Developing a risk management mechanism for the Gaming Industry in Macau

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Abstract: Beyond doubt the gaming industry is most important to the sustained success for Macau. While the industry has been growing spectacularly well since its liberalization in 2004, time is ripe to critically review the factors that may adversely affect its long term, healthy, and harmonious development. We need to be vigilant in peace time. Being able to think of possible crises while living in safe environment has been our traditional wisdom. There is an obvious need to develop and maintain a risk management mechanism for the gaming industry. Appropriate precautionary measures developed through rigorous study can help mitigate the damage brought by crises and in turn will ensure the sustained development of Macau. Risks and crises, if handled properly, can possibly be transformed into opportunities. This research adopts an integrative approach through systematic and comprehensive investigation to establish an approach to monitor and to predict risks and crises for the gaming industry in Macau. This would provide a useful reference for the society and government of Macau in handling them.

Through a series of focus group meetings supplemented by Delphi questionnaires, a list of 18 risk items is identified. Five dimensions of risk are deployed to quantify 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 groups, i.e. the academic, veteran professional casino employees, and university students in Macau. Two sets of questionnaires were collected. One questionnaire measures the perceived extent of severity, probability, and detectability of the 18 risks by 236 respondents. The other input form is about the 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 associations among the risk produce a series of Risks Interconnection Map (RIM) to succinctly depict the risk items. Five basic risk

categories are revealed: Human Resources; Macau Government Policy; Crises; Customer Source from China; and Commercial Issues.

Key words: Risk management mechanism: Risk Priority Number (RPN), Multi-Dimensional Scaling (MDS); Risks Interconnection Map (RIM)

The Gaming Industry in Macau

Macau first legalized its gambling business in as early as 1847.   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 about 5,500 in 2012. The slot machine number has increased from around 1,000 to over 15,000 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 is the potential of a disaster occurring.   Risk is measured by how likely this is to happen and how badly it will hurt (Wallace and Webber, 2004). 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 (Molak, 1997).   A Key Risk Indicator (KRI) is a measure to indicate the potential presence, level, or trend of a risk. A KRI can indicate 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 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 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).

According to Alizadeh, et al. (2009), the risk-management process involves the following key steps:
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 addresses:
-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?

According to Fraser and Simkins (2010), the ISO Working Group identified 10 principles for risk management (after ISO 31000, clause 4):
1. Creates value for objectives of health, reputation, profits, compliance, and

so on, less the costs of risk management.

2. *Is an integral part of organizational processes including project management, strategic planning, auditing, and all other processes.*

3. *Is part of decision making through analysis and evaluation to understand risk and determine its acceptability as treated.*

4. *Explicitly addresses uncertainty and how it can be modified.*

5. *Is systematic, structured and timely and produces repeatable and verifiable outcomes and decisions.*

6. *Is based on the best available information including historical data, expert opinion, stakeholder concerns, and so forth, tempered with the quality and availability of the information.*

7. *Is tailored to the organization, its objectives, its risks, and its capabilities.*

8. *Takes human and cultural factors into account in addition to technical and other "hard" factors that impact the likelihood of consequences.*

9. *Is transparent and inclusive so that communication and consultation with stakeholders and others keeps the risk management and risk criteria current and relevant.*

10. *Is dynamic, iterative and responsive within a "continuous improvement" environment that responds to changes in context, trends, risk factors and other internal and external factors.*

Hierarchical Holographic Modelling (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 desire to have 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 (Borstrom and Cirkovic, 2008; Chittester and Haimes, 2004).

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 (Haimes, Lambert, Kaplan, Pikus,

Leung, 2002; Haimes and Weiner, 1986; Horowitz and Haimes, 2003):

Phase I. Scenario Identification - a Hierarchical Holographic Modelling 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).

Research approaches
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, Guang Zhou, and Hong Kong.   The qualitative comments were analyzed and the findings were constantly cross-validated and triangulated with quantitative research tools like Delphi questionnaire (Appendix 1) and Multi- Dimensional Scaling technique (Appendix 2).   Initially 20 risk items were preliminarily identified through various focus group meetings.   The Delphi questionnaires were sent to academic experts, gaming practitioners, and representatives from NGOs (a total of 55 experts and 32 veterans participated).   Academic experts are 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 questionnaires were distributed and after

consolidating a series of their findings, the questionnaire was gradually revised to 18 items (see Appendix 1).

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) 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 (Crane and Crane, 2006; Meyer, 2000).   FMEA is a popular quality management tool to predict and manage risks for products and it is used to quantify more systematically the true extent of external risks.   Under 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 SEV, OCC and 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)

The origin of MDS technique was from psychometric. It has a wide range of applications in analyzing data with proximities (or dissimilarity data).   MDS can describe the structure of a group of items through the distance data among respective individual pairs of events. 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.

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In the case of measuring the various similarities and differences of different items, especially subjective perceptions towards risk items, it is not possible to be very exact. Instead the ranking order of risk items is used to represent their similarities and differences among them.   In this respect the data input form would be an asymmetrical matrix with ordinal data (i.e. the ranking order, e.g. Appendix 2).   The MDS Positioning technique can be applied in market segmentation (顧良智, 顧向恩. (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 to construct the Risks Interconnection Map (RIM).

Results of Risk Analyses for Macau Gaming Industry

Because of the uniqueness of the gaming industry, judgmental sampling approach was adopted.   Samples are drawn based on some criteria which the researcher thinks 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. 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 non-probability, it should be representative of an educated group of residents in Macau, Hong Kong, and China.

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.   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	
	Freque ncy	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 significant difference in their 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. 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

Accordingly the casino industry should have concerted effort to reduce the adverse impact of 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 risk factors are perceived to be more probable on a relative basis:

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

The gaming industry should work together to avoid the five risks from happening.

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	

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 are 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 find ways 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 vital risk dimensions used to quantify the risks. Their product is also a common 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 is the product of Severity, Probability, and Detectability. Using the means of neutral value of 5.5, the neutral value of RPN should be $(5.5)^3 = 166.375$.

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

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.

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 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.

Multi-Dimensional Scaling (MDS)

Figure1: MDS of all 253 respondents
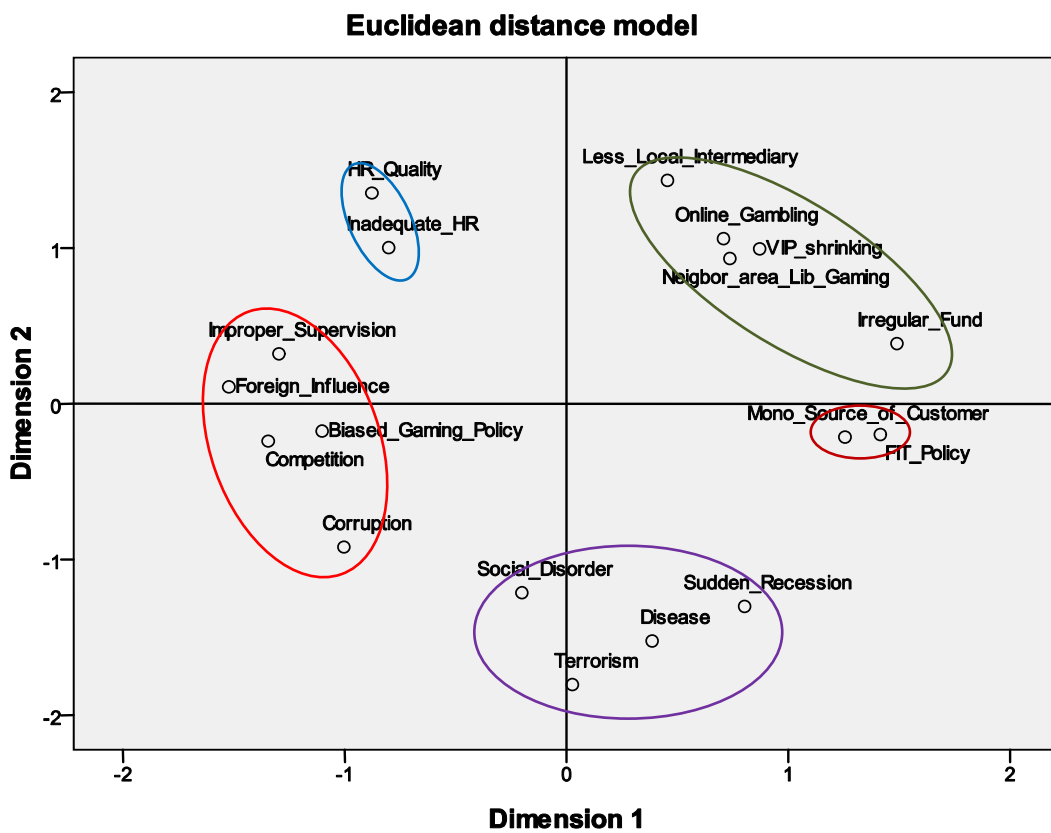

Euclidean distance model

Figure 1 depicts the perceptual mapping of the 18 risk factors by all 253 respondents. There are obviously five clusters of risks, viz.:

Human Resources
    HR Quality
    HR Supply

Macau Government Policy
    Improper industry supervision
    Foreign Power domineering in Macau
    Biased gaming policy
    Corruption issues (possibly caused by improper supervision)
    Competition (This may be due to viewing competition being initiated by improper supervision by the Macau Government)

Crises (crises have low probability of occurrence and severe consequences)
    Social Disorder
    Sudden Economic Recession
    Pandemic disease
    Terrorism

Customer source from China
    FIT policy
    Mono Source of Customers

Commercial Issues
    Less Local Intermediaries
    On-line gambling gaining popularity
    VIP Market Shrinking
    Neighbor Areas Liberalize Gambling
    Irregular Funding Sources disappearing

Risks Interconnection Map (RIM)

Figures 2 depicts the interconnectedness of the risk items in terms of correlation coefficients of RPN. Interconnection lines are drawn for the pairs of risk item 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 way to describe the interconnection among the risk items. Strong correlation coefficients imply a possible causal relationship.

Table 10:   Correlation Coefficients of RPN Scores of 18 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

Figure 2: Risk Interconnection Map (RIM) representing RPN linkages
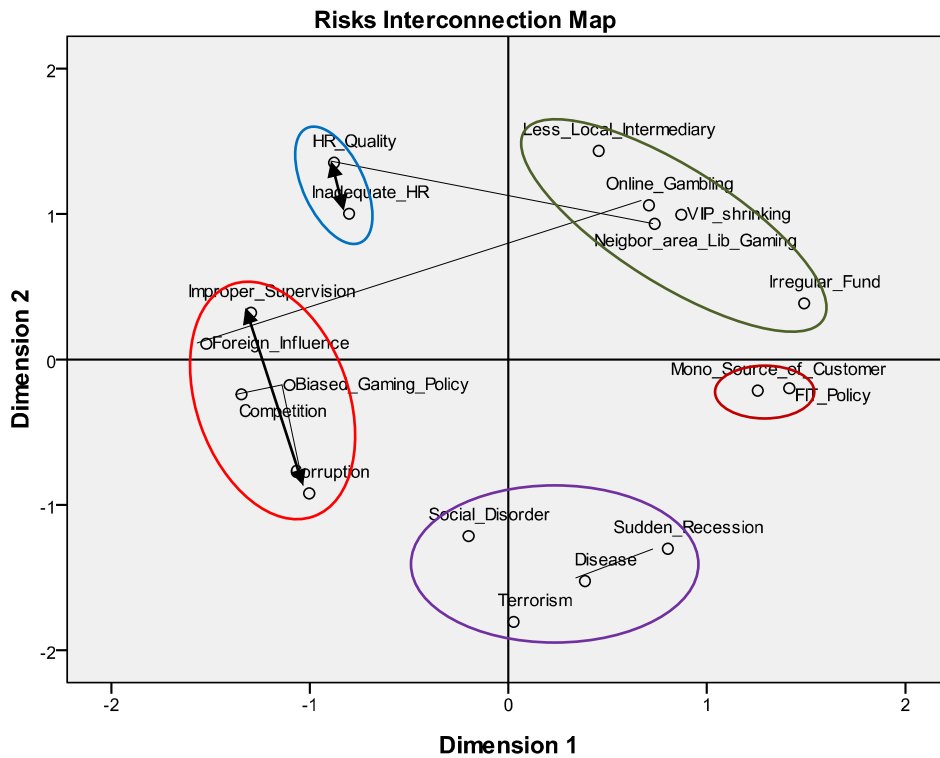
Risk Priority Number (RPN) is the product of Severity, Probability, and Detectability containing the most information about risks concerned.   "HR inadequacy vs. HR quality" and "corruption vs. improper supervision" are highly interconnected.   The risks of sudden economic recession and pandemic disease 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.

Table 11:   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-Neighbor 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 11 succcintly summarize the perceived magnitudes of the 18 risk factors The last two columns in Table 11 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.

Recommendations:
The Risk Priority Number (RPN) contains the most information (i.e. Severity, Probability, and Detectability) about the attributes of risks.   The RPN is 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 gaming industry. Information provided in Table 3 to table 6 can serve as supplementary information. The following are the seven risks with the highest RPN with their respective recommendations:

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 risks.   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 than 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.   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 can be 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 a 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.

　　澳門博彩研究學會現進行一項關於『**澳門博彩業危機與風險研究**』，研究經費由澳門基金會贊助，研究結果會向公眾發表，希望能提供有用的參考訊息給澳門政府、博彩業界、學術機構及澳門市民。研究方法包括有德爾菲法(Delphi method)，這方法採用匿名專家發表意見的方式，專家之間不作互相討論，不聯繫，通過多次專家對問卷所提問題的看法，經過反覆徵詢、歸納、修改，最後彙總成專家基本一致的看法，作為預測的結果。

　　本會誠邀閣下協助，作為澳門博彩業的專家，填寫以下問卷，本會萬分感謝閣下對本研究的支持和合作，研究完成後，本會將會把研究報告交給閣下留念，以表謝意。

　　所謂行業風險是指影響整個澳門博彩行業長時期、健康及和諧發展的情況。(風險是操作性定義為逐漸發生的事件；而危機指的是發生機率較低但嚴峻程度會較高，如戰爭、種族仇殺、大型基建意外倒塌或自然災害。)

　　嚴峻程度(代表危機或風險事項真的發生時如何負面地影響整個澳門博彩業的程度，1=絕不嚴峻，…10=絕對嚴峻)

　　發生機率(代表危機或風險事項發生的可能性，1=絕不可能，…10=絕對可能)

　　被偵察程度(代表危機或風險事項是否容易被**偵察**或**預測**出來及**可被控制**的程度，1=絕對容易被偵察的危機或風險，…10=絕對難被偵察，難預測，難控制的的危機或風險)

　　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, collapse 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)

Delphi Questionnaire

事項 Item	可能影響澳門博彩行業的因素： Factor that might affect the Macau gaming industry	嚴峻程度 Severity	發生機率 Probability	被偵察程度 (預測及可控制 程度) Detectability
1	鄰近地區發展博彩業 Neighbor areas liberalize gaming			
2	貴賓廳市場萎縮 Shrinking of VIP market			
3	人才質素下降 Deterioration of HR quality			
4	澳門人才不足 Inadequate HR supply			
5	非本地中介人減少 Less non-local intermediaries			
6	賭客來源單一化 Mono source of customers			
7	不規範資金消失 Irregular funding source disappearing			
8	博彩業監管執行不善 Improper industry supervision			
9	廉潔發生問題 Corruption issues			
10	澳門政府博彩業政策存在偏差 Biased gaming policy			
11	博彩行業過分擴張帶來惡性競爭 Fierce competition			
12	網上博彩普及 Online gaming gaining popularity			
13	外國勢力控制澳門發展 Foreign power domineering			
14	突發性經濟衰退 Sudden economic recession			
15	國家調整自由行政策 Revision of FIT policy			
16	恐怖襲擊 Terrorism			
17	澳門治安發生問題 Social disorder			
18	新疫症出現 Pandemic disease			
其它				

謝謝

Thank you

MDS Input Form

請把以下各種影響澳門博彩業的 18 項風險/危機逐對比較，最相似的評分爲 "1"，第二相似的爲 "2"，如此類推，......，最不相似的爲 "17"

	人才質素下降	不規範資金受阻	外資勢力控制澳門	非本地中介人減少	突發性經濟衰退	恐怖襲擊	國家調整自由行政策	過分擴張帶來惡性競爭	博彩業監管執行不善	貴賓廳市場萎縮	廉潔發生問題	新疫症出現	網上博彩普及	賭客來源單一化	鄰近地區發展博彩業	澳門人才不足	澳門治安發生問題	政府博彩業政策不公平
人才質素下降	0																	
不規範資金受阻		0																
外資勢力控制澳門			0															
非本地中介人減少				0														
突發性經濟衰退					0													
恐怖襲擊						0												
國家調整自由行政策							0											
過分擴張帶來惡性競爭								0										
博彩業監管執行不善									0									
貴賓廳市場萎縮										0								
廉潔發生問題											0							
新疫症出現												0						
網上博彩普及													0					
賭客來源單一化														0				
鄰近地區發展博彩業															0			
澳門人才不足																0		
澳門治安發生問題																	0	
政府博彩業政策不公平																		0

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	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

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