concession valid through March 31, 2020. SJM is 80% owned by STDM, which is 15.8% owned by Shun Tak and 30% owned by Stanley Ho. Wynn signed a 20-year concession valid through June 26, 2022. US-listed Wynn Resorts, Ltd owns 90% of the vote and 100% of the economic interest in Wynn. In March 2006, Wynn sold its gaming license sub-concession to Publishing and Broadcasting Limited (PBL) of Australia for US$900 million. Galaxy also signed a 20-year concession valid through June 26, 2022. In December 2002, Galaxy granted a sub-concession to Venetian Macau S.A. (Sands), a wholly owned subsidiary of US-listed Las Vegas Sands Corp, which runs Venetian Las Vegas. The market share among the six gaming operators (Macao Daily Times, 2012 February 1) are: SJM 27%; Galaxy Entertainment Group 19%; Sands China Ltd. 19%; Melco Crown 13%; Wynn Macau 12%, and MGM China 10%.

The growth of the industry has been moderate until its liberalization in 2004 and since then the growth has been very rapid. The gaming tables have grown from 340 to 5498 in July 2012 (Macao Daily News, 2012 July 17). The slot machine number has increased from around 1,000 to over 17,000 during the period. The casino revenues in Macau first overtook that of Las Vegas Strip in 2007, and those of Nevada and New Jersey combined in 2009. The gaming revenues of the largest operator SJM alone have already exceeded those of some 40 casinos in Las Vegas Strip in 2010 (Hong Kong Commercial Daily, 2011 May 13). In the 2012 policy address, the Macau Chief Executive Fernando Chui Sai On mentioned that while strengthening and deepening the stable development of the tourism and gaming industries, the government is moderately adjusting the growth of gaming industry. Stronger supervision of the gaming industry develops and upgrades integrated tourism relevant industries and promotes a diversified economy. The government has announced a maximum number of gaming tables, set at 5,500 within three years beginning in 2010, and strictly controls new casinos and gaming tables. The relevant bureaus also strictly regulate commission related to junkets (this cannot exceed 1.25% of the betting amount), and continues to strengthen video surveillance in casinos. By the end of 2012, the government will complete the auditing works of cage procedures operated by the six gaming concessionaires, and will encourage them to build internal surveillance systems in accordance to their own needs. In addition, the government will look to revise minimum internal surveillance requirements and strengthen financial audits in the six gaming concessionaires. The government continues to study the sports gambling market and will create a working team in 2012 to implement relevant plans. The government continues to develop responsible gaming (Jornal Do Cidadao, 2011 November 16).

Risk

Risk can be viewed qualitatively as the result of a threat with adverse effects to a vulnerable system.

Quantitatively, risk is a measure of the probability and severity of adverse effects. Risk is either a condition of, or a measure of, exposure to misfortune - more concretely, exposure to unpredictable losses. Risk has three distinct aspects related to the anticipated values of unpredictable losses. The three facets are Expected Loss, Variability of Loss Values, and Uncertainty about the Accuracy of Mental Models intended to predict losses (Bostrom and Cirkovic, 2008; Chittester and Haimes, 2004). Risk is the potential of a disaster occurring and is measured by how likely this is to happen and how badly it will hurt (Wallace and Webber, 2004). In this study, a gaming industry risk is operationally defined as any event that will affect the long term, healthy, and harmonious development of the entire gaming industry. Risk is a creeping event and crisis refers to event with lower occurrence probability but more severe consequence e.g. war, racial killing, collapse of major infrastructure building, or natural catastrophe.

Molak (1997) suggests that risk assessment is a process whereby the nature and size of a risk are assessed and characterized. Risk management is a process whereby the ways in which a risk may be abated or eliminated, or its consequences mitigated, are developed, and appropriate ways are chosen and implemented. A Key Risk Indicator (KRI) is a measure to indicate the potential presence, level, or trend of a risk. A KRI indicates whether a risk has occurred or is emerging, a sense of the level of the risk exposure, the trending of and/or changes in risk exposure. KRIs can provide information about a risk situation that may or may not exist and serves as a signal for further action. When developed and implemented properly, KRIs can provide significant insight into changes in the risk profile and bring strategic and operational value to an organization (Fraser and Simkins, 2010). A systemic risk (i.e. crisis) is the potential loss or damage to an entire system as contrasted with the loss to a single unit of that system. Systemic risks are exacerbated by interdependencies among the units often because of weak links in the system. These risks can be triggered by sudden events or built up over time with the impact often being large and possibly catastrophic (World Economic Forum, 2010).

The risk-management process involves the following key steps (Alizadeh and Nomikos, 2009):

1. Identification of all significant risks affecting the value of the company (risk identification);
2. Evaluation of the potential frequency and severity of losses due to those risks (risk evaluation);
3. Development and implementation of appropriate methods for the management of the risks (risk management);
4. Monitoring the performance and suitability of the risk management methods and strategies on an ongoing basis (risk monitoring)

According to Chittester and Haimes (2004), risk assessment and management is a process that builds on two sets of triplet questions. In risk assessment, the following questions are addressed:

-What can go wrong?

-What is the likelihood that it would go wrong?

-What are the consequences?

Answers to these three questions help identify, measure, quantify, and evaluate risks and their consequences and impacts. Risk management builds on the risk assessment process by answering the following three questions:

-What can be done and what options are available?

- What are the associated trade-offs in terms of all costs, benefits, and risks?

-What are the impacts of current management decisions on future options?

Hierarchical Holographic Modeling (HHM)

HHM is a holistic methodology aimed at representing the essence of the inherent diverse attributes of a system - its multiple aspects, perspectives, facets, views, dimensions, and hierarchies. The term holographic refers to the approach of a multi-view image of a system when identifying vulnerabilities. Views of risk can include (1) economic, (2) health, (3) technical, (4) political, and (5) social systems. In addition, risks can be geography related and time related. The term hierarchical refers to the desire to understand what can go wrong at many different levels of the system hierarchy. HHM recognizes that for the risk assessment to be complete, there are macroscopic risks that are understood at the upper management level of an organization that are very different from the microscopic risks observed at lower levels (Chittester and Haimes, 2004; Borstrom and Cirkovic, 2008). The HHM methodology generates a comprehensive set of sources of risk, i.e., categories of risk scenarios. These sources are discriminated as to the likelihood and severity of their consequences, systematically on the basis of principled criteria and sound premises. For this purpose, the proposed methodological framework for risk filtering and ranking is based on the following considerations:

- It is often impractical to apply quantitative risk analysis to hundreds of sources of risk. Qualitative risk analysis may be adequate for decision purposes under certain conditions.
- All sources of evidence should be harnessed in the filtering and ranking process to assess the significance of the risk sources. Such evidence includes common sense, professional experience, expert knowledge, and statistical data.

Risk assessment covers risk identification, quantification, and measurement while risk management deals

with the creative identification and meaningful evaluation of risk mitigation options to address the risks effectively. The Risk Filtering, Ranking, and Management (RFRM) method involves eight phases (Horowitz and Haimes, 2003; Haimes, Lambert, Kaplan, Pikus, Leung, 2002; Haimes and Weiner, 1986):

Phase I. Scenario Identification - a Hierarchical Holographic Modeling is developed to describe the as-planned scenario

Phase II. Scenario Filtering - the risk scenarios identified in Phase I are filtered according to the responsibilities and knowledge of the domain experts

Phase III. Bi-Criteria Filtering and Ranking - based on likelihood and consequences

Phase IV. Multi-Criteria Evaluation – based on criteria of risk

Phase V. Quantitative Ranking - the filtering and ranking of scenarios continues based on quantitative and qualitative matrix scales of likelihood and consequence, as well as ordinal-scale response to scenario resiliency, robustness, and redundancy

Phase VI. Risk Management - intelligence collection options for dealing with the filtered scenarios are identified, and the cost and the potential for prevention for each event are estimated.

Phase VII. Safeguarding Against Missing Critical Items - scenarios previously filtered out in Phases II to V are re-examined and compared to the consequences, cost, and preventive potential of the selected options

Phase VIII. Operational Feedback - experience and information gained during this application are used to refine the scenario filtering and decision processes in earlier phases.

A very large number of risk scenarios, hierarchically organized into sets and subsets, are generated through HHM. The RFRM then ranks the elements of the scenario model, giving strong preference to those elements that are considered most important from several different areas of expertise (Horowitz and Haimes, 2003). In this paper, only the first five phases of the RFRM method are used. Phases VI to VIII involve the implementation of the risk management and feedback and are outside the scope of this study.

Research approaches

Owing to the uniqueness of the gaming industry, judgmental sampling approach was adopted. Samples are drawn based on some criteria which are appropriate for the study. The criteria used in this study include: education level, place of residence, and type of career. The group of respondents that participated in the Delphi method and focus groups are either academia with doctorate degree or professors in various universities in Macau, Hong Kong and China or they hold at least five years of managerial positions in the gaming industry. The other groups of respondents are Macau residents pursuing university education. They were selected because of their knowledge about Macau's gaming industry. A total of 236 sets of

risk questionnaires were collected and 253 sets of MDS questionnaires were collected.

A core working team comprising of risk management experts from Macau and Hong Kong and industry veterans was formed in July, 2011 to design, implement and monitor the entire research process. Four rounds of focus group discussions and numerous working meetings among the core working team members were held in Macau, Guangzhou, and Hong Kong. The qualitative comments from the focus groups were analyzed and the findings were constantly cross-validated and triangulated with the quantitative Risk questionnaire (Appendix 1 is the final version after four rounds of Delphi questionnaire reaching near consensus view among the experts in the core team). The second questionnaire was designed to adopt Multi- Dimensional Scaling technique to plot the relative perceptual map of the final 18 risk factors among the respondents (Appendix 2). Initially 20 risk factors were preliminarily identified through various focus group meetings using the RFRM Method. The Delphi Risk questionnaires were sent to academic experts, gaming practitioners, and representatives from NGOs (a total of 55 experts and 32 veterans participated). Academic experts are invariably doctoral degree holders or professors in universities in Macau, Hong Kong, and China. Industry veterans have at least over five years of managerial experience in the gaming and/or NGO businesses. Four rounds of Delphi Risk questionnaires were distributed and after consolidating a series of their findings, the questionnaire was gradually revised to 18 risk factors (see Appendix 1).

Five dimensions of risk are used to measure the risks, viz., severity, probability, detectability, the product of severity and probability, and the product of severity, probability, and detectability (i.e. the Risk Priority Number, RPN). The participants comprise of three unique groups, i.e. the academic, veteran professional casino employees, and university students in Macau. Two sets of questionnaires were administered. One is called the risk questionnaire which measures the perceived extent of severity, probability, and detectability of the 18 risks by a total of 236 respondents. The other questionnaire aims to collect the perceived ranking scores of relative similarity and dissimilarity of the same 18 risks to generate various perceptual maps among 253 respondents using Multi-Dimensional Scaling (MDS) technique. The MDS together with the correlation coefficients among the18 risks produce a Risks Interconnection Map (RIM) to clearly depict the relative positions and association among the 18 risk factors. Five basic risk categories are revealed from the MDS analysis, viz.: Human Resources; Macau Government Policy; Crises; Customer Source from China; and Commercial Issues. These 18 risk factors are further studied by exploratory factor analysis using the five dimensions respectively.

Most risk analysts quantify the severity and probability of risk in the assessment of risks. In this study the core research team agreed the inclusion of a third dimension of risk quantification, i.e. detectability as used in Failure Modes and Effect Analysis (FMEA). Failure Modes and Effects Analysis (FMEA) as a quality management method used in risk assessment in product design, is a systematic group of activities intended to do three things: (a) recognize and evaluate the potential failures of a product or process and the effects of those failures, (b) identify actions that could eliminate or reduce the chance of potential failures occurring, and (c) document the entire process (Meyer, 2000; Crane and Crane, 2006). FMEA is used to predict and manage risks for products and it is used to quantify more systematically the true extent of external risks. Using the FMEA method, the extent of perceived external threats (i.e. risks) can be estimated by use of Risk Priority Numbers (RPN) which can take a value from 1 to 1000 (Each of Severity (SEV), Probability of Occurrence (OCC) and Detectability (DET) below can have a value from 1 to 10). The higher is the value of RPN, the more serious the threat is to the organization (Koo, et al., 2011; Koo, 2011).

Risk Priority Numbers (RPN)

= Severity x Probability of Occurrence x Likelihood of detection

- *Severity (SEV) indicates how significant the impact of the effect is*
- *Probability of Occurrence (OCC) indicates how often the cause of the failure mode is to occur*
- *Likelihood of Detection (DET) indicates how likely the current control is able to detect the failure mode*

Multi-Dimensional Scaling (MDS) Technique

The origin of MDS was from psychometric. It has a wide range of applications in analyzing data with proximity or dissimilarity. MDS can describe the structure of a group of items through the distance data among respective individual pairs of items. Each item is represented by a point in a multi-dimensional space. Two similar items are represented by two near points and two dissimilar events are represented by two distant points in the space. Generally speaking, this is the Euclidean two or three dimensional distance. The Euclidean distance of two points i and j can be represented by the following formula:

$$d_{ij} = [\Sigma(x_{ia} - x_{ja})^2]^{1/2}$$

where x_{ia} is the coordinate of point i in a dimension

and x_{ja} is the coordinate of point j in a dimension.

From a distance matrix table with continuous data, we can use MDS to reproduce a map showing the relative positions of the various points. Analogy can be made with that of the works done by a surveyor who draws up a map representing the series of points whose distances have been surveyed. To start with a geographic map, one can easily prepare a distance matrix table. However to draw a map from a distance matrix table would be almost an impossible task. MDS is a scientific statistical tool which can help solve this particular problem. It can be used to analyze the relationships among the distance data to develop the spatial map. The geographic map drawing example utilizes continuous data on a symmetric matrix. This model is called Classical MDS (for one single dissimilarity matrix). In the case of measuring the various similarities and differences of different items, especially subjective perceptions towards risk factors, it is not possible to be very exact. Instead the ranking order of risk factors is used to represent the extent of similarity and difference among them. In this respect the data input form would be an asymmetrical matrix with ordinal data (i.e. the ranking order in Appendix 2). The MDS positioning technique can be applied in market segmentation (Koo, H., 2005). In this study MDS is deployed to graphically represent the relative perceived similarity and difference among the risk factors. The goal of MDS is to detect meaningful underlying dimensions that explain observed similarities or dissimilarities (distances) between the investigated objects. It is used in this study to construct the Risks Interconnection Map (RIM).

Risk Analyses for the Gaming Industry in Macau

The following tables depict the demographic pattern of the respondents in the two questionnaire surveys. A visual comparison of valid percentage distributions indicates that the two samples are rather similar. Although the sampling approach is of non-probability nature, it should be representative of an educated or experienced group of respondents who are knowledgeable about the gaming industry in Macau. While the two groups are not identical, over 85% of them participated in both questionnaire surveys.

Table 1: Distribution of gender of respondents

	Risk questionnaire		MDS questionnaire	
	Frequency	Valid percent	Frequency	Valid percent
1 Male	103	45.4	108	47.0
2 Female	124	54.6	122	53.0
Missing	9		23	
Total	236		253	

The sample comprises of slightly more female than males. Independent samples T-test can be performed to discern whether there are significant differences between the two respondent gender groups.

Table 2: Distribution of whether respondents are working in casino

	Risk questionnaire		MDS questionnaire	
	Frequency	Valid percent	Frequency	Valid percent
1 Non casino	136	59.9	132	57.4
2 Casino	91	40.1	98	42.6
Missing	9		23	
Total	236		253	

About 40% of the respondents are working in the casino industry. It would be useful and interesting to find out whether the two respondent groups (i.e. those working in the gaming industry and those that are not) have significantly different views towards the various aspects of risk factors.

Table 3: Descending order of risk severity

	N	Mean
Sev15 Revision of FIT policy	236	**7.47**
Sev14 Sudden economic recession	236	**7.37**
Sev11 Fierce competition	236	**7.25**
Sev4 Inadequate HR supply	236	**6.94**
Sev18 Pandemic disease	236	**6.92**
Sev9 Corruption issues	235	**6.82**
Sev7 Irregular funding source disappearing	236	6.76
Sev6 Mono source of customers	236	6.75
Sev8 Improper industry supervision	236	6.73
Sev13 Foreign power domineering	236	6.66
Sev17 Social disorder	236	6.64
Sev10 Biased gaming policy	236	6.63
Sev3 Deterioration of HR quality	236	6.61
Sev2 Shrinking of VIP market	236	6.59
Sev16 Terrorism	235	6.59
Sev1 Neighbor areas liberalize gaming	236	6.38
Sev12 Online gaming gaining popularity	236	6.16
Sev5 Less non-local intermediaries	235	5.68
Valid N (listwise)	233	

From Table 3 above, all risk factors are perceived to be severe i.e. with mean score exceeding 5.5. However the following risk factors are perceived to be more severe on a relative basis:

- Revision of FIT policy
- Sudden economic recession
- Fierce competition

- Inadequate HR supply
- Pandemic disease
- Corruption issues

The casino industry (i.e. the six gaming operators, Macau Government, gaming intermediaries, and gaming related institutions) should exercise concerted effort to mitigate the severity of adverse impact arising from the above six risk factors.

Table 4: Descending order of risk probability

	N	Mean
Prob11 Fierce competition	236	**6.67**
Prob4 Inadequate HR supply	236	**6.61**
Prob1 Neighbor areas liberalize gaming	236	**6.50**
Prob6 Mono source of customers	236	**6.38**
Prob9 Corruption issues	236	**6.27**
Prob12 Online gaming gaining popularity	236	6.09
Prob3 Deterioration of HR quality	236	6.07
Prob10 Biased gaming policy	235	5.85
Prob8 Improper industry supervision	236	5.73
Prob15 Revision of FIT policy	236	5.73
Prob14 Sudden economic recession	236	5.66
Prob7 Irregular funding source disappearing	236	5.45
Prob2 Shrinking of VIP market	236	5.30
Prob13 Foreign power domineering	236	5.24
Prob5 Less non-local intermediaries	236	5.05
Prob17 Social disorder	236	4.86
Prob18 Pandemic disease	236	4.17
Prob16 Terrorism	235	2.94
Valid N (listwise)	234	

The following five risk factors are perceived to be more probable to occur on a relative basis:

- Fierce competition
- Inadequate HR supply
- Neighbor areas liberalize gaming
- Mono source of customers
- Corruption issues

Similarly, the stakeholders in gaming industry should work together to avoid the five risk factors from happening. Fierce competition refers to cut-throat price competition in the form of rebate to customers. Fierce competition occurred once in 2008 when many casinos began increasing their rebate margin to attract customers. This unhealthy situation resulted in the Macau Government to intervene by setting the ceiling of 1.25% rebates for all casino operators. To some extent, this measure helped reduce the likelihood of fierce competition from occurring.

Table 5: Descending order of risk detectability

	N	Mean
Det16 Terrorism	235	**6.96**
Det18 Pandemic disease	236	**6.82**
Det14 Sudden economic recession	236	**5.95**
Det9 Corruption issues	236	**5.76**
Det15 Revision of FIT policy	234	**5.71**
Det7 Irregular funding source disappearing	236	**5.69**
Det17 Social disorder	236	**5.58**
Det8 Improper industry supervision	236	5.38
Det13 Foreign power domineering	236	5.09
Det5 Less non-local intermediaries	236	5.03
Det10 Biased gaming policy	236	4.99
Det11 Fierce competition	236	4.78
Det6 Mono source of customers	236	4.77
Det12 Online gaming gaining popularity	236	4.71
Det3 Deterioration of HR quality	236	4.70
Det2 Shrinking of VIP market	236	4.65
Det4 Inadequate HR supply	236	4.56
Det1 Neighbor areas liberalize gaming	235	3.90
Valid N (listwise)	232	

Detectability is operationally defined as the extent of ease to detect, predict, and control the risk. In this study a Likert scale of risk detectability is used with "1" representing absolutely easy to detect, … , "10" representing absolutely difficult to detect. Thus a mean score of 5.5 represent a neutral mean score. From Table 5 above, seven risk factors are perceived to be difficult to detect. However the appearance of

following risk factors is perceived to be more difficult to detect on a relative basis:

- Terrorism
- Pandemic disease
- Sudden economic recession
- Corruption issues
- Revision of FIT policy
- Irregular funding source disappearing
- Social disorder

Detectability is a complicated concept involving the mixed notion of detecting, predicting, and controlling. The gaming industry should develop a monitoring scheme to detect, predict, and control the above seven risk factors.

Table 6: Descending order of risk severity*probability

	N	Mean
SP11 Fierce competition	236	**50.8347**
SP4 Inadequate HR supply	236	**49.0127**
SP6 Mono source of customers	236	**45.3644**
SP9 Corruption issues	235	**44.5745**
SP15 Revision of FIT policy	236	**44.2500**
SP14 Sudden economic recession	236	**43.2288**
SP1 Neighbor areas liberalize gaming	236	**42.7966**
SP3 Deterioration of HR quality	236	**42.5636**
SP10 Biased gaming policy	235	**40.3787**
SP8 Improper industry supervision	236	**40.3390**
SP12 Online gaming gaining popularity	236	**39.9110**
SP7 Irregular funding source disappearing	236	**37.5636**
SP13 Foreign power domineering	236	**37.1483**
SP2 Shrinking of VIP market	236	**36.2797**
SP17 Social disorder	236	**33.9110**
SP5 Less non-local intermediaries	235	**30.4468**
SP18 Pandemic disease	236	30.2203
SP16 Terrorism	234	19.7350
Valid N (listwise)	231	

If the neutral values for severity and probability are 5.5, then the neutral values for the product of the two risk dimensions would be 30.25. Severity and Probability are two common risk dimensions used to

quantify the risks. Their product is also a popular risk quantification approach. From Table 6, it can be observed that 16 out of 18 risks are above the neutral value of 30.25.

Table 7: Descending order of risk priority number (RPN)

	N	Mean
RPN9 Corruption issues	235	**273.3064**
RPN14 Sudden economic recession	236	**260.1907**
RPN15 Revision of FIT policy	234	**257.5897**
RPN11 Fierce competition	236	**249.0678**
RPN8 Improper industry supervision	236	**231.3941**
RPN7 Irregular funding source disappearing	236	**223.3729**
RPN4 Inadequate HR supply	236	**223.2458**
RPN6 Mono source of customers	236	**208.6737**
RPN10 Biased gaming policy	235	**206.4596**
RPN18 Pandemic disease	236	**205.9746**
RPN3 Deterioration of HR quality	236	**200.7500**
RPN12 Online gaming gaining popularity	236	**195.2034**
RPN13 Foreign power domineering	236	**195.0381**
RPN17 Social disorder	236	**193.4619**
RPN1 Neighbor areas liberalize gaming	235	**175.5319**
RPN2 Shrinking of VIP market	236	**173.5975**
RPN5 Less non-local intermediaries	235	159.7191
RPN16 Terrorism	233	134.8026
Valid N (listwise)	227	

The adoption of Risk Priority Number (RPN) deploys more information of various risks in their quantification. RPN represents the product of Severity, Probability, and Detectability. Using the means of neutral value of 5.5 for each risk dimension, the neutral value of RPN should be $(5.5)^3 = 166.375$. A total of 16 risk factors are perceived to be worth monitoring after aggregating the impact of the three dimensions of risk factors (i.e. severity, probability, and detectability). The risk factor of corruption issues came top on the list. The six gaming operators together with the Macau Government should set up a more effective anti-corruption scheme to combat this risk factor.

Table 8: Independent Samples T-Test with Gender as independent variable

	D1 Gender	N	Mean	Std. Deviation	Std. Error Mean
Sev18 Pandemic disease	**1 Male**	103	6.47	3.096	.305
	2 Female	124	7.23	2.589	.232
Prob16 Terrorism	1 Male	103	2.40	1.844	.182
	2 Female	123	3.40	2.242	.202
SP16 Terrorism	1 Male	102	15.137	15.4868	1.5334
	2 Female	123	23.707	19.7980	1.7851
SP18 Pandemic disease	1 Male	103	26.786	22.2219	2.1896
	2 Female	124	32.871	22.2703	1.9999
RPN16 Terrorism	1 Male	102	92.892	86.7780	8.5923
	2 Female	122	171.02	169.651	15.359

Inferential statistical analyses are performed to identify which demographic variables are of discerning nature. In this respect, the views from each respondent group can be better understood. In reading Table 8, prefixes "Sev" denoting "Severity dimension, "Prob" denoting "probability of occurrence", "SP" denoting "The product of Severity and Probability of Occurrence"; and "RPN" denoting "Risk Priority Number". On the whole female respondents are significantly (at 0.05 level) more sensitive to the risks of Pandemic disease and Terrorism than the male respondents. This may be due to female's more gentle and humane character than their male counterpart.

Table 9: Independent Samples T-Test with Whether working in casinos as independent variable

	D3 Working in Casino?	N	Mean	Std. Deviation	Std. Error Mean
Sev2 Shrinking of VIP market	1 Non casino	136	6.81	2.216	.190
	2 Casino	91	6.18	2.283	.239
Sev10 Biased gaming policy	1 Non casino	136	6.88	2.112	.181
	2 Casino	91	6.25	2.025	.212
Sev16 Terrorism	1 Non casino	136	7.07	3.205	.275
	2 Casino	90	5.79	3.384	.357
Sev18 Pandemic disease	1 Non casino	136	7.21	2.717	.233
	2 Casino	91	6.41	2.989	.313
Prob4 Inadequate HR supply	1 Non casino	136	6.29	2.360	.202
	2 Casino	91	7.10	2.441	.256
Prob6 Mono source of customers	1 Non casino	136	6.12	2.251	.193
	2 Casino	91	6.79	2.229	.234
Prob10 Biased gaming policy	1 Non casino	135	5.59	2.211	.190
	2 Casino	91	6.24	2.120	.222
Prob11 Fierce competition	1 Non casino	136	6.40	2.426	.208
	2 Casino	91	7.05	2.147	.225
SP4 Inadequate HR supply	1 Non casino	136	45.6324	25.92034	2.22265
	2 Casino	91	53.9121	28.98530	3.03849
SP6 Mono source of customers	1 Non casino	136	41.2206	25.07166	2.14988
	2 Casino	91	51.0549	27.78303	2.91245

The perception between those working in casinos and those who are not are somewhat mixed. As far as risk severity is concerned, those who are not in the gambling industry are significantly (at 0.05 level) more sensitive in shrinking of VIP market; Biased gaming policy; Terrorism, and Pandemic disease. Those working in the casinos have significantly (at 0.05 level) higher perception of probability of occurrence of the following risks: Inadequate HR supply, Mono source of customers, Biased gaming policy, and Fierce competition. They are also more concerned with Inadequate HR supply and Mono supply of customers when both severity and probability are considered together. In short those not working in the gaming industry perceived the severity of some risk factors significantly higher than those who work in the casinos. On the other hand those working in the casinos feel the probability of certain

risk factors significantly higher than those who are not working in the casinos.

Table 10: Independent Samples T-Test with Marital Status as independent variable

	D2 Marital Status	N	Mean	Std. Deviation	Std. Error Mean
Sev3 Deterioration of HR quality	1 Married	28	5.82	2.667	.504
	2 Not Married	198	6.76	2.137	.152
Sev4 Inadequate HR supply	1 Married	28	5.82	2.868	.542
	2 Not Married	198	7.09	2.230	.158
Sev5 Less non-local intermediaries	1 Married	28	4.43	2.150	.406
	2 Not Married	197	5.78	2.173	.155
Sev16 Terrorism	1 Married	28	5.32	3.507	.663
	2 Not Married	197	6.75	3.272	.233
Det9 Corruption issues	1 Married	28	4.79	2.587	.489
	2 Not Married	198	5.91	2.527	.180
Det18 Pandemic disease	1 Married	28	7.89	2.424	.458
	2 Not Married	198	6.69	3.114	.221
SP5 Less non-local intermediaries	1 Married	28	21.6071	17.54009	3.31477
	2 Not Married	197	30.6244	19.50199	1.38946
SP16 Terrorism	1 Married	28	13.2143	12.18486	2.30272
	2 Not Married	196	20.8214	19.02694	1.35907
RPN4 Inadequate HR supply	1 Married	28	148.4286	121.19877	22.90442
	2 Not Married	198	236.9848	199.57810	14.18340
RPN5 Less non-local intermediaries	1 Married	28	99.1786	80.82723	15.27491
	2 Not Married	197	165.2843	148.10590	10.55211
RPN9 Corruption issues	1 Married	27	188.0370	181.00733	34.83488
	2 Not Married	198	285.2778	238.44830	16.94578

On the whole those who are not married are more sensitive to the following risks: Deterioration of HR quality, Inadequate HR supply; less non-local intermediary; Terrorism; Corruption issues; Pandemic disease; and Corruption issues. Being single, they have less family burden and are more cautious about the future of the casino industry.

19 Xing, W. X., Koo, L. C., and Khong, Eva Y.W.(2012) "A Critical Review of Risk Factors of the GamingIndustry in Macau" *Academy of International Business Southeast Asia Regional Conference* 6-8 December, Xiamen, China

Table 11: Independent Samples T-Test with Age in casinos as independent variable

	D4 Age	N	Mean	Std. Deviation	Std. Error Mean
Sev1 Neighbor areas liberalize gaming	>= 30	26	5.46	2.302	.451
	< 30	199	6.49	2.322	.165
Sev16 Terrorism	>= 30	26	5.00	3.453	.677
	< 30	198	6.79	3.258	.232
Sev17 Social disorder	>= 30	26	5.58	2.730	.535
	< 30	199	6.72	2.427	.172
Det4 Inadequate HR supply	>= 30	26	3.42	2.386	.468
	< 30	199	4.75	2.412	.171
SP1 Neighbor areas liberalize gaming	>= 30	26	35.0000	17.24181	3.38140
	< 30	199	43.4322	24.68824	1.75010
RPN3 Deterioration of HR quality	>= 30	26	142.1154	134.61748	26.40066
	< 30	199	207.8392	164.91530	11.69054
RPN4 Inadequate HR supply	>= 30	26	150.5385	190.55587	37.37108
	< 30	199	235.8442	192.70955	13.66082

Bulk of the respondents' ages is below 30 years. The sample is divided into two age groups and Independent samples T-Test is performed. In general those over 30 years old are more sensitive towards the risk items.

Table 12: ANOVA with Working Experience as an independent variable

D5 Working Experience	Sev16 Terrorism	Prob4 Inadequate HR supply	Det5 Less non-local intermediaries	RPN16 Terrorism
1 No	7.39	6.24	5.04	151.6460
2 less than 2 years	5.38	6.78	5.07	63.7308
3 2-5 years	5.79	7.50	5.23	134.9375
4 5-10 years	5.48	6.88	5.32	110.3600
5 Over 10 years	7.38	5.63	2.88	209.3750
Total	6.59	6.63	5.04	135.0182
Significant at 0.05 level	**1>2 1>3**	**1<3**	**3>5**	**1>2**

Those with no working experience perceive the severity and RPN of Terrorism to be significantly (at 0.05) higher than those of working less than two years. They perceive the probability of inadequate HR supply risk to be significantly (at 0.05) less than those who are working for 2-5 years. Those with less than two years of working experience perceive the RPN of Terrorism to be significantly (at 0.05) less than those who have no working experience.

Table 13: Summary of all risk factor means grouped under respective Risk Clusters

Risk Cluster		Severity(S)	Probability(P)	Detectability(D)	$(SP)^{1/2}$	$(SPD)^{1/3}$
Human Resources	3-HR Quality	6.61	6.07	4.7	6.21	5.41
	4-HR Supply	6.94	6.61	4.56	6.66	5.59
Cronbach Alpha		*0.717*	*0.697*	*0.793*	*0.741*	*0.76*
Macau Government Policy	8-Improper Industry Supervision	6.73	5.73	5.38	6.09	5.67
	13-Foreign Power Domineering	6.66	5.24	5.09	5.69	5.23
	10-Biased Gaming Policy	6.63	5.85	4.99	6.09	5.48
	9-Corruption Issues	6.82	6.27	5.76	6.38	5.99
	11-Fierce Competition	7.25	6.67	4.78	6.84	5.82
Cronbach Alpha		*0.762*	*0.728*	*0.676*	*0.755*	*0.742*
Crises	17-Social Disorder	6.64	4.86	5.58	5.46	5.27
	14-Sudden Economic Recession	7.37	5.66	5.95	6.29	5.94
	18-Pandemic disease	6.92	4.17	6.82	5.09	5.32
	16-Terrorism	6.59	2.94	6.96	4.02	4.54
Cronbach Alpha		*0.812*	*0.667*	*0.629*	*0.711*	*0.679*
Customer Source from China	15-FIT Policy	7.47	5.73	5.71	6.35	5.88
	6-Mono Source of Customers	6.75	6.38	4.77	6.41	5.5
Cronbach Alpha		*0.402*	*0.311*	*0.338*	*0.374*	*0.431*
Commercial Issues	5-Less Non-Local Local Intermediaries	5.68	5.05	5.03	5.2	4.98
	12-On-line gaming gaining popularity	6.16	6.09	4.71	5.95	5.24
	2-VIP Market Shrinking	6.59	5.3	4.65	5.77	5.2
	1-Neighber Areas Liberalize Gambling	6.38	6.5	3.9	6.24	5.02
	7-Irregular Funding Sources disappearing	6.76	5.45	5.69	5.88	5.65
Cronbach Alpha		*0.526*	*526*	*0.603*	*0.542*	*0.568*

Table 13 summarizes the perceived magnitudes of the 18 risk factors from five different dimensions. The last two columns in the table represent the means of the square roots and cube roots of the products of "severity and probability" and those of "severity, probability and detectability" respectively. These conversions normalize the range of scores from "1" to "10" as in the original input in order to make them more comparable. The Cronbach alpha for reliability measure for each of these risk factor categories are listed in Table 13. The five risk categories are grouped and named through discussions among the subject experts of the core research team and have under this circumstance some face validity.

Multi-Dimensional Scaling (MDS)

Multidimensional scaling (MDS) is a set of related statistical techniques used in information visualization for exploring similarities or dissimilarities in data. An MDS algorithm starts with a matrix of item–item similarities, and then assigns a location to each item in N-dimensional space, where N is specified a priori. For sufficiently small N, the resulting locations may be displayed in a graph or 3D visualization. (*http://en.wikipedia.org/wiki/Multidimensional_scaling*). MDS is used especially in behavioural, econometric, and social sciences to analyze subjective evaluations of pair wise similarities of entities. MDS is often used for creating a space where the entities can be represented as vectors, based on some evaluation of the dissimilarities of the entities (*http://users.ics.tkk.fi/sami/thesis/node15.html*).

Figure1: MDS of all 253 respondents

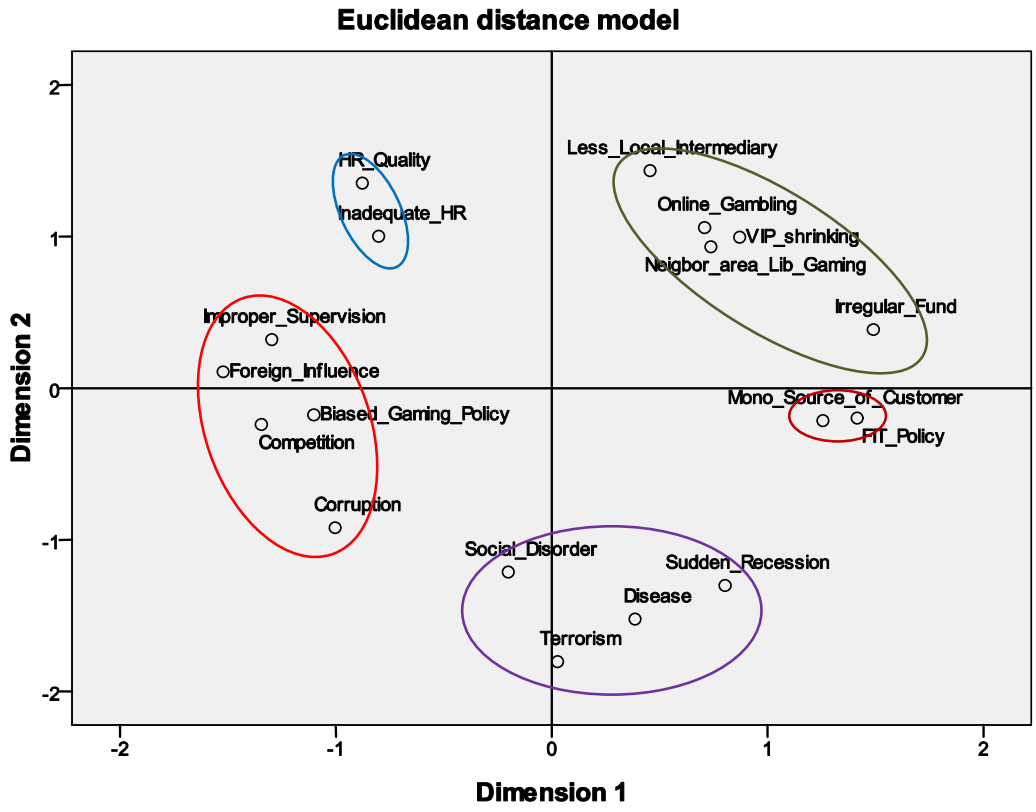


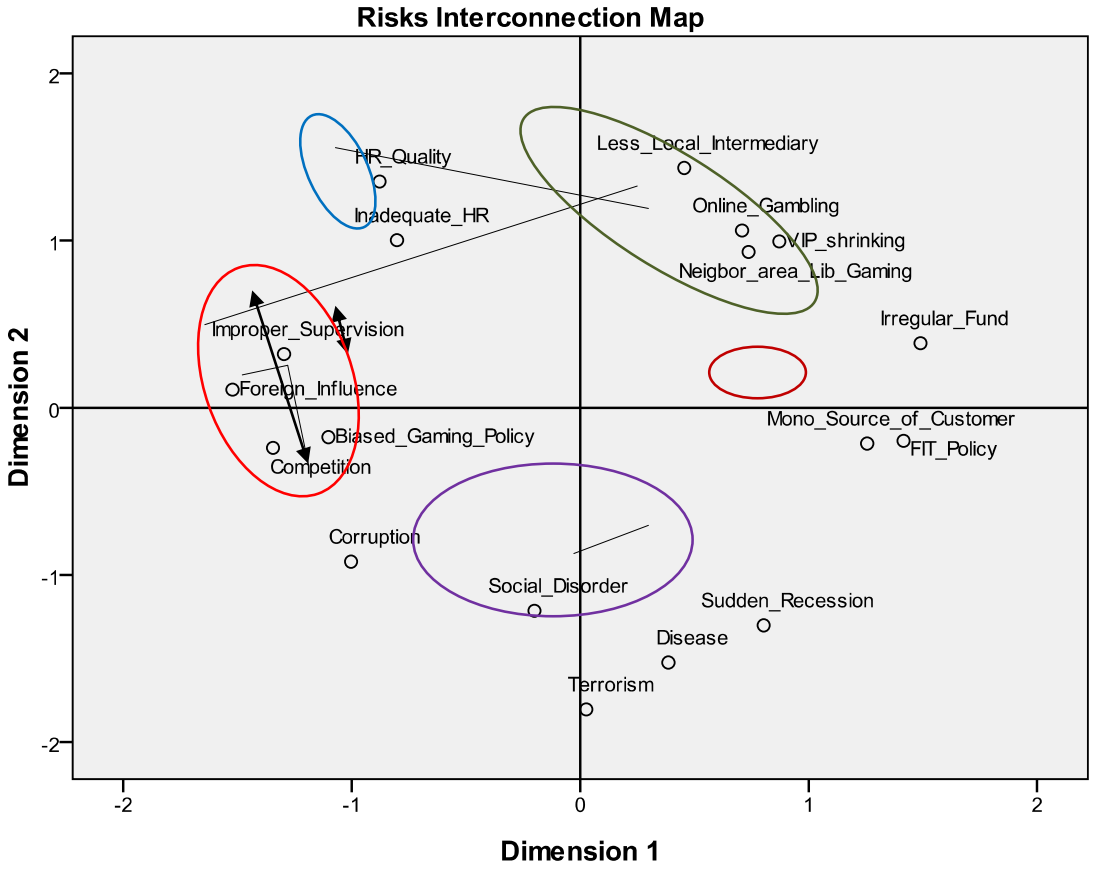
Figure 1 depicts a two dimensional perceptual mapping of the 18 risk factors by all 253 respondents. There are five categories of risks visually present in the map. Dimension 1 of the MDS perceptual map may be interpreted to denote "*Macau Government policy vs. Sources of supply of gamblers*" and

Dimension 2 to denote "*risk vs. crisis*".

Risks Interconnection Map (RIM)

Figure 2 illustrates the interconnectedness of the risk factors in terms of correlation coefficients of RPN. Interconnection lines are shown for any pair of risk factors that have correlation coefficients exceeding 0.4 (all are significant at 0.01 levels). Thick lines (with arrow head at the ends of the lines) are drawn for correlation coefficients exceeding 0.5. The RIM is a succinct and vivid way to depict the interconnection among the risk factors. Strong correlation coefficients imply a possible causal relationship.

Figure 2: Risk Interconnection Map (RIM) representing RPN linkages



Risk Priority Number (RPN) is the product of Severity, Probability, and Detectability containing the most information about risks concerned. "HR inadequacy vs. HR quality" and "corruption vs. improper supervision" are highly interconnected. The risks of sudden economic recession and pandemic disease are interconnected (i.e. the nature of change is similar). Biased gaming policy is correlated with corruption

and fierce competition. Cross cluster interconnectedness exist between HR quality and Neighbor area liberalizing gaming suggests that employees may be attracted by neighboring areas and causing deteriorating HR quality. On-line gambling and Foreign influence is interconnected may be due to the perception by respondents that on-line gambling gaining popularity may trigger foreign power to exercise more of their influence in Macau to protect their vested interest in Macau.

MDS versus Factor Analysis

Being able to uncover underlying dimensions based on a series of similarity judgments by respondents, MDS is popular in many research situations. MDS may be thought of as a way of representing subjective attributes in objective scales. A type of perceptual mapping, the central MDS output is a set of scatter plots in which the axes are the underlying dimensions and the points are the objects of comparison. The objective of MDS is to array points in multidimensional space such that the distances separating points physically on the scatter plot reflect as closely as possible the subjective distances obtained by the respondents. MDS shows graphically how different objects of comparison do or do not cluster. MDS is mainly used to compare objects when the bases (i.e. dimensions) of comparison are not known. Though it is possible to use MDS with quantitative variables, it is more common to use factor analysis to group variables whose dimensions are objective and measurable. Because MDS does not require assumptions of linearity, or multivariate normality, sometimes it is preferred over factor analysis (*http://faculty.chass.ncsu.edu/garson/PA765/mds.htm*). In factor analysis, the similarities between variables are expressed in the correlation matrix. With MDS, any kind of similarity or dissimilarity matrix can be used. MDS and factor analysis are fundamentally different methods. Factor analysis requires that the underlying data are distributed as multivariate normal, and that the relationships are linear. MDS imposes no such restrictions. As long as the rank-ordering of similarities in the matrix is meaningful, MDS can be used. In terms of resultant differences, factor analysis tends to extract more factors (dimensions) than MDS; as a result, MDS often yields more readily, interpretable solutions. MDS can be based on respondents' direct assessment of similarities between stimuli, while factor analysis requires subjects to rate those stimuli on some list of attributes (for which the factor analysis is performed). In summary, MDS methods are applicable to a wide variety of research designs because distance measures can be obtained in any number of ways (http://www.statsoft.com/textbook/multidimensional-scaling/).

Exploratory Factor Analyses were performed on the five risk dimensions respectively. The results are shown in Tables 14 to 18. Both KMO measure of sampling adequacy and Bartlett's test of sphericity suggest the factorability of the 18 risk items according to the five dimensions. These factor analyses

provide additional insight of the risk factors that may be useful to the academia and business practitioners alike.

Table 14: Factor Analysis on Severity of the 18 Risk Factors

Factor Analysis on Severity of Risks[a]

		Component					
		1	2	3	4	5	6
Crises	Sev16 Terrorism	**0.87**	.090	-.035	.088	-.016	.074
	Sev18 Pandemic disease	**0.81**	.184	-.013	.122	-.025	.065
	Sev17 Social disorder	**0.75**	.188	.131	.018	.082	-.085
	Sev14 Sudden economic recession	**0.64**	-.048	.128	.254	.296	.161
Macau Government Policy	Sev9 Corruption issues	.088	**0.77**	.151	.045	.040	-.023
	Sev10 Biased gaming policy	.139	**0.71**	.080	.043	.221	.298
	Sev8 Improper industry supervision	.219	**0.64**	.337	.215	.186	.002
Human Resources	Sev3 Deterioration of HR quality	.152	.223	**0.79**	.089	.106	-.093
	Sev4 Inadequate HR supply	-.036	.350	**0.77**	.018	-.080	.087
	Sev1 Neighbor areas liberalize gaming	.058	-.151	**0.59**	.190	.441	.241
VIP Market	Sev2 Shrinking of VIP market	.225	-.052	.204	**0.76**	.069	.003
	Sev5 Less non-local intermediaries	.025	.189	-.078	**0.74**	.069	.032
	Sev7 Irregular funding source disappearing	.138	.048	.160	**0.52**	-.064	.380
Foreign Influences	Sev12 Online gaming gaining popularity	-.031	.115	.055	-.029	**0.81**	-.007
	Sev13 Foreign power domineering	.282	.314	.075	.241	**0.59**	-.050
	Sev11 Fierce competition	.110	.429	.044	-.076	**0.47**	.419
Customer Source from China	Sev6 Mono source of customers	-.061	.203	-.073	.130	.020	**0.81**
	Sev15 Revision of FIT policy	.458	-.130	.241	.045	.027	**0.57**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 9 iterations.

Table 15: Factor Analysis on Probability of the 18 Risk Factors

Factor Analysis on Probability of Risks[a]

		Component				
		1	2	3	4	5
Macau Government Policy	Prob9 Corruption issues	**0.79**	.000	.021	-.024	.210
	Prob10 Biased gaming policy	**0.74**	.048	.160	.156	.021
	Prob8 Improper industry supervision	**0.7**	.212	.163	.206	.011
	Prob11 Fierce competition	**0.6**	.090	.321	.078	.169
Crises	Prob16 Terrorism	.044	**0.77**	-.030	.109	-.182
	Prob18 Pandemic disease	.009	**0.74**	.058	.052	.253
	Prob17 Social disorder	.210	**0.61**	.236	-.126	.350
	Prob13 Foreign power domineering	.168	**0.4**	.119	.383	.196
People Issues	Prob4 Inadequate HR supply	.216	.088	**0.78**	.078	.004
	Prob3 Deterioration of HR quality	.167	.114	**0.75**	.201	.032
	Prob6 Mono source of customers	.155	-.087	**0.4**	.286	.099
VIP Market	Prob5 Less non-local intermediaries	.198	-.036	0.07	**0.64**	.072
	Prob2 Shrinking of VIP market	.028	.163	.303	**0.6**	.029
	Prob1 Neighbor areas liberalize gaming	-.163	-.070	.354	**0.56**	.228
	Prob7 Irregular funding source disappearing	.282	.302	-.086	**0.53**	-.161
Customer Source	Prob12 Online gaming gaining popularity	.342	-.062	-.068	.204	**0.65**
	Prob15 Revision of FIT policy	-.011	.141	.330	-.083	**0.61**
	Prob14 Sudden economic recession	.154	.394	-.099	.228	**0.59**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 10 iterations.

Table 16: Factor Analysis on Detectability of the 18 Risk Factors

Factor Analysis on Detectability of Risks[a]

		Component				
		1	2	3	4	5
Foreign Influences	Det1 Neighbor areas liberalize gaming	**0.73**	-.128	.008	.229	-.086
	Det3 Deterioration of HR quality	**0.73**	.214	-.145	.069	.043
	Det4 Inadequate HR supply	**0.7**	.152	-.273	.148	.225
	Det13 Foreign power domineering	**0.65**	.104	.242	-.016	.049
	Det12 Online gaming gaining popularity	**0.58**	.123	.071	.103	.319
	Det11 Fierce competition	**0.53**	.300	-.083	.316	.154
Macau Government Policy	Det9 Corruption issues	-.027	**0.8**	.117	.084	-.080
	Det8 Improper industry supervision	.168	**0.74**	-.081	.102	.088
	Det10 Biased gaming policy	.364	**0.63**	.077	.178	-.035
Crises	Det16 Terrorism	-.113	.095	**0.83**	-.031	-.011
	Det18 Pandemic disease	-.077	.082	**0.65**	.015	.427
	Det14 Sudden economic recession	.188	-.056	**0.58**	.209	.223
VIP Market	Det2 Shrinking of VIP market	.412	-.201	-.048	**0.64**	.020
	Det7 Irregular funding source disappearing	-.041	.260	.181	**0.62**	.013
	Det5 Less non-local intermediaries	.197	.247	.086	**0.6**	.015
	Det6 Mono source of customers	.218	.111	-.360	**0.54**	.395
Customer Source	Det17 Social disorder	.214	.052	.168	-.122	**0.75**
	Det15 Revision of FIT policy	.048	-.115	.166	.214	**0.73**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Table 17: Factor Analysis on product of Severity and Probability of the 18 Risk Factors

Factor Analysis on (Severity x Probability) of Risks[a]

		Component					
		1	2	3	4	5	6
Government policies	SP10 Biased gaming policy	**0.76**	.052	.141	.038	.168	.050
	SP9 Corruption issues	**0.73**	.035	.111	-.145	.102	.135
	SP8 Improper industry supervision	**0.69**	.072	.311	.122	.134	.041
	SP11 Fierce competition	**0.64**	.154	.177	.117	.188	.088
	SP12 Online gaming gaining popularity	**0.63**	.046	-.101	.318	-.397	.091
	SP13 Foreign power domineering	**0.48**	.415	.054	.379	-.126	-.145
Crises	SP16 Terrorism	-.001	**0.78**	-.142	.141	.119	-.108
	SP18 Pandemic disease	.069	**0.78**	.098	-.085	.072	.280
	SP17 Social disorder	.224	**0.61**	.367	-.045	-.199	.141
Human Resources	SP4 Inadequate HR supply	.218	-.027	**0.8**	.131	.213	.032
	SP3 Deterioration of HR quality	.237	.081	**0.79**	.180	-.084	.078
VIP Market	SP2 Shrinking of VIP market	-.072	.172	.189	**0.71**	.067	.120
	SP5 Less non-local intermediaries	.195	-.083	.023	**0.67**	.232	.037
	SP1 Neighbor areas liberalize gaming	.077	.003	.386	**0.52**	.083	.295
Customer sources	SP6 Mono source of customers	.281	-.118	.003	.138	**0.68**	.318
	SP7 Irregular funding source disappearing	.156	.206	.111	.291	**0.67**	-.152
Mass Market	SP15 Revision of FIT policy	.100	.116	.151	.136	.046	**0.83**
	SP14 Sudden economic recession	.254	.480	-.079	.220	-.012	**0.5**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 9 iterations.

Table 18: Factor Analysis on RPN of the 18 Risk Factors

Factor Analysis on RPN of Risks[a]

		Component				
		1	2	3	4	5
Macau Government Policy	RPN9 Corruption issues	**0.8**	.084	.019	.189	-.071
	RPN8 Improper industry supervision	**0.77**	.187	.063	.064	.040
	RPN10 Biased gaming policy	**0.66**	.133	.367	.091	.171
	RPN11 Fierce competition	**0.51**	.174	.321	.041	.262
Creeping Risks	RPN3 Deterioration of HR quality	.203	**0.79**	.125	.134	.039
	RPN4 Inadequate HR supply	.160	**0.71**	.218	.008	.000
	RPN1 Neighbor areas liberalize gaming	-.009	**0.62**	.248	.186	.027
	RPN17 Social disorder	.204	**0.49**	-.252	.351	.318
	RPN12 Online gaming gaining popularity	.219	**0.44**	.111	.013	.383
VIP Market	RPN5 Less non-local intermediaries	.150	.235	**0.67**	.012	.158
	RPN2 Shrinking of VIP market	-.106	.277	**0.64**	.293	-.146
	RPN6 Mono source of customers	.349	.013	**0.55**	.110	-.054
	RPN7 Irregular funding source disappearing	.277	.145	**0.55**	-.103	.327
Crises	RPN18 Pandemic disease	.129	-.062	-.126	**0.8**	.278
	RPN14 Sudden economic recession	.140	.224	.139	**0.69**	.141
	RPN15 Revision of FIT policy	.080	.228	.315	**0.63**	-.049
Foreign Influences	RPN16 Terrorism	-.117	-.080	.026	.168	**0.8**
	RPN13 Foreign power domineering	.267	.267	.101	.197	**0.6**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 9 iterations.

Conclusion and Implications

The Risk Priority Number (RPN) contains the fullest information (i.e. Severity, Probability, and Detectability) about the attributes of risk factors and it serves as a single aggregated measure of the magnitudes of the risks. From Table 7, the following risks need to be addressed with higher degree of priority by the stakeholders in the gaming industry in Macau. Information provided in Table 3 to table 6 provides supplementary information.

The economic implications of the seven most important risks (with the highest RPN) are as follows:

1) Corruption issues – This risk would jeopardize the image of Macau of being a leading casino city in the world. The investment costs in Macau's casino and related industries will be unnecessarily increased and be less certain. This corruption image may adversely affect future investments into Macau.
2) Sudden Economic Recession – The world has been badly hit by the financial tsunami since 2008. The European debt crisis has slowed down the growth of casino business in 2012. The disposable incomes of most people will decrease in economic recession times and this would affect the gaming industry as well.
3) Revision of FIT Policy by the Chinese Government – Macau is heavily dependent on tourist and

patrons coming from China. Being a tourist city with no natural resources, Macau gaming industry's prosperity relies very much on the FIT policy which can be adjusted rather quickly.

4) Fierce Competition – Fierce competition through price cutting (i.e. rebates for gaming chips) affect the long term sustainability of individual casino operators and intermediaries who may experience higher bad debts.
5) Improper industry supervision – This may lead to image deterioration of the industry as a whole, affecting Macau gaming industry's competitiveness in the region. Poor supervision will adversely affect the quality of the service of the six gaming operators and increase the operating costs of the casinos.
6) Irregular funding source disappearing – This risk would mainly affect the VIP market in Macau. Irregular funding provides the credit liquidity and financial channel for VIP gamblers.
7) Inadequate supply of Human Resource – This risks affect the operating costs of the casinos directly as employee salary is the main expenditure of the employer in the service sector. The quality of human resources has been deteriorating in recent years. This will affect the service standard and competitiveness of the gaming industry.

The following are the respective recommendations of the key risks for the gaming industry in Macau:

1) Corruption issues - This may be caused by improper supervision by the Macau Government. The industry should pressurize the Macau Government to make the gaming policy more transparent. Fair mechanism in policy making should be adopted.
2) Sudden Economic Recession – The "suddenness" in a major economic recession makes it difficult to predict (with detectability score mean of 5.95) and control the risk. An econometric predictive model of relevant economic variables on the casino revenues should be developed to predict and monitor the effect of economic recession on the gaming industry. It is also important for the industry to guard against unwarranted and unhealthy expansion of gaming tables. In this respect the Macau Government has announced that the annual growth rate of gaming tables would be contained at 3% per annum after 2013. Moreover the industry should contain their costs through enhancing their cost effectiveness through various quality management initiatives. Individual casino operators should be required to prepare and maintain a Business Continuity Plan.
3) Revision of FIT Policy by the Chinese Government – The industry collectively should build a positive image of the gaming industry portraying an image that is in line with the national policy of turning Macau into a genuine leisure and entertainment tourist attraction. An industry survey in the form of Customer Satisfaction Index will help enhance the positive image of Macau as a

tourist city. Once this positive image is created then the FIT policy will be more like to remain unchanged or even be further relaxed by the Chinese Government. The industry should also appeal to the Chinese Central Government and the Macau Government to simplify the immigration procedure and to extend the immigration service to 24 hours a day.

4) Fierce Competition – Competition is unavoidable and can be healthy to the industry as long as cut-throat price competition is prevented. As far as commission rebate is concerned the Macau Government has made a clear guide line that it cannot exceed 1.25%. The operators in the casino should be encouraged to compete on service and quality. This would help establish a positive image for the gaming industry and also bring positive financial return to the individual operators. The adoption of Customer Relationship Management technology can help prevent frauds and cheating against the casinos. This technology can also help detect money laundry activities in the casinos.
5) Improper industry supervision - The correlation coefficients of "Improper industry supervision" and "Corruption issues", are high and significant. Apart from a high degree of interconnectedness, it cannot conclude which is the cause and which is the effect. The quality of industry supervision needs improvement. Criteria of an ideal industry supervision should be formulated and then the quality of gaming industry be properly monitored in a fair and open manner. The criteria of good industry supervision should perhaps include adjectives like: long term development, healthy competition; harmonious atmosphere in the society; positive and professional image of the industry; supervision being fair and open.
6) Irregular funding source disappearing – Over 70% of the gaming revenues come from VIP market. If the irregular funding is stopped then it would have a major adverse impact on the casino revenues. The industry operators should build a fair and professional image as an integrated cultural and entertainment resort area to attract customers and to take effective measures to prevent money laundry activities in the casinos.
7) Inadequate supply of Human Resource – The Macau Government and the gaming industry should enhance their effects in training and re-training. A retraining institution should be established to help Macau residents to adapt to the changing environment. Apart from the corporate social responsibility requirements, the casino operators can help address the issue of human resource shortage. Among the gaming operators they should not compete on salary (a different form of price competition), they should compete in the labour market by being a responsible and caring employers to recruit and retain their employees. As the future growth on gaming table would be capped at 3% per annum, the demand on front line dealers would be stabilized and there is

already a trend that newly established casinos shifted their focus on slot machines and through closed circuit video technology.

Limitations and Future Research

As risks are dynamic, changing, and difficult to detect, other factors may need to be explored in order to give a more comprehensive explanation to risk propensity in the gaming industry. Future research may be extended to explore the remaining phases of the Risk, filtering, Ranking, and Management model to contribute to a comprehensive gaming industry risk management. Being vigilant in peace time and being able to think of possible risks and crises while living in a safe environment should be practised by the stakeholders in the gaming industry.

Appendix 1

Risk Questionnaire

The Macau Gaming Research Association (MGRA) is conducting a study on "Risk and Crisis Analyses for the Gaming Industry in Macau". This research is funded by the Macao Foundation and the results will be released to the public. We expect the findings will provide useful reference information to the Macau Government, the Gaming Industry, Academic Institutions, and the public. The research tools include Delphi method which collects opinions from selected experts on an anonymous basis and the experts do not meet and discuss among themselves. After several iterations of data collection, analyses, and modifications the views can converge closer to a consensus opinion. These findings will be used as a basis for prediction.

The MGRA sincerely invites you as an expert on the gaming industry to complete the questionnaire. We appreciate your support and cooperation and will send you a copy of the findings in due course.

Industry risk is any event that will affect the long term, healthy, and harmonious development of the entire gaming industry. (Risk is operationally defined as a creeping event. Crisis refers to event with lower occurrence probability but more severe consequence, e.g. war, racial killing, collapses of major infrastructure building, or natural catastrophe).

Severity (represents the extent of negative impact on the gaming industry in Macau, 1=absolutely not severe, … , 10= absolutely severe)

Probability (represents the likelihood of the risk or crisis happening, 1=absolutely not likely to happen, … , 10= absolutely likely to happen)

Detectability (represents the extent of ease to **detect**, **predict**, and **control** the risk or crisis, 1=absolutely easy to detect, … , 10= absolutely difficult to detect)

Item	Factor that might affect the Macau gaming industry	Severity	Probability	Detectability
1	**Neighbor areas liberalize gaming**			
2	**Shrinking of VIP market**			
3	**Deterioration of HR quality**			
4	**Inadequate HR supply**			
5	**Less non-local intermediaries**			
6	**Mono source of customers**			
7	**Irregular funding source disappearing**			
8	**Improper industry supervision**			
9	**Corruption issues**			
10	**Biased gaming policy**			
11	**Fierce competition**			
12	**Online gaming gaining popularity**			
13	**Foreign power domineering**			
14	**Sudden economic recession**			

15	**Revision of FIT policy**			
16	**Terrorism**			
17	**Social disorder**			
18	**Pandemic disease**			

Thank you

Appendix 2

MDS Questionnaire

Please compare the following 18 risks line by line. Rank the most similar pair as "1", the second most similar pair as "2", … , the most dissimilar pair as "17"

	Deterioration of HR quality	Irregular funding source disappearing	Foreign power domineering	Less non-local intermediaries	Sudden economic recession	Terrorism	Revision of FIT policy	Fierce competition	Improper industry supervision	Shrinking of VIP market	Corruption issues	Pandemic disease	Online gaming gaining popularity gaining popularity	Mono source of customers	Neighbor areas liberalize gaming	Inadequate HR supply	Social disorder	Biased gaming policy
Deterioration of HR quality	0																	
Irregular funding source disappearing		0																
Foreign power domineering			0															
Less non-local intermediaries				0														
Sudden economic recession					0													
Terrorism						0												
Revision of FIT policy							0											
Fierce competition								0										
Improper industry supervision									0									
Shrinking of VIP market										0								
Corruption issues											0							
Pandemic disease												0						
Online gaming gaining popularity													0					
Mono source of customers														0				
Neighbor areas liberalize gaming															0			
Inadequate HR supply																0		
Social disorder																	0	
Biased gaming policy																		0

Personal particulars:

Age: 1- Male[ ] 2- Female[ ]

Whether working in Casino: 1- Not working in Casino [ ] 2- Working on Casino [ ]

Age: 1- 30 years and below [ ] 2- Over 30 years old [ ]

Working Experience: 1- No experience [ ] 2- less than 2 years [ ]

3- 3 to 5 years [ ] 4- 5 to 10 years [ ] 5- Over 10 years [ ]

Appendix 3

Correlation Coefficient matrix of RPN scores of the 18 risk factors

	RPN1 Neighbor areas liberalize gaming	RPN2 Shrinking of VIP market	RPN3 Deterioration of HR quality	RPN4 Inadequate HR supply	RPN5 Less non-local intermediaries	RPN6 Mono source of customers	RPN7 Irregular funding source disappearing	RPN8 Improper industry supervision	RPN9 Corruption issues	RPN10 Biased gaming policy	RPN11 Fierce competition	RPN12 Online gaming gaining popularity	RPN13 Foreign power domineering	RPN14 Sudden economic recession	RPN15 Revision of FIT policy	RPN16 Terrorism	RPN17 Social disorder	RPN18 Pandemic disease
RPN1 Neighbor areas liberalize gaming	1	.373**	.475**	.343**	.212**	.185**	.226**	.175**	.127	.231**	.236**	.178**	.303**	.218**	.211**	.041	.247**	.162*
RPN2 Shrinking of VIP market	.373**	1	.299**	.256**	.389**	.270**	.196**	.183**	.079	.243**	.140*	.210**	.137*	.214**	.315**	.026	.066	.098
RPN3 Deterioration of HR quality	.475**	.299**	1	.550**	.299**	.201**	.286**	.317**	.261**	.321**	.299**	.326**	.324**	.328**	.307**	.061	.352**	.130*
RPN4 Inadequate HR supply	.343**	.256**	.550**	1	.312**	.217**	.322**	.267**	.227**	.245**	.272**	.254**	.163*	.233**	.243**	.063	.275**	.050
RPN5 Less non-local intermediaries	.212**	.389**	.299**	.312**	1	.274**	.371**	.226**	.198**	.372**	.293**	.289**	.228**	.223**	.251**	.059	.107	.020
RPN6 Mono source of customers	.185**	.270**	.201**	.217**	.274**	1	.264**	.284**	.205**	.348**	.344**	.118	.187**	.158*	.226**	-.001	.098	.047
RPN7 Irregular funding source disappearing	.226**	.196**	.286**	.322**	.371**	.264**	1	.275**	.253**	.351**	.377**	.162*	.258**	.181**	.204**	.210**	.090	.026
RPN8 Improper industry supervision	.175**	.183**	.317**	.267**	.226**	.284**	.275**	1	.547**	.459**	.320**	.267**	.316**	.147*	.169**	.047	.256**	.161*
RPN9 Corruption issues	.127	.079	.261**	.227**	.198**	.205**	.253**	.547**	1	.459**	.315**	.162*	.206**	.261**	.181**	.006	.199**	.191*
RPN10 Biased gaming policy	.231**	.243**	.321**	.245**	.372**	.348**	.351**	.459**	.459**	1	.469**	.299**	.384**	.210**	.240**	.055	.192**	.157*
RPN11 Fierce competition	.236**	.140*	.299**	.272**	.293**	.344**	.377**	.320**	.315**	.469**	1	.322**	.289**	.242**	.204**	.074	.227**	.165*
RPN12 Online gaming gaining popularity	.178**	.210**	.326**	.254**	.289**	.118	.162*	.267**	.162*	.299**	.322**	1	.425**	.249**	.268**	.115	.288**	.059
RPN13 Foreign power domineering	.303**	.137*	.324**	.163*	.228**	.187**	.258**	.316**	.206**	.384**	.289**	.425**	1	.338**	.183**	.278**	.279**	.301**
RPN14 Sudden economic recession	.218**	.214**	.328**	.233**	.223**	.158*	.181**	.147*	.261**	.210**	.242**	.249**	.338**	1	.399**	.121	.278**	.444**
RPN15 Revision of FIT policy	.211**	.315**	.307**	.243**	.251**	.226**	.204**	.169**	.181**	.240**	.204**	.268**	.183**	.399**	1	.068	.266**	.308**
RPN16 Terrorism	.041	.026	.061	.063	.059	-.001	.210**	.047	.006	.055	.074	.115	.278**	.121	.068	1	.230**	.287**
RPN17 Social disorder	.247**	.066	.352**	.275**	.107	.098	.090	.256**	.199**	.192**	.227**	.288**	.279**	.278**	.266**	.230**	1	.346**
RPN18 Pandemic disease	.162*	.098	.130*	.050	.020	.047	.026	.161*	.191**	.157*	.165*	.059	.301**	.444**	.308**	.287**	.346**	1

Personal particulars:

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