Promotion of Safety Culture at Airports

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1. Introduction
It goes without saying that ensuring safety is of paramount importance to an airport. If a major accident were to occur in an enormous, complex system such as an airport, it would have extremely serious consequences on the society. While safety technology is progressing daily along with advances in science and technology, the role of humans who control it is becoming ever more important. Events do not always transpire according to theory and people responding to them often make mistakes. System design, production, inspection and operation are human roles; we can thus say that humans are the last stronghold. To ensure safety, we must reduce making mistakes as much as possible and, even when mistakes do occur, use our imagination more fully to foresee individual risks in detail so that we can deal with any situation. It is vital to maintain positive attitude to ensure safety under any and all circumstances and to remain constantly aware that accidents could occur even if safety measures are fully implemented.

This paper will attempt to define organizational safety culture, which is an important element in pursuing safety, even in our rapidly changing world. It will also highlight and make observations on safety promotion activities at Narita International Airport Corporation (NAA). And, lastly, it will present recommendations on practical ways to foster safety culture, mainly from the perspective of equipment maintenance.

2. Safety Culture
2.1 What is safety?
Safety is defined as a state of being free from unacceptable risks. A risk is a factor that may cause harm to something or somebody. It is very difficult to prove that something is in a risk-free state because, in reality, there is no such thing as zero risk. Since levels of judging safety differ from organization to organization, it is necessary to take actual conditions into consideration to control risks at an acceptable level. In other words, safety varies depending on the organization you belong to and the circumstances that prevail at any given time.

2.2 What is culture?
Culture is defined in many different ways. For example, culture can relate to an abstract collection of standards, values, religions, laws, ideologies and concepts among a group of people. Culture influences people's actions and is reflected in their results. Although invisible to the eye, the results of its influence will come to light in people's actions and their consequences. In this paper, the author will define culture as ideologies formed within an organization which influence the actions of those working within that organization, either directly or indirectly.
2.3 Defining safety culture

Simply put, safety culture is a culture where safety is pursued exhaustively. However, since safety is a subjective term that is influenced by the organization to which one belongs or by prevailing circumstances, it is not easy to present a definition that applies to all situations. Safety is achieved through activities of people (organizations) who utilize the support of science and technology. Then again, the quality of those activities is influenced by the people's (organizations') awareness and abilities, as well as external conditions. In this paper, the author will define safety culture as psychological factors that influence the activities of people (or organizations) as shown in Figure 1. Safety culture is a key concept in the safety activities of an organization.

![Figure 1. General concept of safety culture](image)

2.4 Characteristics of a safety culture

Each organization has its own unique safety culture. Generally speaking, a safety culture is formed by people (organizations) over a long period of time. It is not only deep-rooted but also resilient and difficult to change. As this resilience comes from a natural human aversion to change, to make a change in the prevailing safety culture is not easy, and it requires time and effort for any change to become permanent. In order to bring about changes in any safety culture, it is essential to instill a sense of crisis within the organization regarding the existing conditions and for people to see actual results of some sort in order to bring their perceptions into alignment. Initially, some people may be skeptical but seeing visible results will bring them around and, when combined with a sense of crisis, positive changes can be expected. Another factor inhibiting changes to the safety culture could be the fact that changes are being initiated by people within the same organization. It is easy to say that we need to change our perspectives, but those making the changes must always be mindful of external trends so that they can analyze their own organization objectively.
A change of culture means a transition from an established, stable environment to an unstable one, and then seeking stability in that new environment. A small group of people with a sound awareness of the issues must be allowed to express their opinions freely in a setting where other people's views are respected, so that long-term plans can be implemented steadily.

2.5 What is a "good" safety culture?

Merely making pledges does not constitute a "good" safety culture. A good safety culture must be accompanied by action. For it to be accompanied by action, adequate communication in both directions -- top-down and bottom-up -- is required for everyone to share and recognize issues. Such two-way communication will help to clarify items to be performed by the top management, the supervisors and the working-level staff, and will serve as the driving force behind their respective actions.

Another key is to learn from accidents. It may be said that an organization has a good safety culture if accidents small and large can be reported openly. This culture is fostered by not simply focusing on the results and reprimanding subordinates for unprecedented accidents, but rather, commending them for reporting those incidents promptly and accurately while asking them to reflect on their mistakes so that the same accidents are never again repeated. Information on accidents is an "asset" for an organization. Needless to say, the cause of the mishap must be identified and countermeasures must be implemented, but the experience will be accumulated within the organization and by ensuring everyone has access to such information, not only will this boost the organization's experience level but also improve its safety culture.

Lastly, let us consider a good safety culture from an opposite angle. When organizations that profess to pursue safety as their highest priority are interviewed on their safety initiatives, they will all say that safety is of primary importance to them. However, we occasionally find that the case is as shown in the Table 1 below.
In some cases, actions may be lacking even though everyone understands that safety is paramount. An organization which can act on its own accord to prevent a situation like this is one with a good safety culture.

### 3. Safety Initiatives at Narita International Airport Corporation (NAA)

#### 3.1 Safety policies

"A trusted airport where safety is paramount" is the first of NAA's management visions and, in order to achieve that, it has set out the following safety policies:

1. Ensuring safety is the foundation of our airport operation and the company will pursue this objective by ensuring that every individual employee places utmost importance on safety as a basis of his/her work activities and that all executives and employees are aware of their individual roles and responsibilities in the pursuit of safety.

2. The company will enhance self-awareness of safety among all executives and employees through lectures and training courses, and work to develop a “safety-first” corporate culture to ensure that the spirit of safety is firmly embedded in everybody’s mind.

3. While encouraging safety reporting and driving forward with disclosure and sharing of safety information, the company will always maintain awareness of the issues and perform appropriate safety inspections to improve and expand its safety management system.

4. NAA will include its group companies in its safety promotion activities while liaising and establishing cooperative relations with the government organizations and other airport stakeholders.

5. Every individual member of the company will fully understand and comply with relevant laws,

<table>
<thead>
<tr>
<th>Category</th>
<th>Factors Affecting Safety</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Excessive control on costs to survive competition</td>
<td>Accidents occur as a result of equipment deterioration.</td>
</tr>
<tr>
<td>Dynamics</td>
<td>Reports made to meet management expectations</td>
<td>Problems will be buried.</td>
</tr>
<tr>
<td>Workforce shortage</td>
<td>Insufficient workforce to handle work adequately</td>
<td>Problems will remain unresolved.</td>
</tr>
<tr>
<td>Inadequate knowledge</td>
<td>Lack of internal technology hand down</td>
<td>Unable to understand the gravity of problems.</td>
</tr>
<tr>
<td>Inadequate experience</td>
<td>Shortage of experienced personnel due to a distorted</td>
<td>Unable to handle problems alone.</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Everybody does it and no-one questions it.</td>
<td></td>
</tr>
<tr>
<td>Irresponsibility</td>
<td>A conviction that somebody else will look after it.</td>
<td>Problem is ignored.</td>
</tr>
<tr>
<td>Disinterest</td>
<td>The conviction that it is not within the scope of one's job.</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Examples of the reality
regulations and standards to ensure safety.

3.2 Safety Management System (NAA-SMS)

The NAA-SMS is a comprehensive management methodology incorporating a system -- identifying safety policies and targets -- which develops (PLAN) management programs for achieving those targets, implements (DO) the programs, monitors progress (CHECK) and takes necessary measures (ACT). Figure 2 shows the PDCA cycle and Table 2 shows the safety indicators and targets for fiscal 2015. By implementing the PDCA cycle as described above, NAA controls tolerable risks, taking into consideration their seriousness and likelihood of occurrence, and pursues safety. The NAA-SMS encompasses the facility- and service-related aspects of primary infrastructure used in aircraft landing and take-off operations, aeronautical navigation facilities, operations of areas under NAA's jurisdiction and duties performed by departments in charge of safety and disaster prevention. More specifically, these include the following:

Ramp control; Inspection and maintenance of airport primary facilities; Maintenance of aeronautical (radio and visual) navigation facilities; Maintenance of passenger terminals and other passenger service facilities; Maintenance of airport roads and car parks; Maintenance of fuel facilities; Maintenance of cargo handling facilities; Maintenance of mechanical, electrical and communication equipment; Security; Firefighting and rescue activities; Bird strike prevention activities; Airside safety management; Apron safety management; Airside driving regulations; Passenger terminal facility safety management; Cargo area safety management; And other necessary activities.

![NAA-SMS PDCA cycle](image_url)

Figure 2. NAA-SMS PDCA cycle
Moreover, NAA introduced the State Safety Program (SSP) led by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in April 2014. This is MLIT's management system for ensuring safety. The program aims to improve the safety of the aviation sector as a whole by monitoring safety based on the number of airside accidents and other safety indicators, providing and sharing safety information, and implementing safety supervision.

Table 2. Fiscal 2015 safety indicators and targets

<table>
<thead>
<tr>
<th>Category</th>
<th>Safety Indices</th>
<th>Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineering &amp; Operations</td>
<td>No. of airside accidents per 10,000 aircraft movements</td>
<td>Max. 3.09 (or less than 70 incidents -- *Subject to change depending on the number of aircraft movements)</td>
</tr>
<tr>
<td></td>
<td><img src="Image" alt="Math equation" /></td>
<td><img src="Image" alt="Math equation" /></td>
</tr>
<tr>
<td></td>
<td>No. of runway, taxiway and apron failures requiring NOTAM issue per 10,000 hours of airport operation</td>
<td>Max. 2.27 (or less than 2 failures)</td>
</tr>
<tr>
<td></td>
<td><img src="Image" alt="Math equation" /></td>
<td><img src="Image" alt="Math equation" /></td>
</tr>
</tbody>
</table>
| Measures to prevent the occurrence of 1 and 2 above | (1) Safety Development & Planning Committee  
(2) Narita International Airport Safety Promotion Council (incl. the Airport Working Group)  
(3) NAA Group Safety Meeting  
(4) Safety promotion seminars  
(5) Paving inspection  
(6) Emergency paving repair drills | (1) 4 times a year  
(2) 4 times a year  
(3) 4 times a year  
(4) Once a year  
(5) Avg. 3 times/week during the summer inspection period (Jun - Sep) and once/week at all other times  
(6) At least twice a year |
|                                  | ![Math equation](Image)                                                      | ![Math equation](Image)                                                |
|                                  | No. of aeronautical lighting system power facility failures requiring NOTAM issue (per million operating hours) | Max. 43.50 (or less than 6.85 failures)                                 |
|                                  | ![Math equation](Image)                                                      | ![Math equation](Image)                                                |
| Measures to prevent 4 above      | (1) Response drills for aeronautical lighting system power facility abnormalities  
(2) Maintenance inspection and monitoring drills for aeronautical lighting system power facilities | (1) At least once a year  
(2) At least once a year |
|                                  | ![Math equation](Image)                                                      | ![Math equation](Image)                                                |
|                                  | No. of radio navigation aids failures requiring NOTAM issue (per million operating hours) | 0                                                                      |
|                                  | ![Math equation](Image)                                                      | ![Math equation](Image)                                                |
| Measures to prevent 6 above      | (1) Crisis management drills for radio navigation aids  
(2) Key equipment failure drills for radio navigation aids | (1) At least once a year  
(2) At least twice a year |

Information collection and dissemination training  
Safety promotion seminars
3.3 Safety Management System (NAA-SMS) implementation framework

3.3.1 Safety Development & Planning Committee
The Safety Development & Planning Committee was established in April 2004 as a forum for discussing safety measures at all levels of the company and formulating policy. It meets four times a year and is attended by all corporate officers, including the President and CEO who chairs the committee. Its tasks include the formulation of fundamental policies for safety promotion, verification of safety promotion arrangements and oversight of implementation progress, as well as making decisions and laterally distributing information pertaining to analysis of the causes and measures to prevent recurrence in the event of an accident or an incident that could lead to an accident, and status of safety inspections and audits.

3.3.2 Narita International Airport Safety Promotion Council
The Narita International Airport Safety Promotion Council was established in April 2005 so that relevant organizations can work together on safety promotion activities and share information on safety measures and precautions, and to encourage collaboration and mutual cooperation for safety promotion.

The Council comprises representatives from government agencies, airlines, railway operators, lifeline companies and other relevant organizations. Moreover, in order to discuss specific policies on safety promotion measures, it is divided into the Airport Operations Working Group which examines safety-related matters for the airport as a whole, the Lifeline Working Group which examines items relating to the safety of lifeline facilities, and the Airport Working Group which examines matters relating to airside safety. These working groups share and discuss information to promote measures and activities.

3.3.3 NAA Group Safety Meetings
The NAA Group Safety Meetings were initiated in April 2005 as a forum to mutually exchange safety information and to implement safety promotion activities concertedly as a group. To discuss specific policies on safety measures, Working Group 1 comprising maintenance companies and Working Group 2 comprising non-maintenance companies are established.

3.4 Observations
3.4.1 Top management initiatives
The top management of an organization must make sure that the policy of ensuring safety is fully understood and permeated throughout the organization. That policy must be consistent with the format of the organization and every worker within the organization should be able to have a clear image of what this means. Therefore, the management must specify in simple, straightforward words what type of safety it is aiming at, what it hopes the organization to be in the future and, to achieve this, how it wishes
workers in the organization to think and act.

3.4.2 PDCA cycle
Ensuring safety through application of the safety management system is synonymous with going through the PDCA cycle and making daily improvements. When further enhancements are incorporated in the NAA-SMS, in the event of a serious facility failure, or if the system no longer matches prevailing conditions, a review is made each time and targets are set to be reflected in the safety promotion activity plans. In today's society, technology advances and changes in conditions occur at a rapid pace. In this light, it is no exaggeration to say that safety can only be achieved by continuing this review process.

3.4.3 Continuous evaluation of safety management system
Generally speaking, where there are set rules, people tend to gradually start to concentrate on sorting things according to a set pattern, making their actions a mere formality. In the short term, this lack of substance may not lead to a serious accident, but it will slowly undermine the organization, eventually threatening its safety. Continuous monitoring, supervision and auditing are therefore essential.

(1) Third-party evaluations
NAA is subject to regular inspections from government institutions and this is very effective. If only self-evaluations are performed, there is a concern of them becoming perfunctory or self-complacent. Because organizations naturally seek to obtain good results, there is a danger of the checkers becoming too lenient, and many things may go unnoticed if they are from the same organization. What we think is perfect may not always appear that way to a third party. When you work for a long time in the same organization and work place, your way of thinking and scope of expectations tend to become prejudiced. Based on past experiences (of success), your decisions may be preceded by thoughts such as "That's impossible" or "That's not suitable for an airport", and you will end up with ideas that are likely to be accepted only within the same organization. Third-party evaluations seem necessary to prevent this from happening.

(2) Internal safety audits
NAA carries out internal safety audits for the ongoing improvement of its safety management system, and checks its conformity, validity and effectiveness through interviews and document checks with each of relevant departments. Remedial actions will be taken when items not in conformity are found. Unlike third-party evaluations, these audits are carried out by persons who are familiar with the activities and, therefore, are very effective if conducted appropriately.
In this regard, the importance of continuous site inspections by managerial and supervisory staff ("supervisors") must be reemphasized as a form of self-evaluation. Supervisors often monitor the
progress of work performed by subordinates and contractors from written reports. However, the amount of information contained in such reports is surprisingly small and it is difficult to determine at a glance if the owner’s requirements are being met. Supervisors should therefore actually visit the work site and convey in advance not only the requirements of the activity but also the expectations, and monitor progress on site. On-site verification by supervisors will produce a synergy effect in the form of communication with the workers on site. Continuous communication on equal terms is the key to improving safety and the work environment.

(3) Evaluating the state of safety culture
As is the case at NAA, evaluation indicators are used to ascertain the level of achievement of safety targets. Clear quantitative targets will help in objective decision-making. Since it is difficult to evaluate an item using a single indicator, several indicators should be used. Here are some examples of indicators, including those that are used by NAA:

- Number of accidents
- Number of work-related accidents
- Time taken to recover from accident
- Number of accidents resulting from human error
- Number of times discussions were held with cooperating companies
- Questionnaires or interviews and their analysis
- Number of awards received
- Number of suggestions for improvement submitted
- Training frequency and level of understanding
- Overtime trends
- Number of traumatic stress disorder cases

Although safety culture is invisible, it influences people's behavior. Once lost, much time and effort is required to recover it. It is important to use various tools to monitor the state of the organization.

4. Specific Recommendations for Promoting Safety Culture
4.1 Always think before acting
Merely setting a goal of eliminating accidents will not tell us what we should do in practical terms. The important thing is for individual workers to have a clear image of what safe conduct entails in their respective duties and to act accordingly. A good way would be to set out specific examples of actions that are consistent with the organization's safety culture in procedure manuals. If workers think they are just small cogs in the organizations and are only aware of themselves and those they work with directly, they do not have a true understanding of their mission and safety will be jeopardized as a result. If individual "cogs" know where exactly they are positioned, what functions they are expected to perform and what impact they will have on the overall framework if they are not there, it will boost their motivation and contribute to ensuring safety.

To achieve safety, it is absolutely essential that everyone participates and everyone takes action. If
everything is left to those responsible for safety planning, this may superficially appear to gloss over the issues but will not enhance the safety culture deep down and, with time, things will revert back to their original state.

4.2 Taking a long-span approach
Safety cannot be achieved through a single deed but, rather, safety is a product of a steady accumulation of actions. Rarely are immediate results obtained from new safety promotion activities. It is through repeated implementation that they become established within the organization and are accompanied by results. To instill a safety culture throughout the organization and improve the quality of actions, it is important to continuously and persistently communicate in simple words the merits of achieving safety and the demerits of causing accidents that have detrimental effects on society, so that individuals are able to grasp this in their minds. This may seem like a long detour but is actually a shortcut.

4.3 External communication
With the progress in division of labor, business activities nowadays are rarely completed entirely within a single organization. NAA outsources much of its airport operations activities to its Group subsidiaries. It is impossible to ensure airport security without the support of Group companies and their partners. Therefore, it is vital for both sides to fully understand each other's viewpoints and make sure what their respective missions are. Even though each party may have different roles, they need to communicate on an equal footing as a team to achieve safety. While executive-level communication is essential, the respective sections concerned should also strive to enhance mutual understanding. Taking the time to hold frank discussions in good faith will build trust and enhance the safety culture.

4.4 Visualization
Here are some suggestions on indicators which will bring objectivity to safety promotion activities from an equipment maintenance perspective.

4.4.1 Visualization of deterioration level
Maintenance methods can be categorized as shown in Table 3. Conducting these five types of maintenance activities in the order shown will help improve maintenance levels and reduce the number of serious incidents, as shown in Figure 3.
<table>
<thead>
<tr>
<th>Maintenance Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Breakdown maintenance</td>
<td>Repairs after breakdown</td>
</tr>
<tr>
<td>2) Routine maintenance</td>
<td>Day-to-day maintenance activities aimed at preventing deterioration</td>
</tr>
<tr>
<td>3) Scheduled maintenance</td>
<td>Repairs and replacements at appropriate intervals</td>
</tr>
<tr>
<td>4) Corrective maintenance</td>
<td>Measures to extend service life, and reduce repair time and costs</td>
</tr>
<tr>
<td>5) Preventative and condition-based maintenance</td>
<td>Inspections and diagnoses to check deterioration, and ensuing repairs</td>
</tr>
</tbody>
</table>

Table 3. Maintenance method categories and concepts

NAA conducts periodic diagnoses for signs of deterioration on key equipment, as described in Table 4. Through these diagnostic tests, physical changes and deterioration in the equipment are quantified to ensure objectivity in the maintenance activities. Not only does this enable preventative and condition-based maintenance to avert accidents in advance, it also leads to a reduction in life cycle costs (running costs, maintenance costs, inventory management and other costs) by enabling estimation of the optimum timing for maintenance, reduction of unplanned maintenance and extension of the service life of key components, and is thus considered to be a beneficial measure.
Table 4. Equipment deterioration diagnoses

<table>
<thead>
<tr>
<th>Diagnostic technology</th>
<th>Diagnostic equipment</th>
<th>Diagnostic methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration check</td>
<td>Torsiograph</td>
<td>Measure changes in trends and absolute values.</td>
</tr>
<tr>
<td>Pressure check</td>
<td>Pressure sensor</td>
<td>Measure changes in pressure.</td>
</tr>
<tr>
<td>Insulation check</td>
<td>Insulation diagnostic equipment</td>
<td>Measure insulation resistance.</td>
</tr>
<tr>
<td>Temperature check</td>
<td>Thermo label</td>
<td>Measure changes in color when temperature exceeds a specified level.</td>
</tr>
<tr>
<td>Displacement check</td>
<td>Displacement sensor</td>
<td>Measure amount of displacement, misalignment and spread.</td>
</tr>
<tr>
<td>Flow volume check</td>
<td>Flow sensor</td>
<td>Measure flow volume inside pipes.</td>
</tr>
</tbody>
</table>

Table 5. Sample analysis sheet

4.4.2 Visualization of equipment impact

Incidents that could occur in regard to system components can be analyzed, and their overall impact evaluated qualitatively. The example in Table 5 below shows the impact of failure in the cooling system.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Failure</th>
<th>Result</th>
<th>Cause</th>
<th>Countermeasure</th>
<th>Impact level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling system</td>
<td>Shutdown</td>
<td>System shutdown</td>
<td>Power loss</td>
<td>Install backup power source</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Compressor shutdown</td>
<td>System shutdown</td>
<td>Deterioration</td>
<td>Replace</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Abnormal vibration</td>
<td>Temporary shutdown</td>
<td>Play in joints</td>
<td>Regular scheduled check</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Lubricant leakage</td>
<td>Continuous operation disabled</td>
<td>Seal deterioration</td>
<td>Part replacement</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 5. Sample analysis sheet

Impact is evaluated quantitatively wherever possible based on several indicators. For example, Figure 4 below is a matrix chart with the variables of frequency of occurrence and seriousness.
4.4.3 Visualization of equipment reliability

Figure 5 is a typical representation of temporal changes in equipment failure rates. This life cycle can be divided into three phases: the initial failure period (when failures occur frequently due to design and manufacturing defects), chance failure period (when failures occur randomly due to contingent reasons), and wear-out failure period (when failures occur frequently due to age-related degradation of the components).

Failures during the chance failure period are merely contingent and this is not a suitable time to replace the entire system. Evaluating the equipment’s operating conditions and employing suitable maintenance methods during this period will help ensure safety and curb costs.

![Sample matrix chart](image)

<table>
<thead>
<tr>
<th>Incident occurrence</th>
<th>Minor</th>
<th>Medium</th>
<th>Serious</th>
<th>Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>High</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Medium</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Very low</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

The average time before equipment fails is referred to as the Mean Time Between Failures (MTBF) and the average time required for repairs is known as the Mean Time To Repair (MTTR). The reliability of
equipment can be evaluated using MTBF and MTTR. On an average, equipment is operable only during the MTBF; once it breaks down, its operations are suspended for the duration of the MTTR. The ratio between these periods is known as the operating rate and is calculated as follows:

\[
\text{Operating rate} = \frac{\text{Operable time}}{\text{Operable time} + \text{Inoperable time}} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}
\]

Equipment with a high operating rate can be regarded as highly likely to fulfill its required functions, and will contribute to safety.

Let us consider an example. Suppose that a particular piece of equipment has an MTBF of 3,000 hours and it takes 20 hours on average to repair it in the event of a failure. To alleviate the impact on operations from sporadic suspensions of the equipment, scheduled inspections requiring equipment shutdown are performed over a period of 3 hours/each on the average, once every 2,000 hours. The following is a comparison of changes in the operating rate with and without scheduled inspections.

- Without scheduled inspections: Operating rate \( = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} = \frac{3,000}{3,000 + 20} = 99.34\% \)

- With scheduled inspections: Operating rate \( = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} = \frac{2,000}{2,000 + 3} = 99.85\% \)

As we can see, the reliability of the equipment can be raised by 0.51% by carrying out scheduled inspections. To improve reliability, we must increase MTBF and decrease MTTR. This in turn means we must seek to eliminate failures and, at the same time, carry out repairs more quickly if failures occur. Since there are technical and cost-related limitations to eliminating failures completely, the key to improving reliability lies in introducing systems that will facilitate repairs. The author hopes to utilize this indicator in practical situations to improve reliability.

If these evaluation techniques are utilized, safety will no longer be threatened by easy curtailments in inspections and postponement of repairs. Because reasons for carrying out maintenance can be identified quantitatively, awareness within the organization can be aligned, and this will contribute to the fostering of a safety culture.

5. Conclusion

Whenever a large accident occurs, people tend to blame it on the organization. However, most of these accidents are the direct results of human involvement. While unsafe acts that are carried out intentionally are out of the question, it can be inferred that, behind those accidents, there were factors that steered the organization or individuals in that direction.

The safer the world becomes with advances in technology, the greater the call will be for safety, and risks that were not previously foreseen will emerge. Safety begins to deteriorate the moment it is attained,
and it is an endless agenda that requires our constant attention. There is no magic remedy for it.

Continuous safety efforts are indispensable if Narita Airport is to make further advances. We must always maintain a sense of crisis, and think and act swiftly, without becoming content with the status quo. This is easier said than done, but whether we can practice this on an ongoing basis or not will decide the future of Narita Airport. This paper has been prepared as a personal reminder so that the author may not forget what is really important when carrying out daily activities. It is hoped that this paper will be of some use in improving the safety of Narita Airport and other member airports of ACI Asia-Pacific region.

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