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PRIORITIZING THE MANAGEMENT OF OPERATIONAL BANKING RISK.

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Abstract: ***— The document presents a hierarchical decision model for evaluating the priority of operational risk management elements in banking institutions in Mexico. It addresses the identification of decision criteria and operational risk management (ORM) elements related to estimating errors caused by individuals, systems, processes, and external factors in the Mexican banking industry, which result in significant losses. Therefore, it is of utmost importance to promote the strength and stability of institutions. The identification of basic decision criteria and risk management elements regarding the effective implementation of operational risk management systems (ORM) in financial institutions was addressed. The research design involved empirical data acquired through interviews with risk assessors in the banking institution. The methodology used is the Analytic Hierarchy Process (AHP), which identified a list of four decision criteria and 13 subcriteria of operational risk management and evaluated their relative importance. One of the findings is that the main criterion for avoiding errors in Operational Risk Management is the personnel factor. AHP proposes a self-regulatory approach for the measures requested by regulatory bodies.***

Keywords**:** AHP Analytic Hierarchy Process, Decision making and Operational risk.

I. INTRODUCTION

Banking institutions suffer losses due to poor risk management. Risk is often considered a deviation from planned values, and events are considered risky when there are doubts about achieving an expected outcome [1]. This combination of uncertainty and harm is described as risk [2].

Initially, operational risk was not recognized, and the banking industry operated with two categories of risks: market risk and credit risk. Any risk not falling into this classification was recorded as "other risks." The mindset of financial institutions changed following successive bankruptcies in the 1990s, which revealed that the banking system was unprepared to handle operational risk. Later, in 2008, the Global Financial Crisis cost the banking sector billions of dollars due to inadequate and ineffective operational risk management. The bank failures highlighted the need to minimize such risks [3] and [4]. The total amount of operational risk losses is caused by personnel, inadequate operations, problems with systems, inadequate control and procedures, or external events [5].

The Basel Committee on Banking Supervision (BCBS) defined operational risk as "the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems, or from external events." Since then, regulators have set principles that banks must adhere to in order to properly manage operational risk and minimize its materialization.

The agreements of the basel committee on banking supervision (bcbs) empower regulators to assess and monitor banks to ensure they maintain a capital buffer to protect against the materialization of operational risk events. the recommendations establish guidelines for minimum capital requirements for risk management [6]. currently, regulations have been modified, and banks have given high priority to operational risk [7]. it is a priority for banks to mitigate operational risk in order to reduce the capital reserves allocated for this purpose.

After the Basel Committee made operational risk management mandatory for banking institutions, various studies were conducted. These include the development of a fuzzy expert system to evaluate operational risk [8], a study on the indirect effects of operational risk events on financial institutions [9], a proposal for a system for operational risk management based on the computational paradigm of Bayesian networks [10], analysis of results using the Generalized Method of Moments (GMM) and extracting data from DataStream [11], a study on evaluation in a fuzzy environment using a Fuzzy Analytic Hierarchy Process (FAHP) [12], mathematical and numerical modelling of qualitative and quantitative characteristics of business process

dynamics to solve optimization problems [13], a study on systemic risk with data obtained from supervision through a direct channel on market values of BHCs experiencing losses, as well as correlated loss channels impacting multiple institutions simultaneously [14], among others.

Operational risk management (ORM) should improve operational decision-making to mitigate events. The distinctive characteristics of operational risk necessitate specific management approaches compared to other types of risk [15].

II. OPERATIONAL RISKS

Banks have the priority of preventing the materialization of risks and have been identifying factors that cause operational risk, which can be attributed to human errors, system errors, processing errors, and errors caused by external factors [5].

This work focuses on operational risk because events caused by operational risk can result in considerable losses. Considering that operational risk is mainly generated by internal sources within the bank, strengthening control systems is necessary to prevent failures.

Banks need to understand the factors that cause operational risks and determine their effects and consequences. The four factors of operational risk are detailed below.

Factors of operational risk related to personnel:

Strategic human resource management addresses the ways in which human resource management is a decisive factor for organizational effectiveness and success [16].

Operational risks are caused by processes based on errors or poor system design or implementation that lead to failures. Therefore, the human factor is associated with the risk of such tasks, and management must ensure that adequate levels of protection are in place [17]. It is important to implement management systems that reduce risks and support continuous effectiveness [18].

Regulations in the banking sector, such as Basel, require banks to include systems for operational risk management. Banks are responsible for designing individual human resource risk management systems. The design of a human resource management system must comply with legal requirements and consider strategic implications [19]. Banks have human resource management systems with standard rules and regulations to prevent conflicts of interest and fraudulent activities among employees.

In practice, errors made by bank personnel are generally not intentional but rather caused by lack of skills, incomplete information, lack of understanding, and knowledge gaps. However, some errors are deliberately committed, such as personal misappropriation of accounts or customer accounts, money laundering, damage to the bank's reputation, physical theft, theft of intellectual property, unauthorized bank transactions, and damage to bank records [12].

Banks are audited by regulatory bodies in areas such as fraud, unauthorized business activities, insider trading, employee illnesses and injuries, discrimination lawsuits, compensation issues, benefits and contract terminations, recruitment or staff retention problems, organized labour activities, and other legal matters [20].

Precautions against operational risk factors involve monitoring personnel errors, preventing corruption among bank staff, and ensuring a safe working environment.

Factors of operational risk related to systems:

Operational risk induced by systems can be defined as losses originating from inadequate technological investments by banks or weak information systems. Banking operations are carried out on computers, so information and communication technologies (ICT) develop parallel to these services [12]. Systems, financial products, and ICT solutions evolve rapidly and become more complex as interconnections and outsourcing of vital services increase [21].

The use of ICT systems increases efficiency, simplifies work, and improves data management and flow. However, systems can fail, leading to technical errors such as system failures, connectivity issues, software application errors, and system crashes, which can affect business operations and result in losses ranging from minor impacts to a crisis in the financial system.

Operational risks can arise from non-compliance with time-sensitive payment requirements and disruptions in payment systems, which could contribute to a severe liquidity shortage in financial institutions [22]. Regulatory bodies identify the following events: hardware and/or software failures, questionable data availability and integrity, unauthorized access to classified information and/or systems, failures or deficiencies in telecommunications, disruptions in automated systems and hacking, viruses, spam, malware, and spyware [20].

The most important precautions to avoid operational risk in the system dimension include assessing the state of ICT, developing and implementing systems, considering the reputational impact of system failures, and addressing cybersecurity concerns.

Factors of operational risk related to processes:

A process is a structured system design aimed at establishing indicators that measure its performance based on outputs or results [23]. For organizations, a process is a set of activities that involve one or more inputs to generate products required by customers [24]. The organization's processes should be linked to how it achieves its objectives [25].

Processes help describe the important aspects of a domain, distinguishing people, departments, and the relationships between them [26]. Errors resulting from banks using their processes incorrectly or inefficiently lead to material and non-material losses for banks [27].

When risks are not understood or defined for a system, banks may address them through risk elimination, avoidance, or transfer. This can involve standardizing processes, contracts, and procedures, building portfolios, managing interest rate risk, loan terms, diversifying or concentrating financial rights or assets [12]. The objective is for banks to mitigate non-essential systematic risks for the financial service

provided or absorb only an optimal amount of a specific type of risk.

Operational risk is subject to regulatory guidelines. For this area, the following events are identified for bank evaluation: non-compliance with mandates, regulations, and laws; incorrect/timely capture, execution, and recording of management; loss of client assets; errors in product valuation; incorrect asset allocation; compliance issues; errors in corporate actions; errors in loan reserves; accounting and tax errors; inadequate accounting of accounting records; and errors in debits and settlements [21].

Banks can take precautions in the process dimension to reduce operational risk by making modifications in data reporting, documentation and contracts, and overall risk management of all processes.

Factors of operational risk related to external factors:

Banks cannot control the occurrence of operational risk due to external factors, which are defined as uncontrollable events that affect business operations. These factors can include political, climatic, and economic changes, as well as the application of technological advancements, among others. External factors affect banking operations, and the bank's level of risk depends on their effects.

Causes of external operational risks include business disruptions caused by economic or political events, product failures in the market, litigation against companies, loss of critical suppliers and raw materials, natural disasters, loss of image/reputation, among others [12].

The regulatory body under the Basel Accord identifies the following events in this area: deficiencies in suppliers and contractors; floods, earthquakes, droughts, or any natural disaster; terrorism, demonstrations, wars; national governments and international institutions; vandalism, theft, robbery, money laundering [21].

To minimize operational losses through risk elimination, avoidance, or transfer, banks must establish emergency plans, provide training, and foster a risk culture to protect themselves from criminal activities and natural disasters. The same applies to political and legal situations that vary according to the geographical location of each bank.

III. MEASURING OPERATIONAL RISK WITH AHP

The Analytic Hierarchy Process (AHP) provides a systematic approach for measuring intangibles and modelling complex decision problems with hierarchical structures [29].

The use of AHP involves breaking down the problem of measuring operational risk into different levels of hierarchy, where the upper level represents the overall objective that decision-makers consider as a priority. The second level corresponds to the criteria for evaluating that objective, and the lower levels are determined by the alternatives being evaluated.

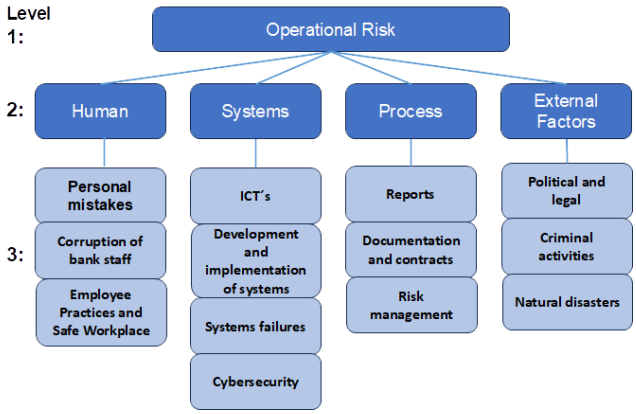

Figure 1. Decision hierarchy model for the APH study of banking operational risk. (Source: own development).

Figure 1 shows the structure of the hierarchical model for operational risk management decision, which includes decision levels in level 1 Goal, level 2 definition of criteria, level 3 definition of sub-criteria, objective, criteria, and alternatives or sub-criteria of the problem. In AHP, a complex problem is decomposed into decisions that can be compared in terms of priorities or performance of the elements at each level pairwise, using Saaty's fundamental 9-point scale shown in Table 1 [28].

TABLE 1. Relative importance intensities by pairwise comparison [28].

Intensity	Linguistic equivalent for criteria comparison
1	Of equal importance
3	Moderated importance
5	Strong importance
7	Demonstrate importance
9	Extreme importance
2, 4, 6, 8	Intermediate values between two adjacent statements

Priorities measure the intangibles in terms of their relative importance to the criteria with respect to the goal or the relative preference for alternatives or sub-criteria with respect to a given criterion, making AHP self-contained through its ability to determine criterion weights [29].

Method

AHP is a measurement theory used to establish the priorities of the hierarchy and the consistency of judgment data provided by the group of respondents [30].

To calculate the priorities, the premise of measurement through comparisons, specifically pairwise comparisons, is established. Let's assume we have n objects $A_1, \dots, A_n$, and their corresponding weight vector is determined by $w = (w_1, \dots . w_n)$

Let's form the pairwise comparison matrix of weights:

$$A = \begin{matrix} \\ A_1 \\ \vdots \\ A_n \end{matrix} \begin{matrix} \begin{matrix} A_1 & \dots & A_n \end{matrix} \\ \begin{bmatrix} w_1/w_1 & \dots & w_1/w_n \\ \vdots & & \vdots \\ w_n/w_1 & & w_n/w_n \end{bmatrix} \end{matrix} \quad (1)$$

Note that we can recover the weight scale $w_1, \dots, w_n$ by multiplying *A* or by the right by *w*, obtaining *nw*, and then solving the eigenvalue problem:

$$Aw = nw \quad (2)$$

where n is the largest eigenvalue of A. In general, we don't know the proportions $\frac{w_i}{w_j}$, they are usually not known but are estimated from data, experiments, or expert opinions. To elicit judgment and automatically enter its reciprocal in the transposed position would lead to disturbances in A in the eigenvalue of A.

To obtain an estimate of the weights *w*, the problem can be solved by:

$$Aw = \lambda_{max} w \quad (3)$$

where λ_{max} is the maximum eigenvalue of the matrix A, and it is weighted by the priority of the property with respect to which the comparison is made. It is a process of extracting vectors from the elements at any level of hierarchy. Thus, a perfectly consistent matrix is impossible. Therefore, we can adopt an acceptable consistency limit using the following consistency index (CR):

$$CR = \frac{\frac{(\lambda_{max} - n)}{(n-1)}}{RI} \quad (4)$$

where *RI* corresponds to the random inconsistency index, whose value is determined according to the size of the matrix. If CR ≤ 0.1, A has an acceptable consistency limit; otherwise, pairwise comparisons should be reviewed.

IV. DEVELOPMENT

In the study, operational risk factors were evaluated using AHP in a Mexican bank with international operations, whose participation is represented in three geographical regions that define the decision-making on the bank's operational risk. This evaluation used the AHP method to determine the weights of the main operational risk factors for its decision-making areas. The evaluation of expert groups allowed us to obtain the weights of the criteria and alternatives. The results were transferred to a spreadsheet in order to describe the relative importance of the main operational risk factors for each of the areas represented by the North Zone, South Zone, and Central Zone.

This hierarchy is based on the understanding that operational risk is expressed in four scenarios, and four criteria are identified: human, systems, operations, and external factors. Each of the criteria, in turn, has alternatives or sub-criteria that are events that may occur. Given the sensitive nature of the bank's information regarding the allocation of resources for Operational Risk Management (ORM), the actual options are referred to by letters and numbers that do not correspond in any order to the elements listed above.

The Risk Committee, through expert decisions, defines five pairwise matrices for the goal and criteria. The AHP evaluation matrix for the main operational risk factors is described in Table 2, which determined the weights of the main factors.

TABLE 2. The AHP evaluation matrix with respect to the main operational risk criteria

Normalized matrix of RO factors	P	S	P	FE	Eingenvector
P	0.3947	0.3750	0.4091	0.4167	0.3989
S	0.3947	0.3750	0.4091	0.2500	0.3572
P	0.1316	0.1250	0.1364	0.2500	0.1607
FE	0.0789	0.1250	0.0455	0.0833	0.0832

TABLE 3. The AHP evaluation matrix with respect to the Systems (S) criterion

Matriz normalizada para (S)	TIC	DIS	FS	C	Eingenvector
TIC	0.2500	0.3000	0.1667	0.2500	0.2417
DIS	0.2500	0.3000	0.5000	0.2500	0.3250
FS	0.2500	0.1000	0.1667	0.2500	0.1917
C	0.2500	0.3000	0.1667	0.2500	0.2417

TABLE 4. The AHP evaluation matrix with respect to the Personnel (Pe) criterion

Matriz normalizada para (Pe)	EP	CPB	PETS	Eingenvector
EP	0.6923	0.7143	0.6000	0.6689
CPB	0.2308	0.2381	0.3333	0.2674
PETS	0.0769	0.0476	0.0667	0.0637

TABLE 5. The AHP evaluation matrix with respect to the Process criteria (Pr)

Matrix normalized for (Pr)	R	DC	AR	Eingenvector
R	0.6522	0.6923	0.5556	0.6333
DC	0.2174	0.2308	0.3333	0.2605
AR	0.1304	0.0769	0.1111	0.1062

TABLE 6. The AHP evaluation matrix with respect to the Process criteria (FE)

Matrix normalized for (FE)	PL	AC	DN	Eingenvector
PL	0.6522	0.6923	0.5556	0.6333
AC	0.2174	0.2308	0.3333	0.2605
DN	0.1304	0.0769	0.1111	0.1062

The correspondence of each consistently acceptable matrix was determined.

TABLE 7. Priority weightings of operational risk criteria and alternatives with respect to branches

Main operational risk criteria	Operational risk alternatives	Criterion Priority	Priority of the alternative within your own criteria	Overall priority of the alternative
Pe	EP	0.3989	0.6689	0.2668
	CPB		0.2674	0.1067
	PETS		0.0637	0.0254
S	TIC	0.3572	0.2417	0.0863
	DIS		0.3250	0.1161
	FS		0.1917	0.0685
	C		0.2417	0.0863
P	R	0.1607	0.6333	0.1018
	DC		0.2605	0.0419
	AR		0.1062	0.0171
F	PL	0.0832	0.5593	0.0465
	AC		0.2605	0.0217
	DN		0.1351	0.0112

As seen in Table 7, the personal criterion (Pe) is the most important primary factor, while the least important criterion is External Factors (FE). Within the alternatives for operational risk caused by Personal (Pe), the most important one is personnel errors (EP), and safe employee practices and workplace is the least important alternative. Bank personnel corruption (CP) is considered an alternative with intermediate value. The second criterion of importance is Systems (S), and among the alternatives, system development and implementation (DIS) is the most important, while system failures (FS) are the least important. ICT and cybersecurity (C) are equally important as the second and third alternatives. The third criterion of importance is Processes (Pr), where reports (R) are the most important alternative, followed by documentation and contracts (DC), and finally risk management (AR). On the other hand, for the last criterion called External Factors (FE), the following alternatives are ranked by importance, with political and legal events (PL) being the most important, followed by criminal activities (AC), and finally natural disasters (DN).

TABLE 8. Weights for operational risk factors with respect to their importance

Criteria	Alternatives	Branch office	Weighting by alternatives	Criterion weighting
Pe	EP		0.5559	0.3718
	EP	S	0.3537	0.2366
	CPB	N	0.3333	0.0891
	CPB	S	0.3333	0.0891
	CPB	C	0.3333	0.0891
	PETS	C	0.0669	0.0043
S	TIC	C	0.0685	0.0166
	DIS	N	0.6579	0.2138
	DIS	S	0.2081	0.0676
Pr	R	S	0.7766	0.4919
	DC	S	0.2431	0.0633
	AR	C	0.1505	0.0160
FE	PL	S	0.6333	0.4011
	DN	N	0.1429	0.0152
	DN	S	0.1429	0.0152
	DN	C	0.7143	0.0758

In Table 8, the behaviour of the bank regarding branch performance is described. It is found that for operational risk caused by personnel (Pe), personnel errors (EP) are critical for Branch N and Branch S. For all three branches, bank personnel corruption (CPB) has moderate importance, and the least significant alternative is safe employee practices and workplace (PETS) for Branch C. For the Systems criterion (S), it is found that system development and implementation (DIS) is critical for Branch C and has moderate importance for Branch S. The alternative of ICT (Information and Communication Technology) is low for operational risk in Branch C. The Processes factor (Pr) presents a critical point in the reports (R) alternative for Branch S, the documentation and contracts (DC) alternative has moderate importance for Branch S, and risk management (AR) is of the least importance for Branch C. For the criterion of External Factors (FE), the political and legal events (PL) alternative is identified as critical for Branch S. As for natural disasters (DN), it has moderate importance for Branch C, while for Branch N and Branch S, it is of minimal importance.

TABLE 9. Global weights of operational risk with respect to its importance

Criteria	Alternatives	Branch office	Weight by alternative	Criterion weighting	overall weighting
Pe	EP	N	0.5559	0.3718	0.1483
Pe	EP	S	0.3537	0.2366	0.0944
Pe	PETS	C	0.0669	0.0043	0.0017
S	TIC	N	0.7766	0.1877	0.0670
S	DIS	N	0.6579	0.2138	0.0764
P	R	S	0.7766	0.4919	0.0791
Pr	DC	C	0.0882	0.0230	0.0037
Pr	AR	C	0.1505	0.0160	0.0026
FE	DN	N	0.1429	0.0152	0.0013
FE	DN	S	0.1429	0.0152	0.0013

In Table 9, the global weights of operational risk are listed in terms of their importance, determining the five worst and five best performances among the branches that impact the bank. The critical points that globally affect the bank's performance are found in the following branches: 1) and 2)

Branch N and Branch S, due to personnel errors (EP) in the Personal criterion (Pe); 3) Branch S, due to reports (R) in the Processes criterion (Pr); and 4) and 5) Branch N, due to system development and implementation (DIS) and information and communication technologies (ICT) in the Systems criterion (S). On the other hand, the branches that manage operational risk the best are: 1) and 2) Branch S and Branch N in the natural disasters (DN) alternative of the External Factors criterion (FE); and 3), 4), and 5) Branch C, which excels in three alternatives with the best considerations for managing operational risk in the bank. These alternatives are employee practices (PE) and workplace safety (PETS) in the personal criterion (Pe), documentation and contracts (DC), and risk management (AR) in the Processes criterion (Pr).

V. CONCLUSION

In this study, the criteria of operational risk were evaluated by applying the AHP methodology to the branches of the Mexican bank. The results of the analysis show that despite having the central bank's guidelines, the branches have differentiated themselves geographically in terms of operational risk criteria and alternatives. It is concluded that Mexican branches have considered different operational risk criteria. The utility of this comparative work is to determine which operational risk alternatives should be managed with differentiated strategies by the branches of the Mexican bank.

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