THE TOTAL RISK MANAGEMENT SYSTEM FOR CONSTRUCTION OF A RAILWAY TRACK IMPROVEMENT PROJECT

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***ABSTRACT*: Certain types of construction, such as continuous grade separation of railway and road, railway track changes within an existing station, and switching tracks to accommodate a new station, take more than 10 hours of work. Temporary suspension of trains, changes of train arrival and departure times, transfer to the nearby bus or train lines, and closing of roads have a large impact on vehicle traffic. Construction delays and other unforeseen problems can have greater impact on the resumption of train service. To avoid these risks, the total risk management system is established and practiced by we starting preparation for a large-scale switchover as early as one year previous to commencement by adjusting the construction schedule, execution plan of the construction day, train timetable , and personnel arrangements.**

***KEYWORDS*: risk management, railway track change, construction**

1. INTRODUCTION

With urban development, railway crossings have caused problems such as traffic congestion and division of city functions. In particular, larger numbers of trains cause greater rate of obstruction in a large city. To eliminate these problems, multiple rail and road grade separation projects have been carried out by our risk management system. For example, the railway station of a railway line is changed due to the increase in trains or tracks, or by bridge reconstruction, or a new railway station is built for the creation of a new urban area a region where there is high demand.

The modern railway in metropolitan areas, has complex railway stations, high density of trains, and requires a high level of function ability of train management. A terminal station has many traffic routes and complex rail lines. For the convenience of the many users, train service runs at a high level of density. A high number of trains can run safely as scheduled as the signal system is highly functional. Therefore, the scale of track switchover projects in a metropolitan area will be larger, requiring longer working hours.

In the final stage of a rail improvement project, a switchover of rail tracks must be

carried out. Switching railway tracks takes from 10 hours to as much as 50 hours, due to the construction of large-scale and complex tracks, and high-performance signal systems. Railway tracks switchover requires cancellation of train service, change of train arrival and departure times, transfer to nearby transportation lines, and closure of crossroads to traffic. Users of the train, car users, and a large number of other people are inconvenienced. Any delay in construction or unforeseen problems at resumption of train service, may cause serious social consequences.

2. THE TRIGGERING INCIDENT

In September 2003, we had a large-scale snag in transport in a rail switchover on JR Chuo Line. Resumption of train service was delayed for more than seven hours due to the signal trouble at the trial operation. The main causes were as follows:

(a) By failing to confirm the signal test, a wiring error was undiscovered.

(b) Due to a delay in approval, crossing safety equipment was not implemented based on an approved design.

(c) The construction sector, business sector, and transportation sector were lacking in mutual coordination.

The incident made clear the importance of risk management systems and the need for comprehensive approaches, thus we had to establish a risk management system as soon as possible.

3. THE TOTAL RISK MANAGEMENT SYSTEM

3.1 THE OVERALL SYSTEM

Previously, the construction office was responsible for everything in railway tracks switchover. However, in an actual tracks switchover, the construction office, marketing division, transport division, and engineering division all have to collaborate with each other. Once a major transportation accident occurs, the railway operator will be subject to liability.

Therefore, the construction offices, branch offices, and railway operation headquarters have to clarify and establish a total risk management system.

The flow of information of this total risk management system is shown in Figure 1.

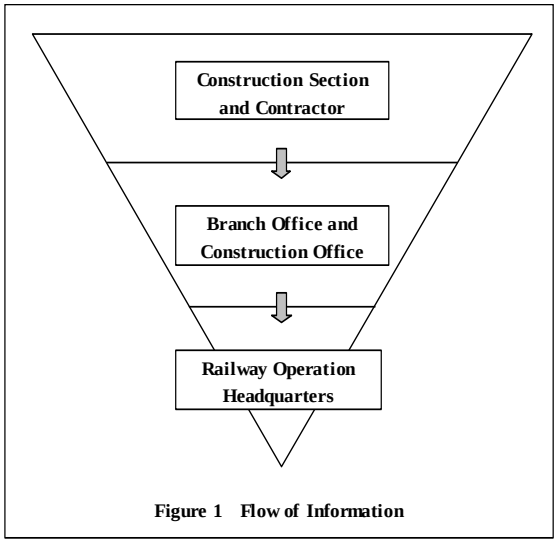

Figure 1 Flow of Information

3.2 CONSTRUCTION SECTION AND OTHER SECTIONS

Under the leadership of the head of the local switchover project, the construction section in a construction office plans and carries out a rail switchover with a construction company. The station, conductor section, operating section, railway section, civil engineering section, power section, signal section and other sections, coordinate with each other under auspices of the construction section for a smooth switchover.

3.3 BRANCH OFFICE AND CONSTRUCTION OFFICE

The construction office, and construction section, which plans, prepares and conducts the rail switchover, coordinates work content, work day, work hours, and switchover systems to adjust branch office. The branch office, according to the demands of the construction office, adjusts transport planning, passenger information, and commissioning plans, in case of a delay in construction. The branch office notifies each section of the contents of its plan. The branch office, in coordination with the construction office, prepares a switchover plan and reports to the railway operation headquarters in order to request cooperation from the related departments.

3.4 HEADQUARTERS

The General Director of Railway Operation Headquarters designates the working day six months previous the "Construction of Large-scale Switchover". He designates "the overall supervisor", "the supervisor of transport", and “the supervisor of local switchover". The general director must follow the following criteria before implementing a switchover project.

(a) Preliminary information for rail passenger.

(b) Confirm final preparation of track switchover.

In case of a delay in construction or major disruptions to train, he will set up a "transportation task force" to take care of the situation.

3.5 TASK FORCE SYSTEM

As a rule, the general manager of branch office is designated as "the overall supervisor". In addition, the manager of the transport division is designated as "the supervisor of transport". And the manager of the construction office is designated as "the supervisor of local switchover". The overall supervisor coordinates the task force of the track switchover. This image is shown in Figure 2.

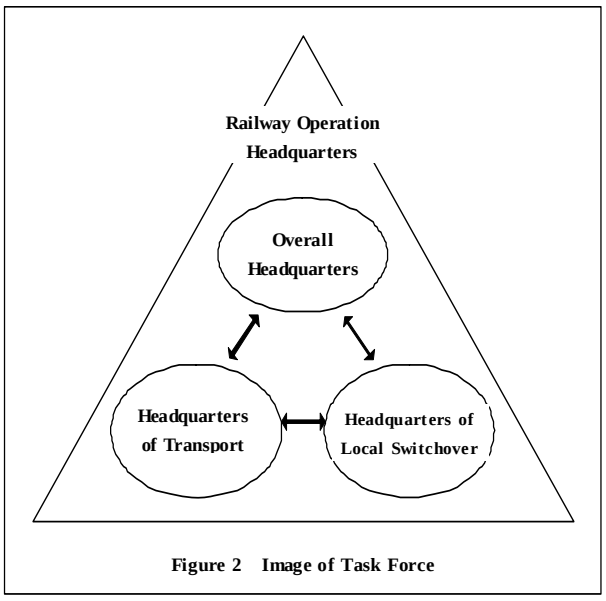

Figure 2 Image of Task Force

3.5.1 THE DUTIES OF THE OVERALL SUPERVISOR

The duties of the overall supervisor are as follows:

(a) He is responsible for the supervisor of transport and the local switchover.

(b) He is responsible for risk management.

(c) Deciding the start of construction, and determination of its completion.

(d) In case of a delay in construction, he decides in agreement with the supervisor of transport and the local switchover regarding the continuing of the track switchover work, train service plans, alternative transportation, provision of information to passengers, and public relations.

(e) In case of a delay in construction, he reports the counter plan to headquarters.

3.5.2 THE DUTIES OF THE SUPERVISOR OF TRANSPORT

The duties of the supervisor of transport are as follows:

(a) He makes the required preparations based on risk management.

(b) He establishes a task force with the supervisor of local switchover so as to facilitate coordination.

(c) He must have a grasp of the construction progress.

(d) In case of a delay in construction, he has to plan arrangement for other transportation in advance.

(e) In case of an unforeseen situation, the overall supervisor direct changes in transportation plans as soon as possible.

3.5.3 THE DUTIES OF THE SUPERVISOR OF LOCAL SWICHOVER

The duties of the supervisor of local switchover are as follows:

(a) He manages the process throughout the track switchover.

(b) He makes the switchover plan based on risk analysis and other required preparations.

(c) He consults regarding risk management in construction with the supervisor of transport.

(d) He works as director of the local construction, in charge of commencement and completion of construction, and the safety of train operation.

(e) He oversees the construction process.

(f) He reports the progress of construction to the supervisor of transport.

(g) In case of a delay in construction, he reports to the overall supervisor.

(h) In case of a delay in construction, he must make alternative plans in advance.

4 THE RISK MANAGEMENT SYSTEM

Risk management is practiced and promoted through closer communication among the construction section and other related sections such as branch office, construction office, and Railway Operation Headquarters. A standard schedule is shown in Figure 3.

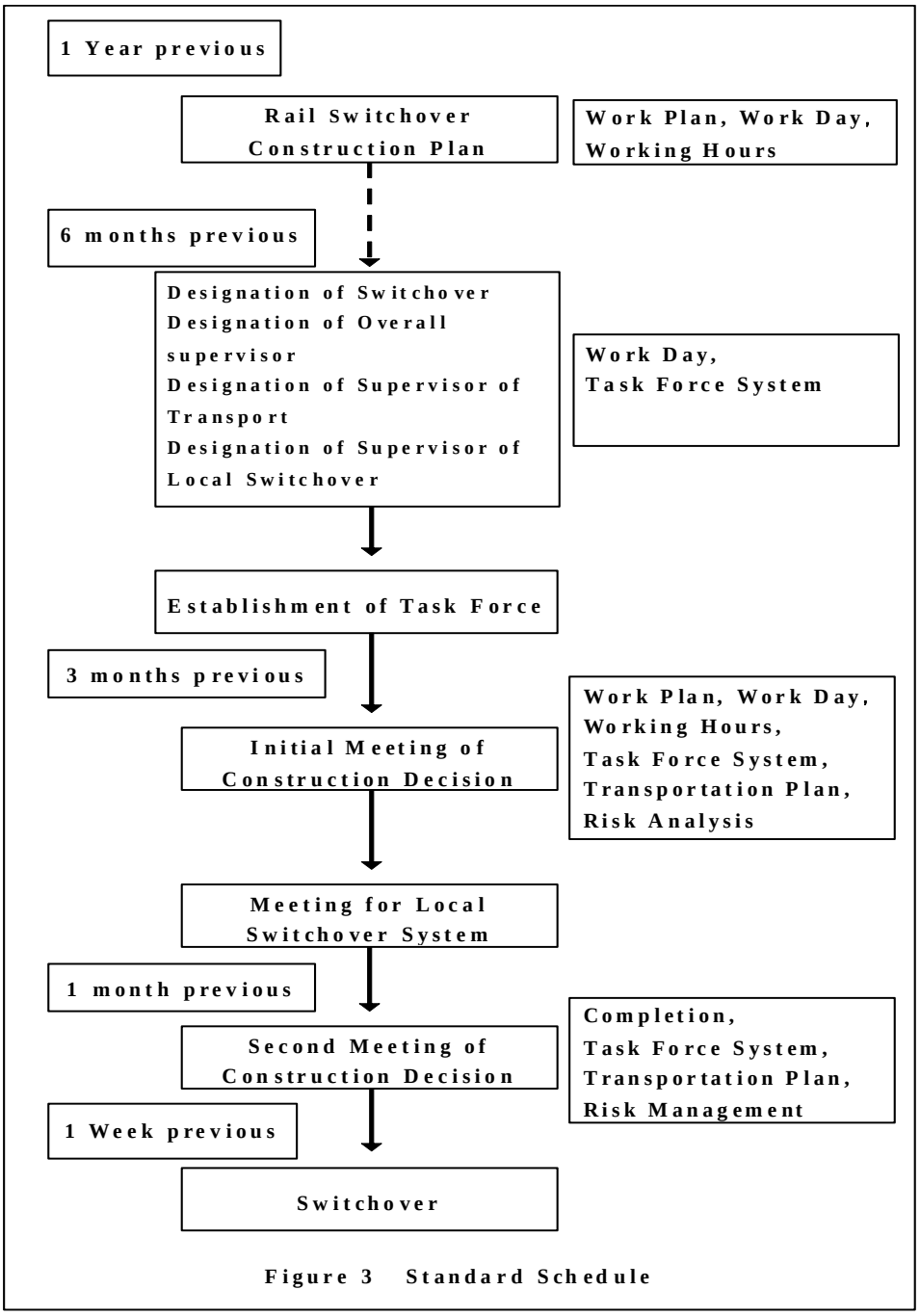

Figure 3 Standard Schedule

4.1 RAILWAY TRACK SWITCHOVER PLAN

The manager of the construction section plans the entire process about one year previous the railway track switchover. He (or she) coordinates the work plan, work day, and working hours with the proper section within the construction office.

The construction section staff of the construction office coordinates the working day with the electrical construction office. Then, they coordinates the work plan, work day, working hours with each section of the branch office. The manager of the construction section reports to the manager of the construction office regarding the result of coordination.

The manager of the construction office determines the work plan, work day, and working hours. He then requests the General Director of Railway Operation Headquarters to finalize the decision.

4.1.1 WORK PLAN

The staff of the construction section organizes the overview of the switchover plan. They plan the extent of railway track construction work, the extent of adjacent tracks affected, the extent of rail suspension, the extent of electrical stoppage, and the extent of signal suspension.

4.1.2 WORK DAY

The construction staff takes into consideration the following matters upon deciding the work day.

(a) They confirm the process up to switchover.

(b) They do not conduct multiple switchover in one day.

(c) The switchover should be avoided during busy seasons.

(d) February and March should be basically avoided because of the university entrance exams.

(e) The summer season should be avoided due to high rail temperatures.

4.1.3 WORKING HOURS

The working hours are set by the work plan based on past performance.

4.2 TASK FORCE SYSTEM

The overall supervisor, the supervisor of transport and the supervisor of local switchover will appoint the deputy supervisor of each section and other duties. Each task force is to be established within this system.

4.3 INITIAL MEETING OF CONSTRUCTION DECISION

Once a month, the manager of construction section meets with member of the construction office and construction companies to coordinate the construction process. He (or she) coordinates the work plan of the switchover, work day, working hours, local switching systems and risk analysis.

The construction office coordinates construction contents, day of switchover, working hours,

local switching systems, trial run plan, transport alternatives, and risk management with related sections of the branch office after making adjustments with the section in charge at the electrical construction office.

The manager of the construction office checks for omission or doubtful points in the report. He requests the General Director of Railway Operation Headquarters to set the initial meeting for construction decision.

About three months previous the switchover, the General Director of Railway Operation Headquarters convenes with the head of related departments from headquarters, the overall supervisor, the supervisor of transport, and the supervisor of local switchover to decide whether or not to proceed with the switchover. The meeting is to confirm work plans, work day, working hours, the local switchover system, trial run, transport alternatives, risk analysis and construction progress.

4.3.1 WORK PLAN

The meeting finalizes the work plan of the railway track switchover.

The manager of the construction section coordinates the implementation with a construction company to reduce the amount of construction work to be carried out on the determined day by shifting any construction possible ahead of the date to save time.

4.3.2 WORK DAY

This meeting finalizes the date of the work day.

4.3.3 WORKING HOURS

This meeting finalizes the working hours of construction.

The construction staff creates a time schedule for switching the railway tracks on the basis of a careful rehearsal. They then fix the working hours by adding to this the time required to suspend and resume train operation, cut off and turn on electricity and making trial runs.

4.3.4 SWITCHIOVER SYSTEM

This meeting determines the overall supervisor, the supervisor of transport, the supervisor of local switchover, and the deputy supervisors.

4.3.5 TRIAL RUN PLAN

This meeting finalizes the times and routes of trial runs to verify the status of tracks, signals, and power lines after the switching of railway tracks.

4.3.6 TRANSPORTATION PLAN

This meeting finalizes the transportation plan. The transportation plan entails single-track operation to next station, piston operation between station and next station, change of train arrival and departure times, substitute bus transportation in affected zone, requesting cooperation of other

systems for alternative transportation, and measures for railway crossing safety. The plan requires implementation of specific methods and procedures, such as train timetables, train's car composition plan, personnel provision, and passenger information.

4.3.7 RISK ANALYSIS

This meeting determines risk analysis.

Risk may include delay by bad weather, accidents, failure of construction machinery, power line failure, delay of switchover, signal defects, defects in trial run, or delay in commencement of operations.

4.3.8 CONSTRUCTION PROGRESS

This meeting confirms the progress of construction by checking for delays or gaps in construction.

4.4 MEETING FOR LOCAL SWITCHOVER

By one month previous to switchover, the manager of the construction section set up the local switchover team through coordination with the branch office and construction office. The supervisor of local switchover hold a meeting in which he inform the detail of the local switchover system to the team regarding the work plan, work day, working hours, switching systems, trial run, transportation plan, and risk management. The manager of construction section requests the construction company to set up an implementation system for the day of switchover.

4.5 THE 2ND MEETING FOR CONSTRUCTION DECISION

The manager of the construction section must be sure to complete the construction, required inspection and testing to be carried out before the switchover.

The manager of the work section of the construction office has to make the risk analysis and evaluation, conduct rehearsals, prepare alternative machinery, arrange for replacement of staff, and carry out restoration measures. The manager of the related section of branch office should be ready to arrange alternative transportation, passenger information, supporting personnel, and risk management. The manager of work section of construction office reports the progress of construction and risk management to the President.

The manager of the construction office then makes sure that preparations for the switchover are complete. He then requests for the 2nd meeting of tracks construction decision to the General Director of Railway Operation Headquarters.

About one week previous the switchover, the General Director of Railway Operation Headquarters calls a meeting with the General Manager of the related departments, the overall

supervisor, the supervisor of transport, and the supervisor of local switchover. The meeting is to confirm work plans, work day, working hours, the local switchover system, trial runs, transport alternatives, risk management and progress of construction.

4.6 RAILWAY TRACK SWITCHOVER

The overall supervisor instructs each task force overall, transport, and local switchover to set up for the switchover.

The switchover of railway tracks under the command of the overall supervisor should be carried out by the total risk management system.

4.6.1 HEADQUARTERS OF LOCAL SWITCHOVER

Under the direction of the overall supervisor, the supervisor of local switchover commences its function as headquarters for local switchover. The supervisor of local switchover roll call the entire staff of the local headquarters with branch office employees, construction office engineers and construction company technicians. At the roll call, instructions of the construction work, safety measures, stop and start time of the rail line, stop and start time of the power line, and the latest report of train operation are confirmed.

4.6.2 PROGRESS OF CONSTRUCTION

The supervisor of local switchover gives instruction for the procedure of the closure of the railway and the procedure for the suspension of the power line after confirming the last train. After confirming the completion of these procedures, he asks the overall supervisor to approve the commencement of work. He then announces the commencement to all personnel working in the headquarters of local switchover.

The construction companies then start to implement security measures on site, the position of safety rope and lighting equipment.

The progress of the construction work should be reported to the manager of construction section by mobile phones or wireless equipment. The manager of construction section uses a bullhorn to report progress to the supervisor of local switchover. The operating schedule which has been posted on site should be filled out to clarify the progress of the work and to manage the switchover. It is most important to relay work progress clearly when managing the switchover of railway tracks. When handing over work in progress from electrical to track, track to civil engineering, civil engineering to track, and track to electrical, it is best to ensure that those in change make face-to-face contact. This is extremely important. The designated

person in charge is to make regular progress reports to the transport headquarters by fax and telephone.

When the work is completed, we confirm whether there remain any equipment on site or any obstacles trains. When confirmed that trains can run normally, the supervisor of local switchover instructs that procedure for the resumption of railway and resumption power line commence. When the completion of these procedures is confirmed, he reports the completion to the overall supervisor.

4.6.3 TRIAL RUN

The overall supervisor instructs the supervisor of transport to commence with the trial run. The supervisor of transport conduct the trial run according to the timetable. The supervisor of local switchover reports to the supervisor of transport to confirm the status of the facilities after the trial run.

4.6.4 DISSOLUTION OF THE TASK FORCE

The overall supervisor declares the dissolution of the task force when he confirms that there is no obstacle to the resumption of train service. The supervisor of local switchover then calls together all related teams and declares them dissolved following a report of completion and confirmation of the safety of all members involved.

5 PRACTICES

Twenty large-scale switching railway tracks have so far implemented the total risk management system in metropolitan area. These switchover project are shown in Table 1.

Railway track switchovers have had the following problems.

(a) The consolidate ballast tamping machine (MTT) failed, and was switched to manual labor.

(b) A delay in trial run was caused by signal failure, but makeshift measures succeeded.

(c) Work was delayed due to a mistake in closing procedure, but time was made up by the construction work.

(d) A safety device at a railway crossing failed, but security personnel was deployed to the site until recovery.

(e) The traffic control system failed because it exceeded the limited number of trains, but a handmade train timetable of the operation was made.

These were all minor incidents, and did not cause serious consequences because they were within the scope of risk management. After the work the train service was normal. The total risk management system is effective and supportable.

Table 1 List of large-scale railway track switchover

No.	Date	Project	Working hours	Workers
1	March27-28, 2004	Changing Track JR Joban Line (9th)	23:30-7:30 (8:00')	369
2	May 29-30, 2004	Urawa Station, JR Tohoku Line grade separation (3rd)	1:10-9:30 (8:20')	781
3	June 5-7, 2004	Ikebukuro Station, JR Yamanote Line, Saikyo Line grade separation (3rd)	23:00-5:30 (30:30')	1838
4	June 26-27, 2004	JR Musashino Line elevation (3rd)	23:30-10:00 (10:30')	881
5	July 18-19, 2004	JR Chuo Line continuous grade separation (2nd)	18:00-7:30 (11:30')	1162
6	July 24-25, 2004	Inaginaganuma Station, JR Nambu Line grade separation (stage 1, 3rd)	23:30-9:15 (9:45')	747
7	Nov. 6-7, 2004	JR Chuo Line continuous grade separation (3rd)	23:00-7:30 (8:30')	1253
8	Nov. 13-14, 2004	Changing Track, JR Joban Line (10th)	23:30-8:30 (9:00')	633
9	Nov. 27-28, 2004	Urawa Station, JR Tohoku Line grade separation (4th)	0:00-10:15 (10:15')	745
10	Sep. 24-25, 2005	JR Chuo Line continuous grade separation (4th)	21:55-9:10 (11:15')	1097
11	Oct. 8-9, 2005	Inaginaganuma Station, JR Nambu Line grade separation (stage 1, 4th)	23:30-8:40 (9:10')	811
12	April 14-16, 2006	Changing tracks, JR Shinjuku Station (4th)	23:30-7:00 (31:30')	2670
13	Oct. 8-9, 2006	JR Chuo Line continuous grade separation (5th)	22:00-8:30 (10:30')	1127
14	Nov. 11-12, 2006	Urawa Station of JR Tohoku Line grade separation (5th)	0:00-13:30 (13hr30min.)	883
15	April 14-15, 2007	Changing tracks, JR Shinjuku Station (5th)	23:30-13:30 (14:00')	907
16	June 30- July 2, 2007	JR Chuo Line continuous grade separation (6th)	15:00-6:00 (39:00')	2066
17	May 17-18, 2008	Urawa Station, JR Tohoku Line grade separation (6th)	0:00-15:30 (15:30')	961
18	June 28-29, 2008	Inaginaganuma Station, JR Nambu Line grade separation (stage 1, 1st)	19:40-7:40 (12:00')	1371
19	Nov. 14-16, 2008	Changing tracks, JR Shinjuku Station (7th)	23:30-6:40 (31:10')	1947
20	Jan. 10-11, 2009	JR Chuo Line continuous grade separation (7th)	20:30-7:20 (11:50')	1310

These switchover are shown in Figure 4 and 5.

Figure 4 Scene of rail switchover (1)

Figure 5 Scene of rail switchover (2)

6. CONCLUSION

The public in Japan continuous to look forward to continuing grade separation projects, etc, which play a role in a more comfortable urban lifestyle.

On the other hand, if they are not implemented as planned, there will be severe criticism from the media and the public due to the impact on society.

Therefore, we have established the total risk management system which should be implemented as planned to ensure the improvement of projects involving railway tracks.

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