

Applicability of Operational Resilience in Financial Institution System Operations: Use of Management Accounting in Terms of Visualizing Opportunity Losses

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Abstract

The author examined how to deal with system failures, which occurring with a reasonable frequency, of financial institution systems, which are indispensable for Japanese financial institutions to continue to fulfill their social responsibilities to provide benefits such as fund settlement, deposits, and loans. The representative examples show that not only careful system design is required, but also that failures in customer response often lead to large-scale system failures. When a failure does occur, it is essential to take alternative measures as much as possible and make efforts to minimize the impact on customers. For this reason, the author has been considering the concept of Operational Resilience (OR), which is the ability of financial institutions to prioritize their highest priority operations and to continue them as long as possible by taking the necessary measures and procedures to keep the impact within the acceptable range assumed in advance.

Moreover, as a countermeasure, it is necessary for the management of financial institutions to first recognize the importance of this issue, and furthermore, it is necessary to motivate the members of the organization to take it seriously. In this paper, the author examined the visualization of the opportunity losses that may occur when the initial behavior of a system failure is mistaken and the failure develops into a large-scale failure. This visualization is connected to the motivation of organizational members to continue their important tasks, and ultimately to avoid a large-scale system failure. The author believes that here lies the contribution of management accounting.

Keywords: Operational Resilience, Financial Institution System, System Failure, Visualization of Opportunity Loss, Motivation

1. Introduction

Japan is the only developed country where interest rates have remained extremely low, zero or negative, for a long time. Even under these special circumstances, financial institutions in Japan are required to assume social responsibility with a sense of mission and tension, as carrying out social infrastructure functions to provide benefits such as fund settlement, deposits, and loans.

Unfortunately, the financial institution systems indispensable for such infrastructure functions, such as the accounting and information systems, which require a reasonable cost burden for development and maintenance, have frequently experienced large-scale system failures.¹ The causes of failures seem to vary, but the main focus is not on achieving zero failures, but on keeping important operations running as long as possible by taking alternative measures to prevent major system failures, even if failures do occur. The concept of Operational Resilience (OR) has been gaining popularity in recent years.

This paper discusses the operation of financial institution systems based on the concept of OR. The author believes that it would be useful to introduce the concept of opportunity loss, which is estimated to be caused by a large-scale system failure, and to "visualize" it to the members of a financial institution's organization to motivate them as part of management accounting not to make mistakes in their initial responses.

Based on the previous studies introduced below, it seems appropriate to consider this study on the basis of management accounting. ITO (2017, 4) defined management accounting as a system that supports the realization of management objectives by providing various types of information required by business managers in various phases of management activities and by psychologically influencing their behavior through the process of creating and communicating such information.

¹ The term "large-scale system failure" used in this paper refers to a level where the number of affected customers cannot be ignored from a socially accepted point of view, because the problem has not been resolved for an extended period of time.

SAKURAI (2019, 5) defined management accounting as accounting for assisting managers through strategy formulation, managerial decision making, management control, and control of field activities. Anthony and Govindarajan (2007, 6-7) defined management control, which is inseparable from management accounting, as communicating information, evaluating information, deciding what actions to take, and influencing people to change their behavior. In other words, this paper focuses on the information-providing function of management accounting and its effect on psychological influence, which is to motivate members of an organization to continue their work while avoiding large-scale system failures through visualization of opportunity losses.

In the following, the author first reviews several system failures in financial institutions and then analyze the background that led to large-scale system failures.² Next, the concept of OR is reviewed. Then, the author estimates and visualizes the opportunity loss caused by a large-scale system failure, which can be used as warning information to motivate the management of financial institutions to recognize the importance of the system failure and to make the members take the system failure seriously. Through these studies, the author discusses the future management stance of the financial institution system in Japan.

2. System Failures in Financial Institutions

2.1 Typical System Failures to Date

Here, the author will look at representative system failures in Japan and overseas, and examine their backgrounds.

2.1.1 System Failure at UFJ Bank

UFJ Bank (now MUFG Bank, created through the merger of Sanwa Bank and Tokai Bank) experienced a system failure when the new bank was launched in January 2002. The Sanwa Bank

² In this paper, the contents of Nikkei Computer (2022) were used as a general reference for contents that could not be confirmed by newspaper articles.

and Tokai Bank systems were integrated at the same time as the new bank was launched, resulting in 180,000 cases of double debit errors.³ In this system integration, Tokai Bank's account system was integrated into Sanwa Bank's system, but there was a problem with the account transfer system (Nikkei Computer 2022, 240).

2.1.2 System Failure at Mizuho Bank

In April 2002, three months after the UFJ Bank system failure, Mizuho Bank experienced a system failure. Mizuho experienced its first major system failure, followed by three more major system failures in March 2011 and February 2021. The following is an overview.

2.1.2.(a) System Failure in April 2002

In the case of April 2002, after the first day of the merger of the three former banks (Dai-Ichi Kangyo Bank (DKB), Fuji Bank (Fuji), and Industrial Bank of Japan (IBJ)), unprocessed account transfers (2.5 million cases), double debits (60,000 cases in total), double transfer incidents (5,000 cases), delayed transfers (2,200 cases), and ATM troubles (147 cases) (Nikkei Computer 2022, 190-193). At this stage, the bank had not completely integrated the systems of the three former banks. While Mizuho Corporate Bank, which was established at the same time (integrated into Mizuho Bank in July 2013), had integrated its systems into those of the former IBJ, the bank kept the systems of the former DKB and the former Fuji, and connected both systems using relay computers (Nikkei Computer 2022, 182-191).

In the external connection system of the ex-DKB system, this former system was connected (via relay computers) to the ex-Fuji system within the bank and to the Zengin system and BANCS (City Bank Cash Service) outside the bank. However, bugs in the connection system made it impossible to use the ex-Fuji's cash cards at the ATMs of the ex-DKB and other banks, and also made it

impossible to use cash cards other than the ex-Fuji's at the ex-Fuji's ATMs (Nikkei Computer 2022, 190-193).

2.1.2.(b) System Failure in March 2011

The next major system failure in March 2011 occurred on the night of March 14, 2011, when the bank was unable to process a large number of requests for donations related to the Great East Japan Earthquake. Not only were 310,000 transfers unprocessed on the following day, the 15th, and ATMs and other facilities unavailable, but also subsequent salary transfers and other transfers could not be processed one after another, resulting in a maximum of 1.2 million transfers not being processed and 1.01 million transfers from other banks also not being processed. The incomplete nighttime batch processing affected online processing during the daytime in various ways, causing ATMs to stop abnormally, transfers to other banks to go unprocessed, and double transfers to other banks to occur (Nikkei Computer 2022, 197-204).

2.1.2.(c) System failure in February 2021

The most recent representative system failure occurred on February 28, 2021, when ATM operations were suspended (up to 4,318 units), passbooks and cards remained in ATM terminals and did not come out (5,244 cases), and some ATM and Internet banking transactions were disabled (System Failure Special Investigation Committee 2021, 5). Although the bank experienced intermittent system failures with different events after this, this section will focus on the first case in February of the same year in order to focus on a representative system failure. It was a Sunday.

In January 2021, the bank began to switch to a passbook-less account for accounts that had not had a passbook for at least one year, and used Saturdays and Sundays, when transaction volume is lower than on weekdays, for this process. According to System Failure Special Investigation Committee (2021, 34-35), the bank assumed that the switch to a passbook-less account would reduce the annual stamp tax burden by about 1.6 billion yen and the cost of reducing passbook issuance by

³ According to the article "180,000 double debits at UFJ Bank" on the front page of the Nihon Keizai Shimbun (dated January 29, 2002), and "Miscalculation in UFJ Bank system integration" on page 7 of the same newspaper.

approximately 10 million yen per year, and that the switchover should be completed by the end of March to avoid paying new stamp tax when the new fiscal year begins. The switchover process exceeded the capacity of the system, resulting in errors with time deposits and other problems. In an attempt to avoid a total system shutdown, the processing section at the entrance to each transaction channel, such as ATMs and Internet banks, began to close, resulting in transaction errors.

As a result, when customers made transactions at the bank's ATMs, they encountered a situation in which their passbooks and cash cards were loaded into the ATMs and did not come out. Until then, the bank had a specification that ATMs would retrieve passbooks and cash cards when a transaction failed for some reason (Nikkei Computer 2022, 53). Such specifications can be found at other banks as well. This was also to prevent damage to accounts that had been used in fraudulent crimes or reported lost or stolen.⁴ Normally, customers can return their passbooks and cash cards to the ATM by calling them on the fixed-line phone installed in the ATM.

However, on the day of the incident, all of the bank's ATMs across the country were involved in the incident at the same time, resulting in a high concentration of calls from customers, which left the ATM centers in a state of disconnection.⁵ Since there was no contact from the bank, customers became concerned about when their passbooks and other items would be ejected from the ATMs, and they were unable to leave their passbooks and cash cards that had been taken. The damage gradually

increased as new customers operating ATMs that appeared to be working properly suffered from the same problem (Nikkei Computer 2022, 16-21). Some customers were unable to leave the ATM for nearly five hours because their passbooks and cash cards did not come out. The Financial Services Agency (FSA) took this situation very seriously and, taking into consideration the fact that there were a series of small-scale system failures with different causes, issued two business improvement orders and forced the bank to investigate the causes.

2.1.3 System Failure at SMBC

In April 2022, Sumitomo Mitsui Banking Corporation (SMBC) experienced a failure that prevented cash withdrawals from convenience store ATMs. It took more than 16 hours for the system to be fully restored. The bank attributed the failure to an unstable connection between its own system and ATMs due to a flaw in some settings.⁶

2.1.4 Failures in the Regional Bank Joint System

In March 2022, several regional banks in Japan experienced system failures that prevented them from using Internet banking, and some of them had problems with their cash cards did not come out from ATMs. The joint system was the "Chance Regional Banks Joint System" developed by IBM Japan,⁷ and since several regional banks had to deal with the system individually, the use of the joint system for the purpose of reducing development costs turned out to be disadvantageous.

2.1.5 System Failure at RBS Group in the UK

Looking overseas, in June 2012, the Royal Bank of Scotland and its two subsidiary banks, National Westminster Bank and Ulster Bank (collectively,

⁴ According to System Failure Special Investigation Committee (2021, 46-47), even when a bankbook or card is forgotten to be retrieved, it is subject to retrieval so that the next user will not be inconvenienced. It is also confirmed that trouble with cash cards being taken has occurred in the failure of the Regional Bank Joint System described below, so this does not seem to be a special specification unique to the bank at this point.

⁵ According to System Failure Special Investigation Committee (2021, 58-59), the telephone call loss ratio (the ratio of calls that fail to connect due to insufficient lines) at ATM centers was generally in the 90% range throughout the day after 10 a.m. on the same day.

⁶ According to the article "SMBC's outage restored, affecting GW settlements" on page 3 of the Nihon Keizai Shimbun dated May 2, 2022.

⁷ According to the article "8 Regional Banks and Lawson Bank Fail, ATMs, Cards Also Taken In" on page 5 of the Nihon Keizai Shimbun dated March 27, 2022.

the "RBS Group⁸"), experienced a typical system failure in the UK. The nighttime batch processing of the banking system was not completed by the next morning, and daytime online processing was halted. The failure occurred when the job scheduler was updated, and when a rollback process was performed to restore the previous version of the job scheduler in order to resolve the problem, the internal data format was also changed at this stage, causing the previous version of the job scheduler to fail. The internal data that had been changed in the previous version of the job scheduler could no longer be read by the new one, further expanding the failure (Nikkei Computer 2022, 243-249).

2.1.6 Sub-Summary

The causes of system failures in financial institutions are many and varied. In particular, failures that occur at the time of a new system release or some time after the release may be due to design flaws or insufficient pre-release testing. The design of a system requires a certain amount of caution, and careful testing is also required before the system is put into operation. From this point of view, some cost burdens are unavoidable.

When the author considers whether such design flaws or insufficient testing prior to release were the only factors that led to a large-scale system failure, it appears that a combination of customer service failures contributed to the trouble. The next section discusses these issues.

2.2 Large-Scale System Failure Caused by Problem Response

In the event of system failures at financial institutions, if the relevant process cannot be executed due to system design errors or others, it is essential to quickly alleviate customer anxiety by providing as many alternative measures as possible for the relevant process and informing them of such measures. In other words, the highest priority is to minimize the impact on the customer in any case.

However, there have been cases where problems have spread further and developed into large-scale system failures due to responses that were not based on these principles. The following are examples of particularly problematic customer responses. From these cases, the author can also find ways to prevent large-scale system failures from occurring.

2.2.1 Customer Relations at RBS Group in the UK

As mentioned above, RBS Group experienced a system failure in June 2012. Ulster Bank was forced to open for business the next day without completing the nighttime batch processing, resulting in a large number of data inconsistencies, and the failure spread in a snowball effect. Thousands of employees were mobilized to manually correct the data inconsistencies, and it took about 20 days for operations to finally return to normal. Andrew Bailey, then Bank of England Deputy Governor, criticized the failure as "a system failure caused by poor legacy systems with limited resilience and inadequate IT risk management" (Nikkei Computer 2022, 246-248).

The cause of this large-scale system failure was the fact that Ulster did not complete the nighttime batch processing, but instead disregarded the impact on customers and forced the bank to open for business the next day.

2.2.2 Customer Relations at Mizuho Bank

As mentioned above, Mizuho has had three major system failures. In the case of the March 2011 failure, the bank continued to operate the next day despite the abnormal completion of nighttime batch processing, as seen in the case of Ulster described in the previous section. This caused data inconsistencies, making system restoration more difficult (Nikkei Computer 2022, 248-249), and it must be said that the impact on customers was equally neglected.

In the failure that occurred in February 2021, the system was overloaded by the passbook-less processing, and each transaction channel such as ATMs and Internet banks began to close, resulting in transaction errors. Although it was a holiday,

⁸ RBS Group changed its name to NatWest Group in February 2020.

the fact that such passbook-less processing was conducted on a day at the end of the month suggests poor risk judgment in selecting a day when various processes are likely to reach their peak.⁹ What is even more problematic is that, as pointed out by System Failure Special Investigation Committee (2021, 84), the bank did not conduct any training to avoid the spread of customer impact, assuming a case of system failure on a holiday or after business hours when prompt contact and physical attendance would be difficult.

2.2.3 Sub-Summary

However, even in the event of a system failure, it is important to take alternative measures as much as possible and inform customers of these measures to alleviate their concerns and minimize the impact on customers, which could lead to a large-scale system failure.¹⁰ It is important not to force operations in an attempt to make things add up, or to assume in advance that a worst-case scenario will occur, and to train oneself to take into account how to get out of the situation to an acceptable level.

For this reason, this paper will focus on the most important operations of a financial institution in the event of a system failure, and will focus on keeping important operations running as long as possible by taking the necessary measures and procedures to limit the impact to within acceptable limits (KAWAHASHI 2022, 9). The concept of OR will be discussed.

3. Considerations Based on OR

3.1 Concept of OR

Here, the author reviews the concept of OR, i.e.,

the ability of a bank to continue to operate its critical business even under disruptions (Prudential Regulation Authority 2018, 18; Bank for International Settlements 2020, 3). The author will then explore measures to motivate institutions to develop a more feasible posture based on this concept.

KAWAHASHI (2022, 8-9) draws a lesson from the perspective of OR: no matter how many double or triple backups are in place, the occurrence of a risk event such as a system failure cannot be avoided, so instead of assuming that the system will never stop, as has been the case in the past. Therefore, it is necessary to prioritize the most important operations of a financial institution in the event of an unexpected event, and to take measures and procedures to limit the impact to within the acceptable range assumed in advance. It is also important to develop a business continuity plan (BCP) to ensure that operations and services can continue to be provided even in an environment where they are suspended. In some cases, it is necessary to break away from the notion that all services must be provided at all times.

In fact, Mizuho Financial Group (MHFG), the parent company of Mizuho Bank, also stated, "Based on the reflection of the system failures, we consider the enhancement of our crisis response capabilities as an important management issue, and we are currently implementing the concept of "OR," which is to prepare for possible business disruptions and to limit their impact to a certain level, from the perspective of customers and market impact, in our ongoing efforts to improve our business operations" (Mizuho Financial Group 2022c, 100). However, they have not announced how they will implement the concept in concrete terms. Mizuho and MHFG are required to promptly show how they can avoid large-scale system failures and how users can truly transact with peace of mind, and this disclosure may be considered inadequate. In this paper, the author will first examine what kind of systems are necessary for financial institutions to prevent system failures from escalating to a large-scale level.

⁹ System Failure Special Investigation Committee (2021, 68, 133) makes much the same point.

¹⁰ In the article "Lessons from the Mizuho Problem: Aggressive DX, Neglectful Defense...", on page 7 of the Nihon Keizai Shimbun dated December 1, 2021, a senior executive of a megabank testified that "five of Mizuho's eight failures are routine occurrences. KAWANAMI (2021, 3) also introduces information from FSA, which states that domestic financial institutions had approximately 1,500 system failures in FY2020 alone, and mentions that the banking system is always incomplete.

3.2 Responding to System Failures Based on OR

Even if a financial institution designs and develops a system with multiple backups in order to reduce system failures to as close to zero as possible, the cost burden will not only be enormous, but eventually some system failures will be unavoidable.

If this is the case, instead of investing huge amounts of money in system development over a considerable number of years,¹¹ the development should be cut off at some stage and an acceptable level that minimizes the impact on customers should first be set as an important task that should be continuously operated. In the event of a system failure, it would be realistic for financial institutions to shift to a recovery mode and strive to quickly recover to the acceptable level by taking prompt action. In addition, to make such a systemic response feasible, it is necessary to conduct periodic drills to shift to emergency response mode, and to make daily efforts to recover to the acceptable level mentioned above. In the next section, the author will discuss the actual posture that financial institutions should take in the event of a system failure.

4. Considerations for Achieving OR

4.1 Emergency Response to System Failures

As seen in the previous section, the following section discusses how to maintain the ability of financial institutions to continue to operate important business operations in the event of a system failure, and how to limit the impact within the acceptable range assumed in advance, keeping in mind the need to quickly provide accurate guidance to customers when a failure occurs on

holidays or during the night.

4.1.1 Response by Full Use of In-House Personnel

Originally, financial institutions have established detailed BCP as shown by Bank of Japan (2003) and Japanese Bankers Association (2012), taking into account the supervisory guidelines for major banks, etc., provided by Financial Services Agency (2022, 310-317), as a measure against emergencies such as a large-scale earthquake. Although safety is a prerequisite, it is a social mission to ensure convenience for residents in the disaster area, to continue fund settlement operations, and to open branches in times of emergency. For this purpose, all financial institutions have basically established an emergency communication system and branch operation procedures, and have cleared inspections by the authorities.

In other words, all financial institutions already have the bare bones in place for employees to assemble in the event of an emergency. For example, if some ATMs are unavailable, the financial institution is required to dispatch employees or agent to all ATMs within one hour. The institution should operate in such a way as to minimize the impact on customers by posting information on the unavailability of ATMs (including the availability of partner ATMs and the policy for dealing with fees incurred by using alternative means) and, in addition, by informing customers whose passbooks and cash cards do not come out that they will be returned at a later date. Thus, operations must be conducted with minimal impact on customers.¹²

4.1.2 Prompt Collection and Dissemination of Information

In the event of a system failure, it is necessary not

¹¹ Nikkei Computer et al. (2020, 17) estimated that the development scale of Mizuho Bank's MINORI account system, which was completed in July 2019, was 350,000 man-months (a man-month indicates the amount of work, and the average man-monthly unit cost of engineers responsible for developing financial institution systems is 1 to 1.2 million yen). The author estimates that about 420 billion yen is the cost of application development.

¹² According to System Failure Special Investigation Committee (2021, 84-85), most of the complaints from customers affected by the Mizuho Bank system failure in February 2021 were not so much anger over the system failure itself, but anger over the bank's response, such as the fact that they had to wait without any communication from the bank. This suggests the importance of reducing customer waiting time.

only to respond at the actual ATM location, but also to collect and disseminate information as a financial institution.

As noted by System Failure Special Investigation Committee (2021, 62), when the Mizuho Bank system failed in February 2021, customers' reactions to the abnormal situation were posted on SNS and other social networking. Considering the possibility that error detection on the part of the bank may not be reliable, it is necessary to utilize such SNS postings as a broad information collection channel. If a system failure has occurred, it is essential to promptly provide appropriate information to customers who plan to use the bank's services on the day of the failure via the bank's website. This is because customers often gather information on the destination before leaving their homes, etc., and there is little likelihood of complaints if information on system failures is disclosed on the homepage of the bank at that time.

4.1.3 Sub-Summary

Thus, from the perspective of OR, it is essential to maintain the ability to continuously operate critical operations even in the event of system failures, and to take measures to limit the impact to within acceptable limits assumed in advance. On the other hand, even if such measures have been decided, it will be necessary to recognize the importance of the above measures as the management of the financial institution and to consider the motivation for the members of the organization to take them seriously.

In the next section, the author will seek ways to estimate and visualize the opportunity losses when a system failure develops into a large-scale failure due to errors in initial actions. This will enable organizational members to recognize the damage to their own bank in the event of a large-scale system failure, and to implement emergency responses from the perspective of OR.

4.2 Visualization of Opportunity Loss

In this section, the author examines the motivations that members of a financial institution need to minimize the impact of system failures and

achieve OR, and estimates opportunity losses based on a fictitious example. The opportunity loss is estimated based on a fictitious case study of Mizuho, where various recent information is disclosed and comparisons can be made easily.

4.2.1 Costs for Initial Response to Failure and Training

First, the author assumes that the bank dispatches its own employees to all ATMs for four hours (including round-trip travel time, which is counted as additional wages) as an initial response when a system failure occurs. The assumption is that system failures occur once a year.

According to Mizuho Financial Group (2022d, 175), there were 5,098 ATMs and 461 domestic outlets at the end of March 2022. Mizuho Bank (2022, 60) reports that there were 1,481 non-branch ATMs at the end of the same month. In an emergency, at least one employee must be dispatched to each domestic branch and each non-branch ATM, so it is necessary to designate 10 employees for each in advance to ensure that they can be dispatched. In this section, the author assumes that, as a result of repeated training, an average of two employees responded to the dispatch instructions, including duplicates, and rushed to the site. Based on Mizuho Bank (2022), the average hourly wage of employees is calculated to be 3,242 yen.¹³ Taking into account the 50% surcharge for

¹³ From Mizuho Bank (2022, 15), the average annual salary for the year ending March 31, 2022, including bonuses, is 7,695 thousand yen, and the number of employees is 25,897 at the end of the same period. The bank's non-consolidated reserve for bonuses at the end of the same period was 24,582 million yen (Mizuho Bank 2022, 176), so the average bonus per employee was 949 thousand yen (rounded down to the nearest unit; the same applies below). Therefore, the average monthly salary is 562 thousand yen, and the average hourly wage is estimated at 3,242 yen, based on the simple annual working hours of 2,080 for a 52-week work of 40 hours per week and 173.3 simple working hours per month. The difference from the timing of the bonus reserve is not taken into account. The number of branches disclosed to the public may not be the actual number of branches, but rather the number of branches in the case where there are two or more branches in the same location (so-called "branch-in-branch"), but it is difficult to verify this precisely. The cost of the emergency communication system for employees is assumed to include costs necessary for BCP in the event of a major earthquake, etc., and additional costs are not taken into account here.

nights and holidays, and estimating that the transportation cost for dispatching one employee is 500 yen, the cost of dispatching one employee is approximately 77.5 million yen (rounded up to the nearest unit).

Apart from this, additional response costs for the system-related and headquarter departments are to be also calculated. The employee's night and holiday premium hourly wage rate described above is still applied here. If 500 staff members would respond for an average of 6 hours, the personnel cost is calculated to be 14.6 million yen, and adding 5.4 million yen (estimated) for website announcements and other costs, the cost would be 20 million yen (estimated). Thus, the initial response cost is estimated to be approximately 97.5 million yen (estimated).

Furthermore, if training is conducted once every six months, with each scheduled dispatched employee held for one hour, the same average hourly wage and premium wage rate as above are considered. Assuming that 10 employees are assigned to each store and ATM as described above, the annual training cost would be approximately 188.9 million yen (rounded up to the nearest unit), and assuming that the additional cost of the headquarters department is 5 million yen per year (estimated), the annual training cost would be approximately 193.9 million yen (estimated).

Therefore, the author can estimate that the cost of initial response to a system failure and the cost of conducting a training once every six months would amount to 291.4 million yen per year.

4.2.2 Opportunity Losses Caused by Large-Scale System Failures

On the other hand, the author estimates the cost of a large-scale system failure for a financial institution that does not conduct the training and initial response described above. The author also estimates the costs associated with the large-scale system failure that actually occurred at Mizuho, as well as the opportunity loss caused by the estrangement of business partners, which is not included in the calculation, and the loss of human resources caused by the decline in employee

motivation, and the additional costs incurred in recruiting personnel as a result. The difference between the cost calculated in this section (4.2.2) and the cost calculated in previous section (4.2.1) is the opportunity loss that the author aims to visualize in this paper.

4.2.2.(a) Costs Incurred from Mizuho's Failure in 2021

According to Mizuho Financial Group (2022a, 8), a total of 12 billion yen (1.9 billion yen in expenses, 3.3 billion yen in contingency expenses, and 6.8 billion yen in IT investment) was appropriated in FY2021 for stable business operations as a result of the large-scale system failures that have occurred at the bank since February 2021. Of this amount, at least 5.2 billion yen, which is the sum of expenses and contingency costs, would not have seemed to be appropriated had the large-scale failure not occurred. It can be regarded as additional temporary personnel costs, related costs (vendor costs, etc.), and other costs (legal fees, costs for dealing with the authorities, costs for dealing with the mass media, related transportation costs, various communication costs, etc.). Therefore, the above 5.2 billion yen is estimated to be the related costs of this case.

However, the author believes that the costs incurred by a large-scale system failure do not stop there.

4.2.2.(b) Opportunity Loss Caused by Estrangement from Customers

One of the possible effects of a large-scale system failure would be a loss of opportunity resulting from the estrangement of customers.

On the other hand, at the "MIZUHO IR Day" for investors on September 14, 2021, in response to the question, "Has the system failure affected your business? We expect the impact to be in the order of several hundred million yen per year, but we will determine whether this is a temporary situation or will continue for some time to come. However, we do not expect any larger impact than this" (Mizuho Financial Group 2021, 2). Mizuho Financial Group (2022a, 8) also stated that the impact of the large-scale system failure on their

gross business profit was negligible, and that the number of individual savings accounts decreased by only about 25,000 accounts in FY2021 compared to the number at the end of March 2021 (end of FY2020), which basically means that the impact on their business was negligible. The number of individual savings accounts decreased by only about 25,000 in FY2021 compared to the end of March 2021 (end of FY2020).

However, Mizuho Financial Group (2022b, 33), a corporate group led by its parent company MHFG, identified system failure as one of the top risk events with significant impact, and stated that the risk scenario includes "inconvenience and disadvantage to customers, damage to trust, and loss of business opportunities." In other words, the company states that it considers estrangement from customers as a possible risk.

Table 1 shows how the domestic net fees and commissions of the three Megabanks and Resona Bank (Four Major Banks) in FY2021 (April 1, 2021 to March 31, 2022) compared to the previous year. This income/expenses includes various fees other than interest on deposits and loans, such as loan fees and foreign exchange commissions.

	Mizuho	MUFG	SMBC	Resona
FY2020	307,327	394,396	250,979	75,250
FY2021	291,771	393,128	286,781	82,967
Percentage Change	Δ5.1%	Δ0.3%	+14.3%	+10.3%

Table 1: Domestic Service Transaction Income and Expenses of the Four Major Banks

Millions of yen, Consolidated basis.

Source: Mizuho Bank (2022, 48), MUFG Bank (2022, 29), Sumitomo Mitsui Banking Corporation (2022, 33), Resona Bank (2022, 25). Calculated by the author.

Under the current ultra-low interest rate, which is mentioned at the beginning of this paper, it is difficult for financial institutions to rely on interest margins, the difference between deposits and loans, as a profit target. For this reason, domestic service transactions are of great importance as a source of revenue for financial institutions in the current situation. However, the trend in the level of the Bank's net interest income shows that the Bank's net interest income has fallen significantly compared to the other three

banks, including MUFG, whose net interest income was almost at the same level as the previous year. On actual basis, the Bank's balance decreased by 15,556 million yen from the previous year.

Tokyo Shoko Research announced that Resona Holdings (Resona HD) has overtaken MHFG for the first time in the ranking of main banks as of 2022 in its annual survey of main banks.¹⁴ The survey stated, "Resona HD has increased the number of companies it does business with through cooperation with Kansai Mirai FG and DX support for small and medium-sized enterprises. On the other hand, MHFG, which experienced a series of system failures, saw only a slight increase in the number of companies," suggesting that the system failures had no small impact.

As shown by SHIKANO (2006, 166-167), the main bank has the largest ratio of loans to clients and sometimes even dispatches executives to act as chaperones to its clients. Although it is not possible to say clearly whether the large-scale system failure really had an impact or not, the regression in the ranking of main banks indicated by the survey is significant because it indicates that the bank (and MHFG) had the opportunity to build close relationships with their clients, and that the bank (and MHFG) was able to enjoy a lower ranking compared to Resona HD.

Although it is only a guess, since the large-scale system failure at the bank has occurred since February 2021, it is considered to have had at least some impact on the figures for FY2021 starting from April 2021. Therefore, the estrangement with clients triggered by the above-mentioned large-scale

¹⁴ According to the contents of "Survey of 1,553,601 Main Banks in Japan: Resona HD Reverses MHFG to Take Third Place in Market Share" (released on August 9, 2022) (https://www.tsr-net.co.jp/news/analysis/20220809_01.html as of 2022/8/10), available on the website of Tokyo Shoko Research Institute, Inc. This study is based on the company's analysis of the main banks in its corporate database as of the end of March of each year. Resona HD (Resona Bank, Saitama Resona Bank, Kansai Mirai Bank, and Minato Bank) had 80,074 main bank-clients at the end of March 2021 and 81,351 at the end of March 2022, while MHFG (Mizuho Bank and Mizuho Trust & Banking) increased its number of main banks from 80,214 (end of March 2021) to 80,762 (end of March 2022). For details, please refer to the company's website.

system failure is considered here to be related to the decline in the bank's status as a main bank, and the amount of 15,556 million yen in FY2021, which is the decrease in domestic service transaction income from the previous fiscal year, is estimated as an opportunity loss for this purpose. The resulting decrease in domestic service revenue and expenditure in FY2021 from the previous year is estimated as the opportunity loss in this section.

4.2.2.(c) Additional Costs Incurred in Terms of Recruitment

In the event of employee turnover due to a decline in employee motivation, it will be necessary to hire experienced workers. In addition, the deterioration of the image of the company is expected to affect the annual recruitment of new graduates and other students.

Figure 2 shows the results of the Employee Attitude Survey at MHFG. Mizuho Financial Group (2022c, 85) stated, "Due to the system failure, the score for the company and management in the employee awareness survey declined. With deep regret and strong determination, the author will strive to create an organization with a sense of unity where all executives and employees can act autonomously and discuss issues constructively." The respondents seem to acknowledge that the decrease in the value of pride in the company in Figure 2 was caused by the system failure.



Figure 2: Employee Attitude Survey at MHFG (Item: Pride in the Company)

Image of the value for fiscal year 2019 as 100. Source: Mizuho Financial Group (2022c, 85). Modified by the author.

If such a decline in employee motivation were to be reflected in an increase in employee turnover, the bank would be in a hurry to hire experienced workers. As mentioned above, the bank had 25,897 employees at the end of March 2022, with an

average monthly salary of 562,000 yen. If the bank were to need to hire an additional 129 experienced employees (0.5% of the total number of employees), the bank would incur a cost of 217.5 million yen (rounded up to the nearest unit) in a simple calculation based on the fact that a recruitment agency would normally be required to pay an introduction fee equivalent to three months of the monthly salary of the employee in question.

In addition, the author estimated that if the company were to advertise in TV commercials (50 times of 15-second spot ads on terrestrial digital broadcasting in five major cities simultaneously) and major newspapers (10 times of 15-page ads on the front page of the Nihon Keizai Shimbun) to wipe out its deteriorating image, which would affect the annual recruitment of new graduates and other students due to the image deterioration caused by the large-scale system failure, the company would have to spend an additional 330.8 million yen including production costs.¹⁵

As a result, the additional cost incurred in terms

¹⁵ For TV commercials, please refer to the website of Advertising (CM no Madoguchi Powered by Advertising Direct) (for production costs, etc., the minimum fee for popular celebrities is 10 million yen (https://cm.kokoku-direct.jp/column/tvcmcreate_price)). For broadcasting costs, please refer to the website of Creative Spark (the minimum fee for popular celebrities is 10 million yen (https://cm.kokoku-direct.jp/column/tvcmcreate_price)). For newspaper advertisements, production fees are available on the Creative Spark website (minimum production fee for newspaper/magazine advertisements: 350,000 yen <https://cm.kokoku-direct.jp/price/tvcm>), and for newspaper advertisements, production fees are available on the Creative Spark website (minimum production fee for newspaper/magazine advertisements: 350,000 yen https://www.spark03.com/ad_tool/newspaper.html), and for publication: 20.4 million yen per ad in the morning edition of Nikkei Shimbun's website (NIKKEI Marketing Portal: 20.4 million yen per ad in the morning edit ion of Nikkei Shimbun <https://>). The fee was calculated based on the content of the Nihon Keizai Shimbun website (marketing.nikkei.com/media/newspaper/prices/nikkei_morning/) (All sites visited as of 2022/8/10.) The minimum fee for production, etc., was calculated based on the content of the Nihon Keizai Shimbun website (NIKKEI Marketing Portal). Production costs were estimated at five times the minimum fee.

of recruitment is estimated at 548.3 million yen.

4.2.2.(d) Calculation of Opportunity Loss

As shown above, (1) the cost of initial response to a system failure and the cost of conducting training once every six months are estimated to be 291.4 million yen per year, while (2) the cost associated with a large-scale system failure is 5.2 billion yen, (3) the opportunity loss caused by the estrangement of customers is 15,556 million yen, and (4) the additional cost incurred in terms of recruiting human resources is 548.3 million yen. The opportunity loss is estimated to be approximately 21,012.9 million yen when calculated as $(2)+(3)+(4)-(1)$.

Although this is only a hypothetical estimate, in the case of Mizuho, it was estimated that an opportunity loss of approximately 21 billion yen would be incurred if emergency responses were not implemented from the perspective of OR in the event of a system failure, as described above. The author believes that the visualization of this kind of numerical information to alert information within financial institutions can be used to motivate the management of financial institutions to recognize the importance of such information and to seriously address it to avoid large-scale failures by making full use of alternative measures, etc. This is the reason why the information is so important.

4.2.3 Role of Management Accounting in Alert Information

Previous discussions in this paper have considered the necessity of avoiding major failures in the event of financial institution system failures, based on the concept of OR. The author has discussed the importance of continuing important operations as much as possible and making full use of alternative measures to increase the effectiveness of these measures. On the other hand, while MHFG has expressed its support for the concept, as mentioned above, it has not disclosed how it will put the concept into practice, and from the perspective of whether users can truly transact with peace of mind, this disclosure is inadequate and somewhat inadequate.

In order to dispel such concerns, it may be important to utilize visualization of opportunity losses as shown in this section as a motivation within the organization in order to thoroughly implement the same concept. In the event of a system failure of a financial institution, which is difficult to reduce to zero, the use of numerical information as alert information is essential for the members of the organization to move flexibly to minimize the impact on customers, and management accounting can play an important role. The establishment of such specific measures is the mission of socially responsible financial institutions to ensure that customers can continue to trade with them with peace of mind in the future. This is the conclusion of this paper.

5. Summary and Future Prospects

In this paper, the author examined how to deal with system failures, which have been occurring with a reasonable frequency, of financial institution systems, which are indispensable for Japanese financial institutions to continue to fulfill their social responsibilities to provide benefits such as fund settlement, deposits, and loans. The representative examples of system failures show that not only careful system design is required, but also that failures in customer response often lead to large-scale system failures. When a failure does occur, it is essential to take alternative measures as much as possible and make efforts to minimize the impact on customers so that the failure does not develop into a large-scale system failure. For this reason, the author has been considering the concept of OR, which is the ability of financial institutions to prioritize their highest priority operations and to continue them as long as possible by taking the necessary measures and procedures to keep the impact within the acceptable range assumed in advance.

Moreover, as a countermeasure, it is necessary for the management of financial institutions to first recognize the importance of this issue, and it is important to motivate the members of the organization to take it seriously. In this paper, the author examined the visualization of the

opportunity losses that may occur when the initial behavior of a system failure is mistaken and the failure develops into a large-scale failure. This visualization is connected to the motivation of organizational members to continue their important tasks, and ultimately to avoid a large-scale system failure. The author confirmed here the existence of the contribution of management accounting.

In this paper, the author has discussed the motivation within an organization by visualizing opportunity loss using hypothetical numerical examples and discussed the continuity of critical operations based on the concept of OR, but the author has not yet achieved actual verification. The author would like to conduct verification based on more detailed data with the cooperation of financial institutions for further research.

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