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Sub Title	
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Abstract	Every year, in Toshiba Elevator Company, 9 maintenance workers are involved in accidents while servicing customer's Elevators. In about one out of these 9 cases a worker dies as a result, while the other cases result in serious injuries. As a result, Toshiba Elevator spends ¥90,000,000 in compensation fees every year in addition to increased workers turnover costs and the impact on employees' morale and company image. The purpose of this report is to study the instances of maintenance worker's accidents in Toshiba Elevator Company and the causes behind them, and to design a plan to recommend for Toshiba Elevator Company to resolve this problem. After using Scenario Graph and CVCA we developed a better overall understanding of the accidents nature and causes. Then through general research and observation and interview of workers, we identified human errors as the major cause of accidents. We will, therefore, focus in this report on the accidents caused by human errors and try to reduce them by improving awareness and alert levels amongst workers, and improving the understanding of accidents' risk causes and the ability to avoid them. To address this problem, we relied on the tools introduced in the ALPS program. We relied on some tools more than others because some of the ALPS' tools proved to be difficult to use or inappropriate for addressing the specific problem at hand. Using Prototyping Rapidly, QFD and Use Case Scenarios we designed a 4 elements solution recommend these four solution elements to be applied. First is the Sharing New Solutions element. This element helps improving the awareness level and the ability to avoid risk sources. The second Branch Manager Visit to Branch Offices element helps improve the awareness level. The third Checking Compliance and Reward element addresses the two requirements that are improving alert level and doing objective risk assessment. Finally, the Group Study and Reward element betters the understanding of risk sources and the ability to avoid these sources of risk. To conclude, we recommend our proposal to Toshiba Elevator Company as a solution for the safety issues faced by its maintenance workers. This solution can help overcoming this problem since it addresses the reduction of human errors that are behind the majority of accidents (about 70%). According to the financial analysis of the solution, we were also able to show that its adoption can be economically sound. Through implementing this solution, Toshiba Elevator will be able to generate a ¥639.4M (NPV) over a 10 years period and will therefore help increase revenues. However, given that the level of depth of this study was affected by limited access to critical accident reports –for internal information privacy reasons,- we recommend that Toshiba Elevator Company uses a contingency plan to deal with pending risks. As defined using the FMEA, there are still 2 major remaining risks. The first risk is regarding the resistance to change. As a matter of fact, the maintenance workers might be reluctant to implement the proposed solution. In general, people don't like uncertainty -and therefore changes,-so the maintenance workers might refuse to adopt the solution. In the occurrence of such issue, senior management (CEO and branch managers) and the Support Group (Safety Division) members should have plans to encourage the maintenance teams and get them to understand the importance of implementing this solution and the risk they incur if the status quo is maintained. The second risk is about the effectiveness of the solution. Since this study was about a social system, it is difficult to assert that results will be attained as planned. Therefore, against expectations, the proposed solution might not be effective enough in reduce human errors induced accidents. In such case, the solution should be reviewed and causes of failure should be identified in order to modify the proposed solution accordingly. We planned a solution validation stage –which we could not conduct within the time frame, information and resources allocated to this study- that we advise Toshiba elevator to implement as an initial pilot phase necessary for the evaluation and fine-tuning of the solution in addition to a yearly review after implementation.

Notes	Student final reports Group 6
Genre	Research Paper
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=KO40002003-00002010-0225

Group 6

Group 6's Theme Proposed by Toshiba Elevator and Building Systems Corporation

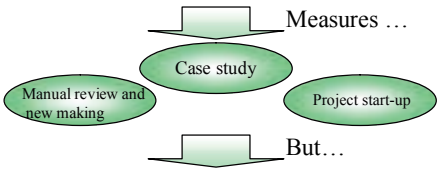
Theme 13:

ALPS "safety and security" theme title:

Mechanism of industrial accident zero making

Proposer Organization's Name:TOSHIBA ELEVATOR AND BUILDING SYSTEMS CORPORATION
Supporter Name and contact info:Satoru Hata E-mail:satoru.hata@glb.toshiba.co.jp

The industrial accident has been happened in each elevator company.



Various industrial accident continues….

The experienced maintenance man often happen accident more than beginner.

The experienced maintenance man knows work process, but not observe it.(Fig 1)

These causes are various. For example,they want to work easily and don't have a lot of working time.

Project subject

This Project aims「Safty and efficient work without accidents」.

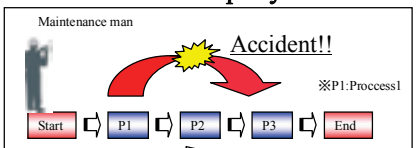


Fig. 1:Work Process(Example)

Fig. 2:Elevator shaft

ALPS Final Report 2010

Group 6

PROJECT TITLE:
“MECHANISM OF INDUSTRIAL ACCIDENT ZERO MAKING”

Theme:

“Mechanism of industrial accident zero making”

Proposer Organization: Toshiba Elevator and Building Systems Corporation

Proposer Organization’s Supporter: Satoru Hata

Keio Mentor: Kenichi Takano

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MECHANISM OF INDUSTRIAL ACCIDENT ZERO MAKING (TOSHIBA ELEVATOR)

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SDM

1. EXECUTIVE SUMMARY

Every year, in Toshiba Elevator Company, 9 maintenance workers are involved in accidents while servicing customer's Elevators. In about one out of these 9 cases a worker dies as a result, while the other cases result in serious injuries. As a result, Toshiba Elevator spends ¥290,000,000 in compensation fees every year in addition to increased workers turnover costs and the impact on employees' morale and company image.

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After using Scenario Graph and CVCA we developed a better overall understanding of the accidents nature and causes. Then through general research and observation and interview of workers, we identified human errors as the major cause of accidents. We will, therefore, focus in this report on the accidents caused by human errors and try to reduce them by improving awareness and alert levels amongst workers, and improving the understanding of accidents' risk causes and the ability to avoid them.

To address this problem, we relied on the tools introduced in the ALPS program. We relied on some tools more than others because some of the ALPS' tools proved to be difficult to use or inappropriate for addressing the specific problem at hand.

Using Prototyping Rapidly, QFD and Use Case Scenarios we designed a 4 elements solution recommend these four solution elements to be applied. First is the Sharing New Solutions element. This element helps improving the awareness level and the ability to avoid risk sources. The second Branch Manager Visit to Branch Offices element helps improve the awareness level. The third Checking Compliance and Reward element addresses the two requirements that are improving alert level and doing objective risk assessment. Finally, the Group Study and Reward element betters the understanding of risk sources and the ability to avoid these sources of risk.

To conclude, we recommend our proposal to Toshiba Elevator Company as a solution for the safety issues faced by its maintenance workers. This solution can help overcoming this problem since it addresses the reduction of human errors that are behind the majority of accidents (about 70%). According to the financial analysis of the solution, we were also able to show that its adoption can be economically sound. Through implementing this solution, Toshiba Elevator will be able to generate a ¥639.4M (NPV) over a 10 years period and will therefore help increase revenues.

However, given that the level of depth of this study was affected by limited access to critical accident reports –for internal information privacy reasons,- we recommend that Toshiba Elevator Company uses a contingency plan to deal with pending risks. As defined using the FMEA, there are still 2 major remaining risks. The first risk is regarding the resistance to change. As a matter of fact, the maintenance workers might be reluctant to implement the proposed solution. In general, people don't like uncertainty -and therefore changes,-so the maintenance workers might refuse to adopt the solution. In the occurrence of such issue, senior management (CEO and branch managers) and the Support Group (Safety Division) members should have plans to encourage the maintenance teams and get them to understand the importance of implementing this solution and the risk they incur if the status quo is maintained. The second risk is about the effectiveness of the solution. Since this study was about a social system, it is difficult to assert that results will be attained as planned. Therefore, against expectations, the proposed solution might not be effective enough in reduce human errors induced accidents. In such case, the solution should be reviewed and causes of failure should be identified in order to modify the proposed solution accordingly. We planned a solution validation stage –which we could not conduct within the time frame, information and resources allocated to this study- that we advise Toshiba elevator to implement as an initial pilot phase necessary for the evaluation

and fine-tuning of the solution in addition to a yearly review after implementation.

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3. PROBLEM STATEMENT

Prior research has shown that, every year, about 40 maintenance workers in the elevator industry are victim of injury from accidents during work-in about 5 of these cases, the accident is deadly. ([1] 昇降機労働災害統計報告)

Toshiba Elevator alone reports about 9 accidents -including 1 deadly- touching its maintenance workers every year.

According to [2] レファレンス協同データベース, Toshiba Elevator holds a market share of about 20%. Relative to the its size on the market and thus the relative size of its maintenance operations, the number of accidents -causing injury or death- at Toshiba Elevator is average compared to the rest of the industry. Toshiba Elevator, however, wants to reduce the number of such incidents for various reasons.

First of all, it affects such accidents have a deep negative impact on the morale of all employees, especially the maintenance workers. In addition to that, the company image is negatively affected by such accidents. And finally, from the economic point of view, these accidents cost the company about ¥290,000,000 in compensation fees every year -according to the evaluation from our sponsor- in addition to other related costs.

Because of confidentiality reasons, we were not granted access to the detailed accident report by Toshiba Elevator. We therefore tried to overcome this difficulty and find out the causes of accidents through general work accident research and information gathered from interviews with maintenance workers.

According to [3]労働災害データベース, [4]失敗学, [5] 図解雑学ー失敗学 and [6] 建設業労働災害防止協会:労働災害統計, 70% of such accidents are caused by human error and the rest of the causes lay in the nature of tools used and the working environmental.

According to the interviewed maintenance workers, most accidents are the result of human errors due to exhaustion or obliviousness of the safety procedures, or both. The outcome of the interviews was thus in concordance with the research mentioned above.

We decided to limit the scope of our study to minimizing maintenance workers accidents through the reduction of human errors by introducing improved maintenance safety procedures. We limit our scope in this way for two reasons. First, Toshiba Elevator has already implemented many solutions to reduce the accidents causes due to tools and environmental reason. The second reason is that Human errors have the most impact on the number of accidents happening in Toshiba Elevator.

4. ANALYSIS AND DISCUSSION OF ALPS METHODS

In this section, we analyze and discuss ALPS tools. We used 19 tools throughout ALPS workshops. And here we give a summary of these tools first, and then we give a detailed evaluation of each tool in the following part. Most of ALPS tools were useful and effective in dealing with different aspects in our project, but some were difficult to apply. Figure1 summarizes our assessment of the value of these tools and shows the sequence according to which we used them.

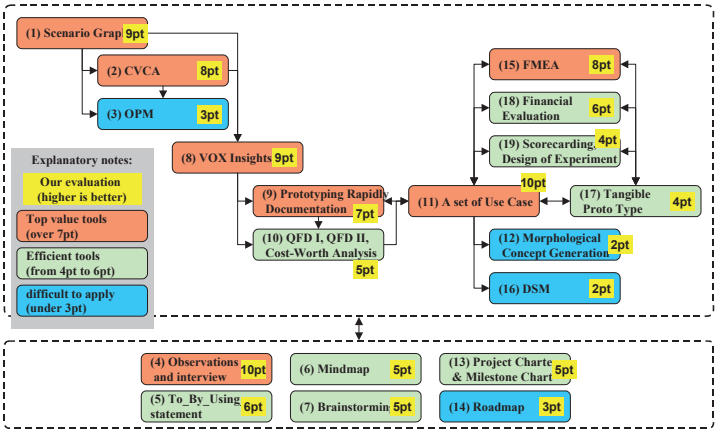

Figure 1 Evaluation of ALPS tools

Among the tools that were of top value to us, Scenario Graph, CVCA and the Observations and Interview allowed better overall understanding of the theme and the stakeholders' concerns which impacts tremendously the output of the whole project from the beginning. Later on, collecting stakeholders requirements being the most important task, the VOX tool helps not only to incorporate the voice of the main customer but also the voice of all stakeholders and social and technical factors and trends that can affect or be affected by the project. After that, the Use Case Scenarios (including work flow) was useful for the understanding of the As Is system and allowing the discussion of various functions and features needed to be supported by the To Be system through reviewing the various use cases of it. Sharing the solution concept with the

stakeholders and getting them to understand it early on in the project development phase is critical to discover the flaws of the current design and to make the necessary adjustments early on with the least costs possible. Prototyping Rapidly effectively ensures that. The initial solution came with many hidden problems and risks. The FMEA tool was very useful for identifying these flaws in order to fix them.

As for the tools we found difficult to use on our project, the OPM and Morphological Concept Generation we think are not really suited for social systems like was the case with our theme. The OPM can help understanding the processes, but the Use Cases analysis is more useful for that. As for the DSM, using it did not add much value to our solution. Finally, the Roadmap was useful to review our design process but using it, at the end of the project, does not add much value neither.

Refer to Annex A for detailed discussion of the tools.

5. DESIGN RECOMMENDATION

In this section, we show our recommended design to address and solve the customer's problem. Figure2 shows the relationships between customer requirements and the recommended solution's elements. First, we listed 8 solution elements to address the customer's requirements using QFD, Prototyping Rapidly and Use Case analysis. Later on, we discovered that 4 of these elements have already been implemented by the company and the others ones happened to show some weaknesses and risks after using the QFD, FMEA, Score carding, DOE and Financial Evaluation on them. Finally, we designed 4 robust solution elements as illustrated in the Figure2.

The details of each solution element are shown on Figure3, 4, 5 and 6. Our tangible prototype is shown on figure7.

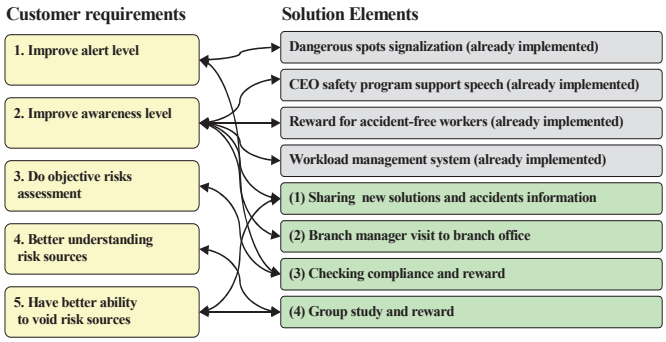

Figure 2 Relationships between Customer Requirements and Solution Elements

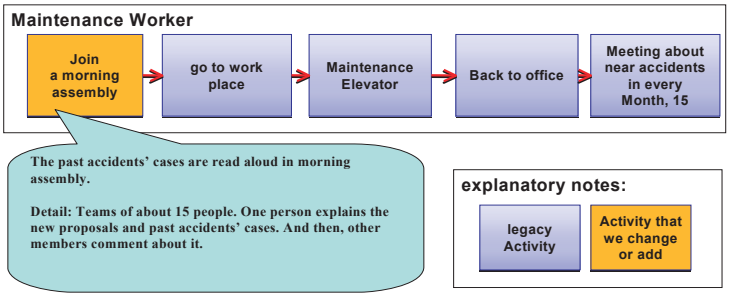

Figure 3 Use Case (Sharing new solutions and accidents information)

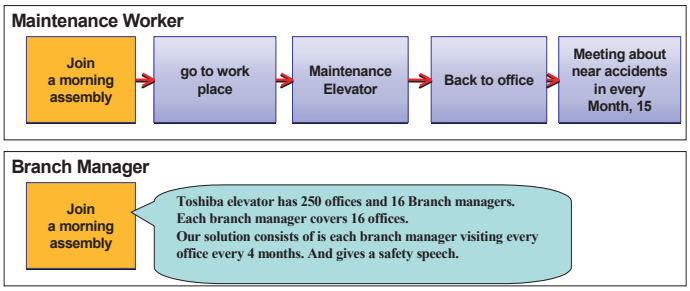

Figure 4 Use Case (Branch manager visit to branch office)

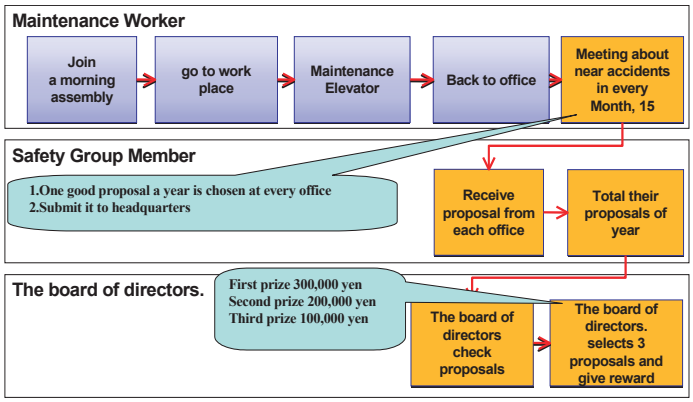

Figure 5 Use Case (Group study and reward)

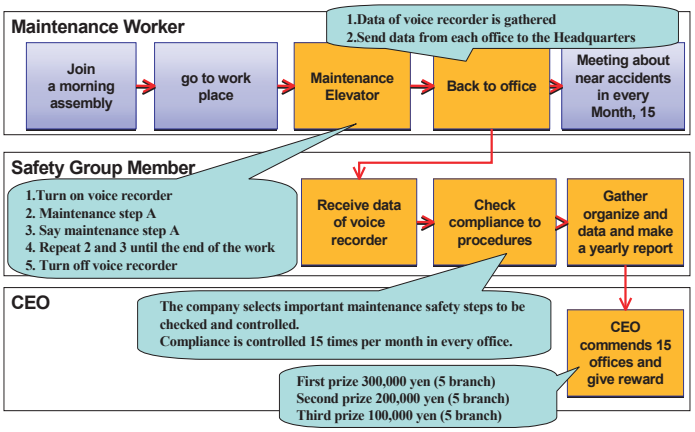

Figure 6 Use Case (Checking compliance and reward)

Figure 7 Tangible Proto Type

6. COMPETITIVE ANALYSIS

In this section, we give an overview of our business model and financial evaluation. Our business model consists of generating revenue through the reduction of compensation fees due to maintenance workers' accidents in addition to other costs caused by these accidents. Figures 8 and 9 illustrate the business model and how revenue is going to be generated.

The final detailed design of the solution is to be developed by the end of 2011, after which, it will be deployed in Toshiba Elevator Company. We did a 10 years financial evaluation for the solution as appears in Table 1.

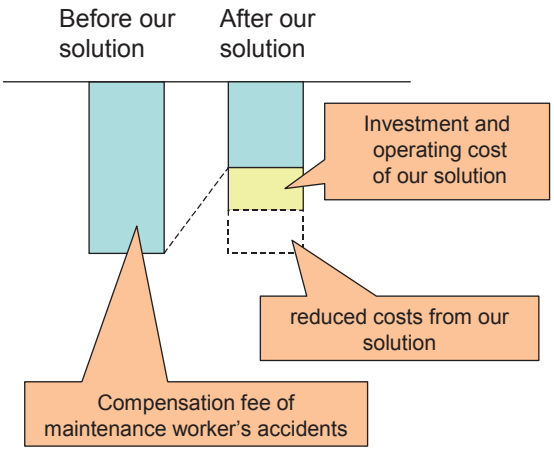

Figure 8 Business Model (How revenue increases)

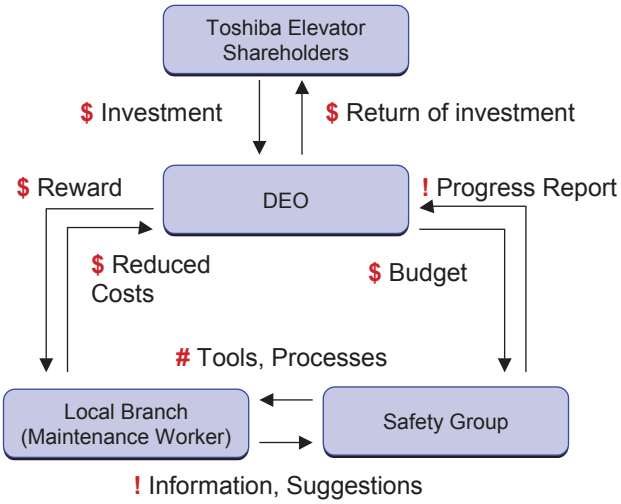

Figure 9 Business Model (How money and information flow)

Table 1 Financial Evaluation (Summary)

	Sensitivity Analysis			Likely Result (Three-Point Estimation)
	Positive	Average	Negative	
Net Present Value (m¥)	948.4	632.5	357.7	**639.4**
Internal Rate Return (%)	100	48	27	**53**
Pay Back Period (year)	2	4	6	**4**

7. ALPS ROADMAP AND REFLECTIONS

In this section, we show our actual ALPS Roadmap (Figure 10), the ALPS Roadmap we wish we had instead (Figure 11) and our comments on the ALPS program for staffs.

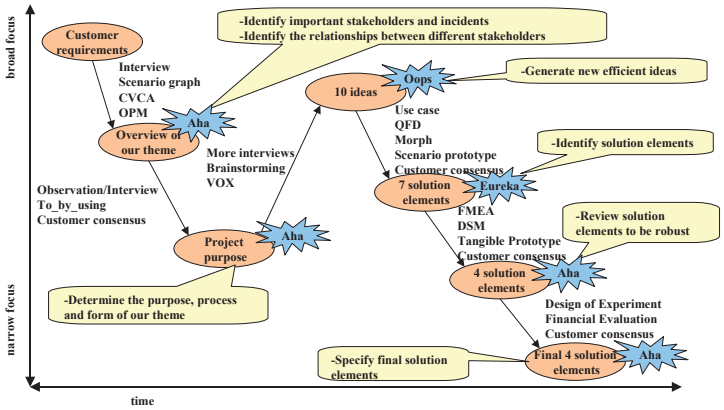

Figure 10 Roadmap (Actual)

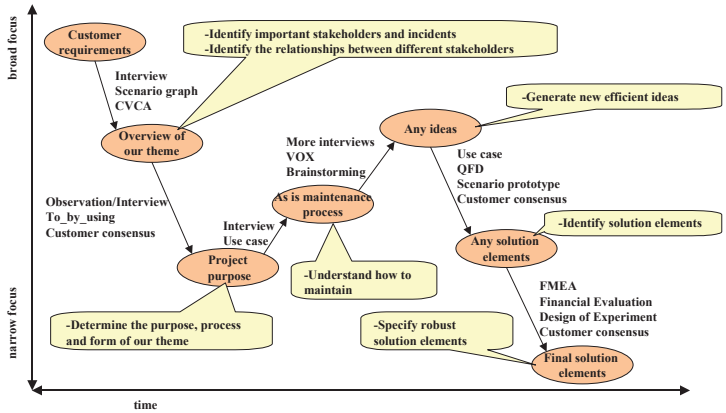

Figure 11 Roadmap (We wish)

1. What did we like?

First of all, we would like to say thank you, every staffs provide us the lecture, constructive feedback and comments. There are 2 aspects we like.

-First is quality of answer.

There are some questions after lecture, so we asked about that, and then we could receive helpful and understandable answer. Probably most of students who asked questions in class get helpful and understandable answer.

-Second is quality of lectures.

The lectures included many examples, DoE and Score carding or something like that. We think they helped students for understanding tools. Actually we heard such opinions after lecture.

2. What do we wish for ALPS in the future?

We wish ALPS should focus on understanding of the ALPS's tools. It means we will be able to use the tools for various cases. In order to do that, we propose 4 things.

1. Include the level of understanding and ability to apply tools in the evaluation of the teams' work.

2. Offer lectures beforehand to explain the meaning and use of the difficult tools.

3. Communicate the schedule of ALPS beforehand (which tools will be introduced when).

4. More homogeneity in the project themes (similar topics) in order to have a fair assessment of all the teams' effort and allow the teams to learn from each other.

8. CONCLUSION AND FUTURE WORK

To conclude, we discuss the reason why we recommend our solution, and we make a proposition for a contingency plan and future works.

1. Conclusions

We recommend the solution we designed, as described in this report, to be used by Toshiba Elevator for the following two reasons:

-To overcome the most important problem.

This solution focuses on reducing human errors, which makes for the majority (about 70%) of the accidents causes.

-The solution is economically sound.

That is, by implementing the solution, Toshiba Elevator will be able to generate revenue of 639.4M (NPV) over a 10 years period.

2. Contingency Plan

According to the output from the FMEA tool, there still are 2 major remaining risks that threaten the success of the solution discussed in this report. Therefore, we recommend that Toshiba Elevator implements a contingency plan to make up for these risks. (This contingency plan has already been taken into consideration in the Financial Evaluation and future works)

- The first risk is regarding the willingness of the maintenance workers to accept the solution.

The maintenance workers in Toshiba Elevator might be reluctant to accept this solution and comply with the requirements it imposes on them. To face this risk, senior management (CEO and branch managers) in addition to the Support Group -Safety Division- members should be prepared to encourage the maintenance workers being more involved and providing more effort to help in the success of this project. They should also make sure that all the parties involved understand the importance of the operation for the whole group's safety and success.

-The second risk is that -even being implemented properly- the solution might not bring the sought after results. In fact, there are not enough guaranties that, against the expectation, the solution might not reduce the accident instances significantly. In such case, the solution should be reviewed, causes of failure identified and fixed. We plan a validation stage in our development cycle just before the deployment phase. In addition to that, we recommend a yearly evaluation of effect of the solution after deployment as continuous monitoring activity ensuring the controlling durability of the effectiveness of the system. Figure12 shows the schedule recommended for the further development of the solution.

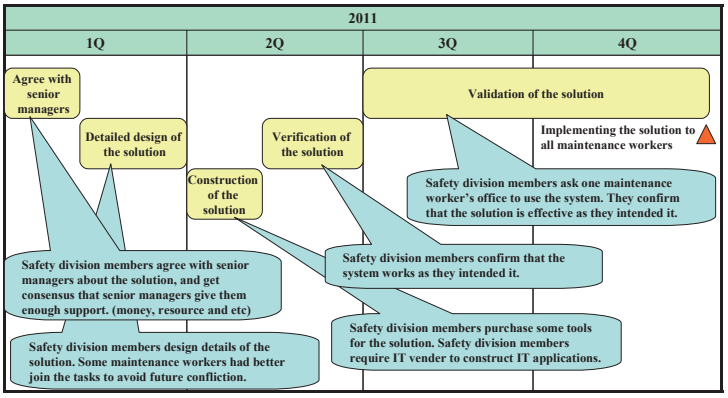

Figure 12 Future works

9. ACKNOWLEDGMENTS

We started this project as a team of people who did not know each other, who did not have any background or experience in the topic we had to deal with and with no previous understanding or knowledge about the majority if not all the tools introduced during ALPS. And after 8 months of work, we were able to be familiar not only with the ALPS tools, but with the topic at hand as well. 8 months throughout which we enjoyed the generous help, support and encouragement of many people we could not have come this far without. We would like, thus, to convey our sincere thanks to all these wonderful people.

We are especially grateful to our mentor, Professor Kenichi Takano for his great support in all aspects during the whole period of our study. Through his kindness, patience, abundant knowledge, and outstanding personality, Prof. Takano has been a role model for all of our team.

We would like also to express our warm and sincere thanks to Mr. Satoru Hata, Toshiba Elevator, to whom we owe a lot in this project. We are sincerely grateful, not only for his great help to us on researching data, organizing interviews and reviewing our study results, but also for his kindness and encouragements throughout the course of the study.

We would like also to express our gratitude and thanks to this wonderful team from all over the world that is dedicated to making of the ALPS program a better opportunity for students like us to enjoy quality learning of tools and methods as well as social skills that make a difference in real life.

And last but not least, a special thanks to Prof. Sun Kim who restlessly looked after this ALPS program and all the teams' projects like his own baby and did whatever was necessary to make it easier and fun for all people involved.

To all, these wonderful people: Thank you!

10. REFERENCES

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http://crd.ndl.go.jp/GENERAL/servlet/detail.reference?id=1000039400

ANNEX A Tools Evaluation

Tool	Key Aspect	Contents
Scenario Graph	Summary	・This tool is useful for the overall understanding of the theme.
	What we learned	・Bettered our overall understanding of the theme ・Identified important stakeholders and incidents ・Chose the most important stakeholders and incidents
	Input and Constraints	・(Input)Brainstorming with team members and our sponsor ・(Input)Interview of our sponsor ・(Constraints)Sponsor's help is necessary.
	how results feeds into another tool	・When we made CVCA and OPM, we referred the results(for instance, who and what). ・Overall understanding of the theme helped us through the project.
	Expected and unexpected	・(Expected)Our team members and sponsor shared overall understanding of the theme. ・(Expected)First, we listed all possible items. We then removed unimportant items using results in CVCA and OPM. Finally, we determined main scenario by discussing with our sponsor.
CVCA	Summary	・This tool is useful for analyzing the roles and relationships among stakeholders.
	What we learned	・Identified the relationships between different stakeholders ・Identified stakeholders' roles and responsibilities ・Identified different methods to investigate the causes of the problem
	Input and Constraints	・(Input)Output of Scenario graph ・(Input)Interview of our sponsor ・(Constraints)Sponsor's help is necessary.
	how results feeds into another tool	・When we made OPM and Use Cases, we used the results(for instance, stakeholder and product). ・Understanding overview of the theme was helpful for us throughout the project.
	Expected and unexpected	・(Unexpected)First, it seemed to be difficult to identify the flow of products in the case of a social systems because our system does not deal with products. But we deal with services instead. ・(Expected)To make CVCA, we required our sponsor to show their organization chart and relationship with Toshiba Elevator's customers.
OPM	Summary	・This tool was difficult to apply to social systems like ours.
	What we learned	・The structure through which the value is delivered. ・The Objects and Processes that constitute this structure.
	Input and Constraints	・(Input)Output of Scenario graph and CVCA ・(Input)Interview of our sponsor ・(Constraints)Sponsor's help is necessary.
	how results feeds into another tool	・Nothing
	Expected and unexpected	・(Unexpected)It was difficult to apply the OPM to a social system. It might be possible to apply this tool to analyze current process, but we think A set of Use Case is better for it.
Observation and Interview	Summary	・This tool is necessary to get important information of our project.
	What we learned	・Detailed information of customer's problem ・What our customer wants ・Which solution is effective
	Input and Constraints	・(Input)All tools ・(Constraints)Sponsor's help is necessary.
	how results feeds into another tool	・Depend on the situation

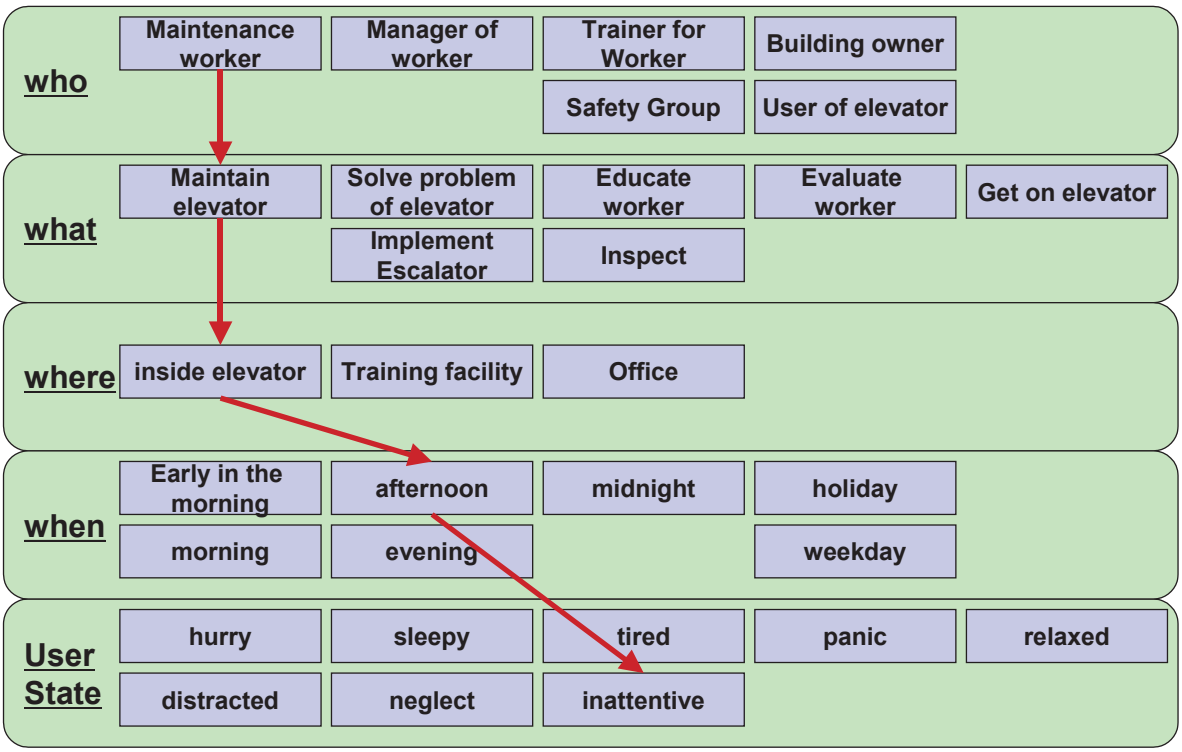
	Expected and unexpected	・(Expected)We visited their offices twice to interview to maintenance workers and were able to get some tips on the problem causes and how we should design the solution . ・(Expected)It was difficult to arrange for the interviews. ・(Unexpected)Our sponsor did not give us important information of accidents causes because of confidentiality. ・(Unexpected)We wanted to visit the maintenance place to observe directly, but Toshiba Elevator and its customers didn't allow us to join because of confidentiality.
To_By_Using_ Statement	Summary	・This tool was useful in understanding the purpose and methodology of the project.
	What we learned	・Determine the purpose, process and form of our theme
	Input and Constraints	・(Input)All tools
	how results feeds into another tool	・Understanding purpose and methodology to be used helped us avoid making misplaced actions.
	Expected and unexpected	・(Unexpected)It was difficult to distinguish "By" from "Using" in our theme. ・(Unexpected)We could identify only 'To' sentence in 'To_By_Using' sentences in the beginning of our homework, whereas we could identify all sentences after 'Observation and Interview'.
Mindmap	Summary	・This tool helps each members to generate new ideas.
	What we learned	・List all known ideas, generate new ideas, summarize the main idea and specify relation between ideas
	Input and Constraints	・(Input)All tools and information
	how results feeds into another tool	・Depend on the situation
	Expected and unexpected	・(Expected) It was useful to visualize these ideas' structure. ・(Expected) When we list ideas of new solution elements by ourselves, this tool is very helpful.
Brainstorming	Summary	・This tool helped our group to generate and expand new ideas.
	What we learned	・Come up with new ideas, expand the existing ideas and categorizing the ideas into groups.
	Input and Constraints	・(Input)All tools and information
	how results feeds into another tool	・Depend on the situation
	Expected and unexpected	・(Expected)Good environment (rooms and atmosphere etc) was necessary to come up with good ideas. ・(Expected)To generate ideas with several people was better than by one person.
VOX Insights	Summary	・This tool is necessary to incorporate not only the voice of the customer but also all the other stakeholders and technical and social aspects and trends that can affect or be affected by our project.
	What we learned	・Understanding inside situation of our customer(i.e. mission of our customer, voice of workers) ・Understanding outside circumstance of our customer (i.e. market trend, technology trend) ・Identifying some customer requirements to our project ・Identifying some scenarios that we try to solve
	Input and Constraints	・(Input)Observation of maintenance place ・(Input)Interview of our sponsor ・(Input)Interview of some maintenance workers who experienced an accident ・(Input)Internet search of our company and competitor's safety programs
	how results feeds into another tool	・When we made Prototyping Rapidly documentation, we used customer requirements and scenarios that we try to solve. ・When we made QFD, we used customer requirements.

	Expected and unexpected	・(Unexpected)Understanding outside circumstance of our company was not so important because our theme is to solve problem inside company.
Prototyping Rapidly documentation	Summary	・This tool helped our group and customer to have concrete visual image of our solution.
	What we learned	・Generating 10 ideas to solve our customer's problem ・Identifying ideas implemented and not implemented by our customer
	Input and Constraints	・(Input)VOX ・(Input)Brainstorming with team members and our sponsor ・(Input)Interview of our sponsor ・(Input)Research of other company's precedents
	how results feeds into another tool	・When we made A set of Use Case, we imaged concrete stakeholder's activities using Prototyping Rapidly documentation. ・When we made QFD, we used 10 ideas that we listed in Prototyping Rapidly documentation.
	Expected and unexpected	・(Expected)We could understand inside situation of our company well through the discussion of our ideas with the sponsor. ・(Expected)We checked our ideas' effectiveness by discussing with the sponsor and maintenance workers.
QFD I, QFD II, Cost-Worth Analysis	Summary	・This tool helped our group tracing all the elements in our solution back to some customer requirements and evaluating each element's cost/worth balance.
	What we learned	・Identifying functions and solution elements of our system ・Understanding the cost/worth tradeoffs of the proposed solution elements
	Input and Constraints	・(Input)VOX ・(Input)Prototyping Rapidly documentation ・(Input)Brainstorming with team members
	how results feeds into another tool	・We reviewed Prototyping Rapidly documentation using the result of QFD.s throughout the project.
	Expected and unexpected	・(Unexpected)We couldn't understand difference between functions and solution elements clearly. We want examples of how to use for social systems like in our theme.
A set of Use Case Scenarios	Summary	・This tool is necessary to make concrete scenarios of our solution.
	What we learned	・Identifying other functions the system needs to perform in some specific scenarios
	Input and Constraints	・(Input)Prototyping Rapidly documentation ・(Input)QFD ・(Input)Brainstorming with team members and our sponsor ・(Input)Interview of our sponsor
	how results feeds into another tool	・We reviewed Prototyping Rapidly documentation using result of A set of Use Case.
	Expected and unexpected	・(Expected)We could understand role and responsibility of each division better.
Morphological Concept Generation	Summary	・This tool was difficult to apply for us because our solution does not include physical elements.
	What we learned	・Listing all solution elements of our system ・Determining efficient set of solution elements
	Input and Constraints	・(Input)A set of Use Case
	how results feeds into another tool	・Nothing
	Expected and unexpected	・(Unexpected)This tool was hard to apply to our theme because most of our solution elements are not physical. We want examples of how to use for social systems like in our theme.

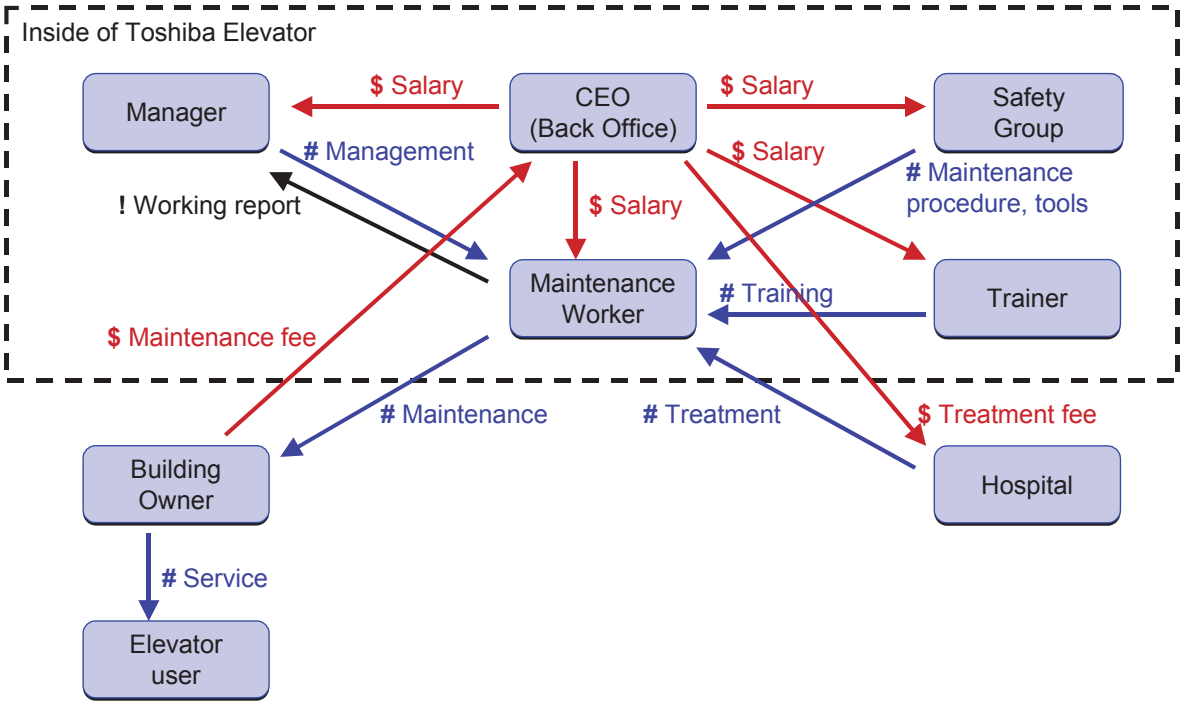
Project Charter & Milestone Chart	Summary	・This tool is useful to share important information (i.e. project overview , project purpose) of our project with our customer.
	What we learned	・Identifying important information of our project (i.e. project overview, project purpose, requirement from customer, important stakeholders and milestones) ・Sharing important information of our project with our customer
	Input and Constraints	・(Input)All tools and information ・(Input)Brainstorming with team members and our sponsor ・(Input)Interview of our sponsor
	how results feeds into another tool	・Understanding and sharing important information of our project avoided having misplaced actions.
	Expected and unexpected	・(Unexpected)We couldn't identify milestones clearly because we couldn't realize what the topic of the next ALPS WS is.
Roadmap	Summary	・This tool helped us visualize and remember what we did in our project.
	What we learned	・Understanding relationship between all tools and all results of our activity. ・Sharing with team members what status our project was in the past.
	Input and Constraints	・(Input)All tools
	how results feeds into another tool	・Nothing
	Expected and unexpected	・(Unexpected)We thought roadmap is planning for the future milestones of a project, but actually the ALPS tools provide a straight forward path for our activities. However, we went through an iterative path redoing some of the steps many times. So, we see it as a lesson for how to proceed with our next stages or projects.
FMEA	Summary	・This tool is necessary to identifying important potential problems and risks in our solution.
	What we learned	・Listing all problems of our solution and identifying the most critical ones. ・Specifying plans to avoid the problems
	Input and Constraints	・(Input)A set of Use Case ・(Input)Tangible Proto Type ・(Input)Brainstorming with team members and our sponsor ・(Input)Interview of our sponsor
	how results feeds into another tool	・We reviewed A set of Use Case using the result of FMEA. ・We reviewed Tangible Proto Type using the result of FMEA.
	Expected and unexpected	・(Expected)Our sponsor's help was necessary to identify failure modes. ・(Expected)We could share the result of FMEA with our team members and our sponsor easily because FMEA's table figure is understandable and the ratings of occurrence and severity help us to identify the most important problems. ・(Unexpected)We couldn't determine the clear rating basis of occurrence and severity, so the rating was decided by members' consent.
DSM	Summary	・This tool was not so effective for such simple order procedures like in our solution.
	What we learned	・Identifying most effective order of our solution's activities.
	Input and Constraints	・(Input)Prototyping Rapidly documentation ・(Input)A set of Use Case
	how results feeds into another tool	・Nothing
	Expected and unexpected	・(Unexpected)We did not get any beneficial result from this tool because our solution order is too simple to use this tool.
Tangible Prot Type	Summary	・This tool helped our group to design a robust solution.
	What we learned	・Reorganizing old 10 elements solution to a new 4 elements robust one

		・Sharing concrete image of our solution with our team members and our customer
	Input and Constraints	・(Input)A set of Use Case ・(Input)Brainstorming with team members and our sponsor ・(Input)Interview of our sponsor
	how results feeds into another tool	・When we review A set of Use Case, we were able to visualize concrete stakeholder's activities using Tangible Proto Type.
	Expected and unexpected	・(Unexpected)At first, we were puzzled about how to make tangible proto type because there were not much physical elements in our solution. But, finally, we realized that we should make scenario proto type someone can join.
Financial Evaluation	Summary	・This tool was necessary to evaluate if our solution is proper or not from a financial point of view.
	What we learned	・Identifying revenues, costs and investment details of our solution ・Estimating profit/loss from implementing our solution
	Input and Constraints	・(Input)A set of Use Case ・(Input)Interview of our sponsor ・(Input)Research of other companies and other fields information
	how results feeds into another tool	・We reviewed A set of Use Case using the result of Financial Evaluation. ・We reviewed Tangible Proto Type using the result of Financial Evaluation.
	Expected and unexpected	・(Expected)In our project, we could easily estimate cost and investment details. On the other hand revenue was difficult to assess because we could not precisely specify how much accidents reduction there will be. So, we prospected 3 scenarios for the revenues (positive, negative and average) after discussion with our sponsor.
Scorecarding, Design of Experiment	Summary	・This tool helped us to plan how to validate our solution.(planning how to confirm biggest Y). ・This tool makes our solution more robust(confirming big Y).
	What we learned	・Identifying our project's biggest Y, its factors and how to confirm factor's effect. ・Identifying our project's big Y, its factors and how to confirm factor's effect. ・How big Y's factor effects to big Y
	Input and Constraints	・(Input)A set of Use Case ・(Input)Interview of our sponsor ・(Input)Brainstorming with our team members ・(Input)Research of other companies and other fields information
	how results feeds into another tool	・We reviewed A set of Use Case using the result of DOE(big Y) conduction. ・We reviewed Tangible Proto Type using the result of DOE(big Y) conduction. ・We will review Financial Evaluation using the result of DOE (biggest Y) conduction.
	Expected and unexpected	・(Expected)In our project, we will confirm the biggest Y just before we implement our solution because Confirming the social system like our project requires actual procedures and maintenance worker's attendance. ・(Unexpected)We confirmed big Y using questionnaire, but we don't know whether conducting questionnaire is proper as a experiment to answer such a question.

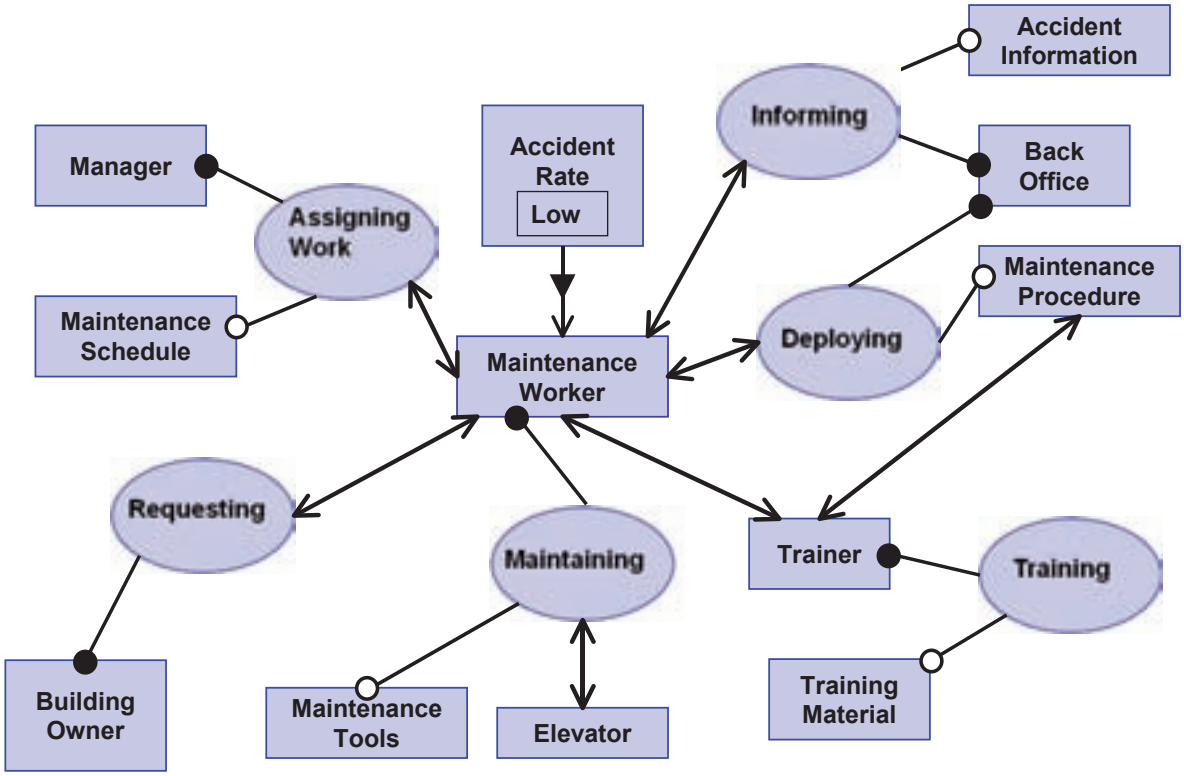
ANNEX B Scenario Graph



ANNEX C CVCA



ANNEX D OPM



ANNEX E Observation and Interview

Inside of company

Mission & Vision	want to raise the efficiency of the maintenance work
	want to improve the safety of workers
Voice of Worker	Have too much workload
	Doesn't take risk of accidents seriously
	Carelessly at Work
Voice of Manager	Third party observation makes workers take things more seriously
Differentiation & Positioning	Toshiba EV is 3rd in Japan (market share)
	In Japanese EV industry, there is no major difference in product or price
Core Competencies	Remote surveillance technology and elevator for outdoor shaft

We try to tackle these questions.

Outside of company

Market Trends	Customers are more concerned about the safety and work conditions of workers
Sources of Change	Not only actual accidents but also hiyarihatto study is important for safety
Societal Changes	the Internet is available everywhere
Voice of Technology	maintenance tools has developed
Voice of Competition	high technology of elevator speed

ANNEX F Prototyping Rapidly Documentation

explanatory notes:
Black :already implemented. Out of Scope.
Red :partially implemented, but not enough
blue :not implemented

Dangerous Spots Signalization

CEO safety program support speech

Reward for accident-free workers

Our customer deploy accident information to maintenance workers, but most maintenance workers never read it.

Sharing precedent accidents' information

Manage workload

Our customer has IT system to monitor, but not to manage workload.

CEO visit to work place

Procedures Compliance Motivation

Risks Discovery and Solutions Proposal Motivation

External Party Monitoring

Accidents' study group

ANNEX G QFD I, QFD II, Cost-Worth Analysis

Customer Requirements
- Improve Workers Awareness
- Improve Workers Alert
- Objective Risk Assessment
- Continuous Risk Assessment
- Identify Risk sources
- Eliminate Risk sources

Engineering Metrics
- Work Load (h/day)
- Awareness Test (score)
- Alert Test (score)
- Procedures Application Rate
- External Assessment Frequency
- # Discovered Causes/ # of Accidents
- # Risk Mitigation Processes/# Known Risk Causes

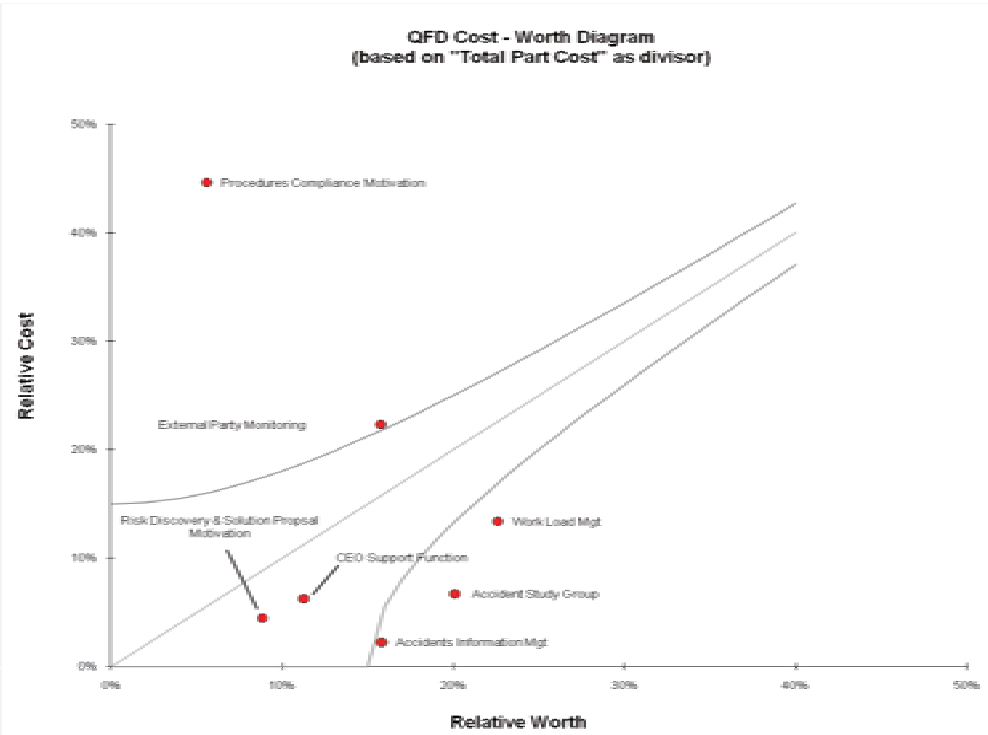
Solution Elements or Enabling Functions
- CEO Support Function
- Procedures Compliance Motivation
- Risk Discovery & Solution Proposal Motivation
- External Party Monitoring
- Accidents Information Mgt
- Work Load Mgt
- Accident Study Group

PHASE I QFD — Toshiba Maintenance

Customer Requirements	Customer Weights	Work Load (h/day)	Awareness Test (score)	Alert Test (score)	Procedures Application Rate (non apliation reported/month)	External Assessment Frequency (#/year)	# Discovered Causes/ # of Accidents	# Risk Mitigation Processes/# Known Risk Causes
		Engineering Metrics						
Improve Workers Awareness	9		9		3		3	
Improve Workers Alert	9	9	3	9	1	3		
Objective Risk Assessement	3					9		
Continuous Risk Assessement	3		1	1		9	3	3
Better Risk sources understnading	3			1			9	
Better Risk sources Avoiding Ability	3		3	3			9	9
Technical Targets		8h/day	>80%	>60%	>75%	12/year	<1	1
	Raw score	81	120	96	36	81	90	36
	Relative Weight	15%	22%	18%	7%	15%	17%	7%

PHASE II QFD — *Toshiba Maintenance Safety*

Engineering Metrics	Phase I Relative Weights	CEO Support Function	Procedures Compliance Motivation	Risk Discovery & Solution Propsal Motivation	External Party Monitoring	Accidents Information Mgt	Work Load Mgt	Accident Study Group			
		Solution Elements or Enabling Functions									
Work Load (h/day)	15%						9	3			
Awareness Test (score)	22%	1	1		1	1		3			
Alert Test (score)	18%	3		3	1		9	3			
Procedures Application Rate	7%	3	9		1		3	3			
External Assessement Frequency (#/year)	15%				9						
# Discovered Causes/ # of Accidents	17%	3		1	3	9	1	3			
# Risk Mitigation Processes/# Known Risk Causes	7%	3		9		9		9			
	Raw score	1.7	0.8	1.3	2.3	2.3	3.3	3.0	0.0	0.0	0.0
	Relative Weight	11%	6%	9%	16%	16%	23%	20%	0%	0%	0%



ANNEX H Morphological Concept

functions	Solutions				
CEO support function	visit	Send mail	Speech		
Procedures Compliance motivation	Money	Promotion	Gifts	List name on Toshiba news	Yellow card
Risks discovery and solutions proposal motivation	Money	Promotion	Gifts	List name on Toshiba news	
External party monitoring	Voice recording	Video			
Accident information management	Booklet	Web site	Web application		
Manage workload	Web application	Guideline			
Accidents' study groups	Case study	Safety circles	Site visit		

ANNEX I FMEA

explanatory note
yellow color : already reviewed the solution
blue color : not review the solution (Contingency Plan)

Function or Requirement	Potential Failure Modes	Potential Causes of Failure	Occurrence	Local Effects	End Effects on Product, User, Other Systems	Severity	Detection	RPN
1. Workload management system	already implemented							
2. Sharing accidents information system	The worker is not recording to the voice recorder	Worker's negligence	2	Loss of traceability for procedure's observance	Failure to improve awareness and alert level of workers	8	10	160
	It takes too much time to record	The reading item is too long	2	Work is delayed	Workload increase	5	4	40
3. CEO visit to work place	The president cannot visit all sites	The number of sites is too large	10	There are site that the president cannot visit	Motivation by the CEO visit does not reach all workers	3	8	240
	The meeting of the president with the workers is not effective	The president lacks essential information	3	The worker is disappointed by the president	The president's visits do not improve the workers' motivation	3	2	18
4. Group study meeting	Not done bottom-up.	Workers are looked at as not having adequate qualification	9	The workers loose interest in the process	The workers stop paying attention to the accidents' risk	4	3	108
	Only few members participate actively	The environment does not encourage participation	7	The workers loose interest in the process	The workers stop paying attention to the accidents' risk	5	8	280
5. External party monitoring	The recorded content is not correct	Worker's negligence	4	It is not possible to evaluate it correctly	The reward cannot be correctly given	7	4	112
	All data cannot be audited	There are too many objects (recordings) to be audited	9	All workers are not evaluated	The rewarding becomes unfair	9	6	486
6. Reward for procedures compliance	The influence that penalty exerts is low	Value to penalty is different respectively	6	The penalty will mean little	They do not think penalty to be shame	8	4	192
	Reward is not enough to motivate maintenance worker	The number of encouraged people is in apposite	8	The value of the encouragement lowers	Workers are not motivated to comply with procedures	9	6	432
7. Reward for solutions proposal	Reward is not enough to motivate maintenance worker	The number of encouraged people is in apposite	8	The value of the encouragement lowers	Workers are not motivated to propose solutions	9	6	432
8. ALL	Maintenance workers hesitate to implement the solution	people don't like changes	5	solution is not implemented	The accident does not decrease	10	8	400
	The solution does not bring enough effect	The solution does not improve human errors	7	the solution does not reduce human errors	The accident does not decrease	9	8	504

ANNEX J DSM

key		A	B	C	D	E	F	G	H	I	J	k	L	m	
Join a morning assembly	A	A													A
Go to work place	B	X	B												B
Maintain elevator	C	X	X	C											C
Back to office	D			X	D										D
Meeting a near accident in every month ,15th	E			X	X	E									E
Receive proposal from each office	F					X	F								F
Total proposals of year	G						X	G							G
Managing Board check proposals	H							X	H						H
Managing board commends 3 proposals and give reward	I								X	I					I
Receive data of voice recorder	J			X							J				J
Check compliance of maintenance	k										X	k			k
Total and rank their data of year	L											X	L		L
CEO commends 15 offices and give reward	m												X	m	m
		A	B	C	D	E	F	G	H	I	J	k	L	m	

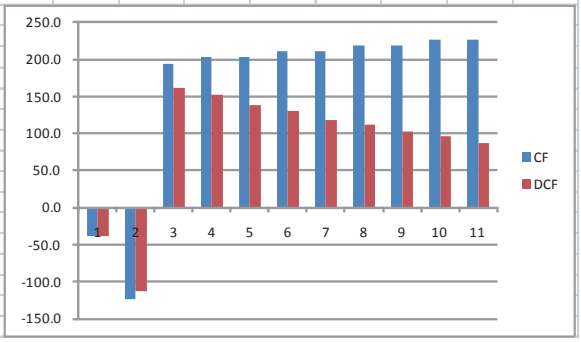
ANNEX K　Financial Evaluation (Revenue and Cost Details / Estimation Condition)

Revenue and Cost Details	EstimationCondition
Revenue	
Decrease accident's compansation(dead)	1 dead accident every year. losing ¥300,000,000 per accident.
Decrease accident's compansation(injury)	8 injury accident every year. losing ¥10,000,000 per accident.
Redeuce workers turnover	1 dead accident every year. required ¥10,000,000 per person.
Increase work force by improving workers motivation	Nothing
Increase sales by improving company image	Nothing
Reduce insurance cost	Nothing
ServiceCost	
Reward(check compliance)	1st prize(¥300,000 * 5) + 2nd prize(¥200,000 * 5) + 3rd prize(¥100,000 * 5)
Reward(study group)	1st prize(¥300,000) + 2nd prize(¥200,000) + 3rd prize(¥100,000)
Human resource(check compliance)	1,200MaintenanceWorker * 12check/year * 1H/check * ¥1,500/H
Human resource(visit office)	250office * 3speech/year * 2H/speech * ¥7,000/H
Human resource(maintain this system and training)	19employee * 12month * 140H/month * ¥3,000/H
InvestmentCost	
Human resource(develop this system)	3employee * 12month * 140H/month * ¥3,000/H
Cell phone cable(check compliance)	1,200cell phone * ¥2,000/cable
Develop cell phone application(check compliance)	Depend on IT vendor. ¥20,000,000

Financial Evaluation (Positive Scenario)

Year	0	1	2	3	4	5	6	7	8	9	10
Revenue		8.0	326.0	334.0	334.0	342.0	342.0	350.0	350.0	358.0	358.0
Decrease accident's compansation(dead)		0.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Decrease accident's compansation(injury)		8.0	16.0	24.0	24.0	32.0	32.0	40.0	40.0	48.0	48.0
Redeuce workers turnover		0.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
ServiceCost		131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5
Reward(check compliance)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Reward(study group)		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Human resource(check compliance)		21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6
Human resource(visit office)		10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Human resource(maintain this system and training)		95.8	95.8	95.8	95.8	95.8	95.8	95.8	95.8	95.8	95.8
InvestmentCost	37.5										
Human resource(develop this system)	15.1										
Cell phone cable(check compliance)	2.4										
Develop cell phone application(check compliance)	20.0										
CashFlow	-37.5	-123.5	194.5	202.5	202.5	210.5	210.5	218.5	218.5	226.5	226.5
DiscountFactor	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51	0.47	0.42	0.39
DiscountedCashFlow	-37.5	-112.3	160.7	152.1	138.3	130.7	118.8	112.1	101.9	96.1	87.3

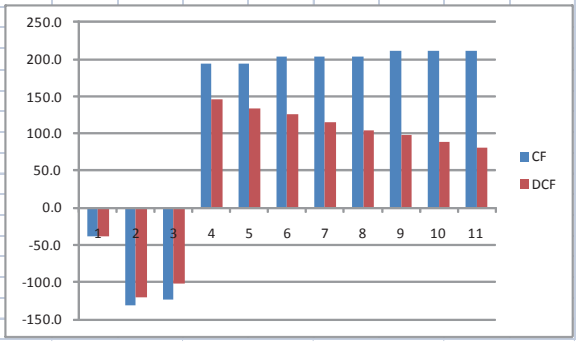
NetPresentValue	948.4	m¥
InternalRateReturn	100	%
PaybackPeriod	2	year



Financial Evaluation (Average Scenario)

Year	0	1	2	3	4	5	6	7	8	9	10
Revenue		0.0	8.0	326.0	326.0	334.0	334.0	334.0	342.0	342.0	342.0
Decrease accident's compansation(dead)		0.0	0.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Decrease accident's compansation(injury)		0.0	8.0	16.0	16.0	24.0	24.0	24.0	32.0	32.0	32.0
Redeuce workers turnover		0.0	0.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
ServiceCost		131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5
Reward(check compliance)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Reward(group study)		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Human resource(check compliance)		21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6
Human resource(visit office)		10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Human resource(maintain this system and training)		95.8	95.8	95.8	95.8	95.8	95.8	95.8	95.8	95.8	95.8
InvestmentCost	37.5										
Human resource(develop this system)	15.1										
Cell phone cable(check compliance)	2.4										
Develop cell phone application(check compliance)	20.0										
CashFlow	−37.5	−131.5	−123.5	194.5	194.5	202.5	202.5	202.5	210.5	210.5	210.5
DiscountFactor	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51	0.47	0.42	0.39
DiscountedCashFlow	−37.5	−119.5	−102.1	146.1	132.8	125.7	114.3	103.9	98.2	89.3	81.2

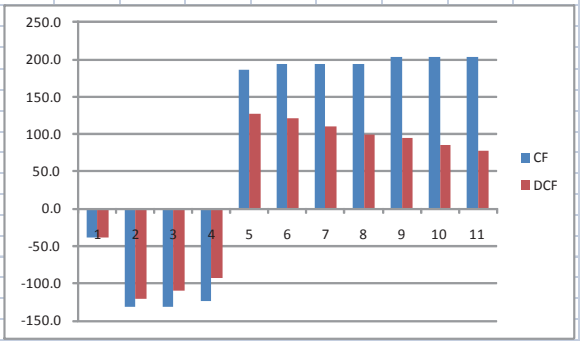
NetPresentValue	632.5	m¥
InternalRateReturn	48	%
PaybackPeriod	4	year



Financial Evaluation (Negative Scenario)

Year	0	1	2	3	4	5	6	7	8	9	10
Revenue		0.0	0.0	8.0	318.0	326.0	326.0	326.0	334.0	334.0	334.0
Decrease accident's compansation(dead)		0.0	0.0	0.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Decrease accident's compansation(injury)		0.0	0.0	8.0	8.0	16.0	16.0	16.0	24.0	24.0	24.0
Redeuce workers turnover		0.0	0.0	0.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
ServiceCost		131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5
Reward(check compliance)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Reward(group study)		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Human resource(check compliance)		21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6
Human resource(visit office)		10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Human resource(maintain this system and training)		95.8	95.8	95.8	95.8	95.8	95.8	95.8	95.8	95.8	95.8
InvestmentCost	37.5										
Human resource(develop this system)	15.1										
Cell phone cable(check compliance)	2.4										
Develop cell phone application(check compliance)	20.0										
CashFlow	−37.5	−131.5	−131.5	−123.5	186.5	194.5	194.5	194.5	202.5	202.5	202.5
DiscountFactor	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51	0.47	0.42	0.39
DiscountedCashFlow	−37.5	−119.5	−108.7	−92.8	127.4	120.8	109.8	99.8	94.5	85.9	78.1

NetPresentValue	357.7	m¥
InternalRateReturn	27	%
PaybackPeriod	6	year



ANNEX L Scorecarding, DOE (Scorecarding)

-Project Objective (Big Y)
Improving awareness level

-Objective Measures
High Compliance rate

-Control Factors (X's)
What can you control?
Rewards frequency
Reward calculation method
Reward distribution

-Noise Factors (V's)
Unfair judgment
Maintenance worker condition

-How can you conduct experiments with your prototypes
Questionnaire to maintenance worker.

Scorecarding, DOE (Result of DOE)

No	Rewards frequency	Reward calculation method	Reward distribution	Vote
1	F1	S1	D1	6
2	F1	S1	D2	1
3	F1	S2	D1	3
4	F1	S2	D2	0
5	F2	S1	D1	3
6	F2	S1	D2	2
7	F2	S2	D1	2
8	F2	S2	D2	1

Vote data: Toshiba EV.LTD, Oct 2010

F1 Once a year
F2 Twice a year
S1 Within high rank of observance rate the fifth place
S2 Observance rate 95% or more
D1 Unit of office
D2 Individual unit

main effect of manufacturer:
{(V2-V1)+(V4-V3)+(V6-V5)+(V8-V7)}/4 =-2.5

Group 6’s Final Presentation Slides

ALPS' Final Presentation

Theme13
Mechanism of industrial accident zero making(Toshiba Elevator)

2010/11/19

Group6

M1	Nagano Yuta
M1	Yamada Junji
M1	Loultiti Ayyoub
M1	Kawamura Tomoyuki
M1	Motoyama Kensei

Agenda

1. Background & Problem Statement
2. Final Solution
3. Business Case & Future recommendations

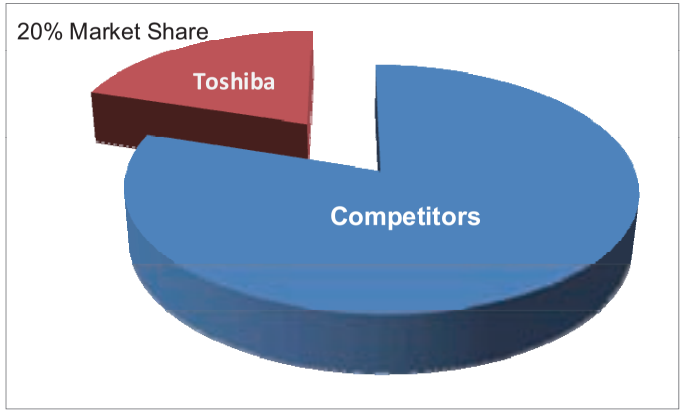
1. Background & Problem Statement

40 accidents/ year in the Elevator industry (Including 5 deadly)

1. Background & Problem Statement

9 accidents/ year at Toshiba Elevator (Including 1 deadly)

1. Background & Problem Statement



Average number of accidents on a Market Share basis

1. Background & Problem Statement

- **Impact:**
  - Compensation fees: 290 M ¥ / year
  - Negative impact on company image and workers motivation
- **Goal:**
  - Decrease Number of Accidents

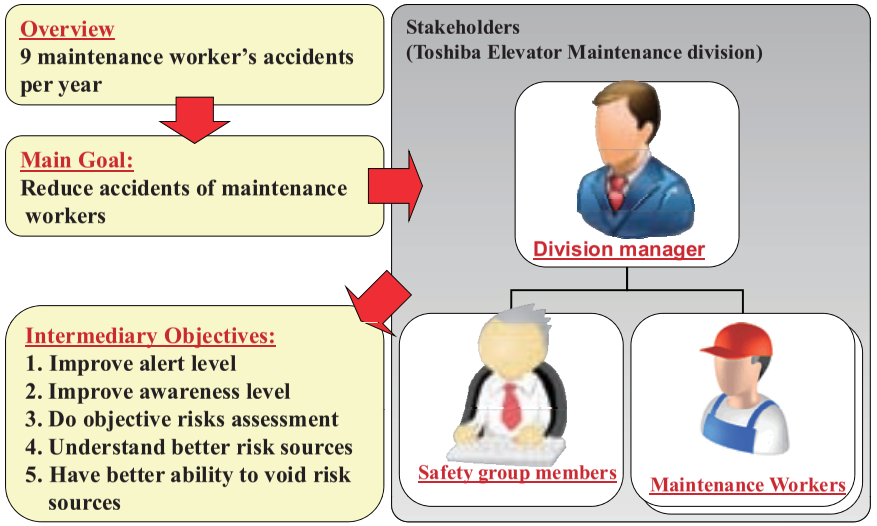
1. Background & Problem Statement

Major Causes:

1.Human errors

2.Facilities and Work environment

1. Background & Problem Statement



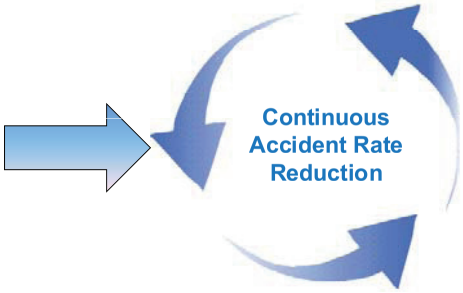
2. Final Solution

1.Sharing new solutions and accidents info system element

2. Branch manager visit to branch offices system element

3.Checking compliance and reward system element

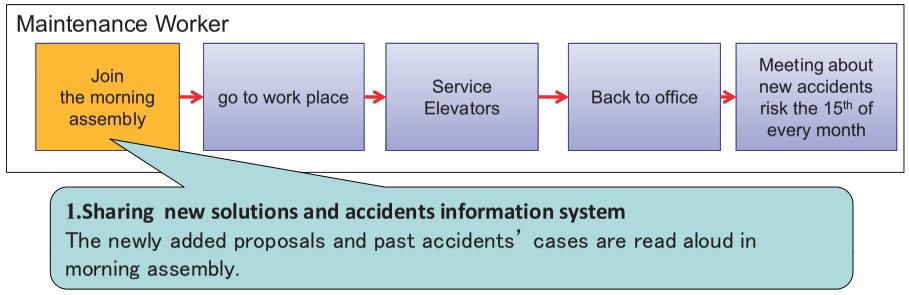
4.Group study and reward system element



2. Final Solution (1st System Element)

1.Sharing new solutions and accidents info system element

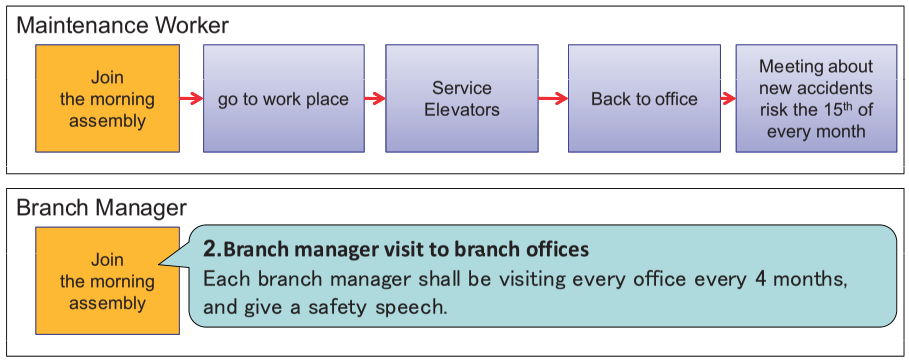
2. Final Solution (1st System Element)



2. Final Solution (2nd System Element)

2. Branch manager visit to branch offices system element

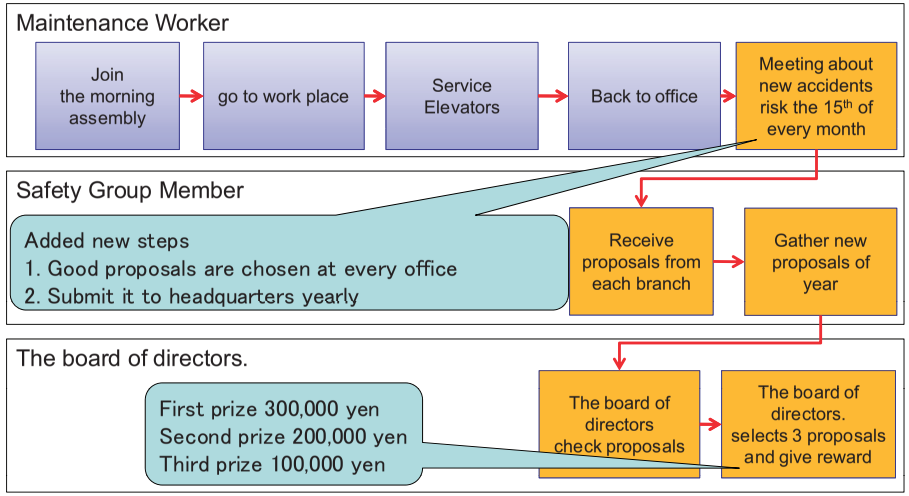
2. Final Solution (2nd System Element)



2. Final Solution (3th System Element)

3.Group study and reward system element

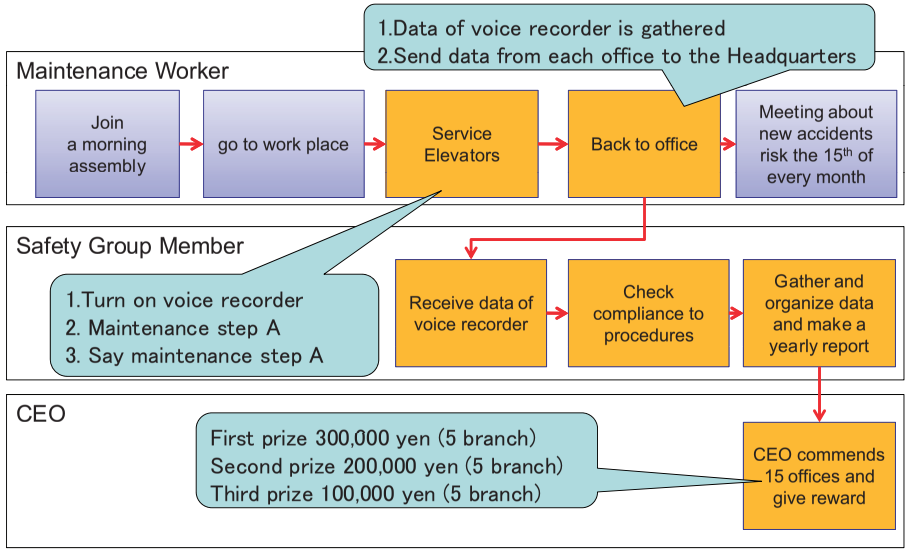
2. Final Solution (3rd System Element)



2. Final Solution (4rd System Element)

4.Checking compliance and reward system element

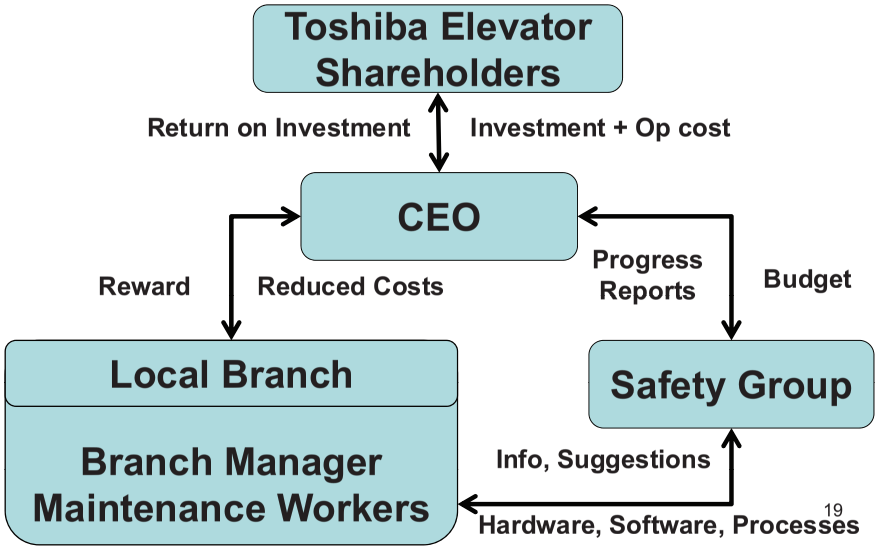
2. Final Solution (4th System Element)



2. Final Solution

- Promotion Video

3. Business case (Business Model)



3. Business case

- Revenues
  - Reduced Compensations from Deadly Accidents
  - Reduced Compensations from Other Accidents
  - Reduced Workers Turnover

3. Business case

- Operating Costs
  - Rewards & Bonuses
  - Human Resources: Additional Labor Hours
- Investment Costs
  - HR: Initial system development and deployment
  - Hardware
  - Software

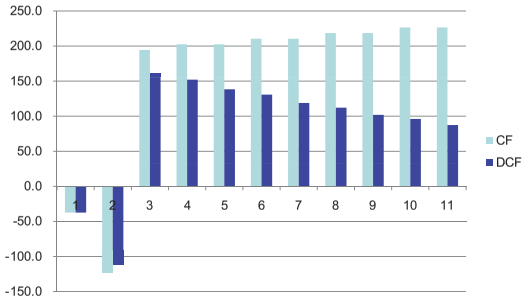
3. Business case

- 3 Cash Flow Scenarios
  - High Return
  - Average Return → Most Likely Return
  - Low Return

3 Point Estimation

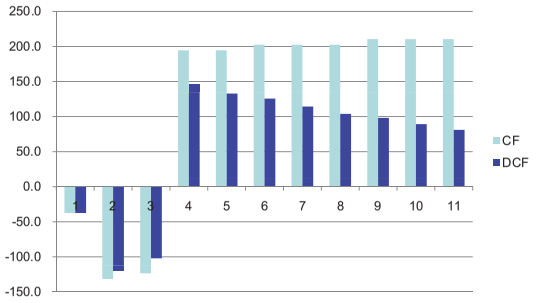
3. Business case

- High Return Scenarios
  - NPV
    948 M¥
  - IRR
    100%
  - Pay Back
    2 Years



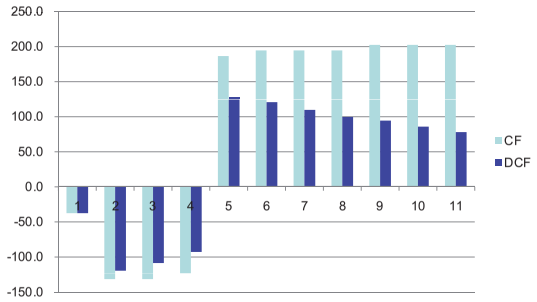
3. Business case

- Average Return Scenarios
  - NPV
    633 M¥
  - IRR
    48%
  - Pay Back
    4 Years



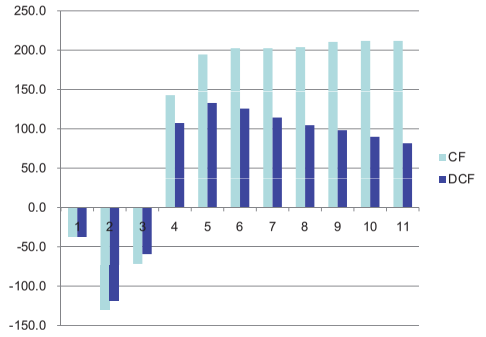
3. Business case

- Low Return Scenarios
  - NPV
    358 M¥
  - IRR
    27%
  - Pay Back
    6 Years



3. Business case

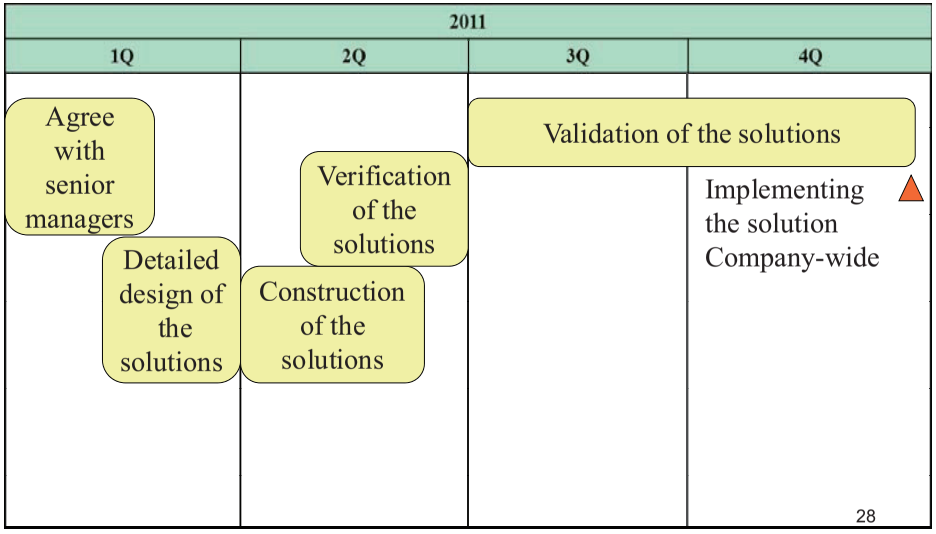
- Most likely Return
  - NPV
    639 M¥
  - IRR
    50%
  - Pay Back
    4 Years



3. Future Recommendations

- Need a Contingency Plan (2 major risks)
  - Resistance to Change
  - Possibility of Insufficient Effect

3. Future Recommendations



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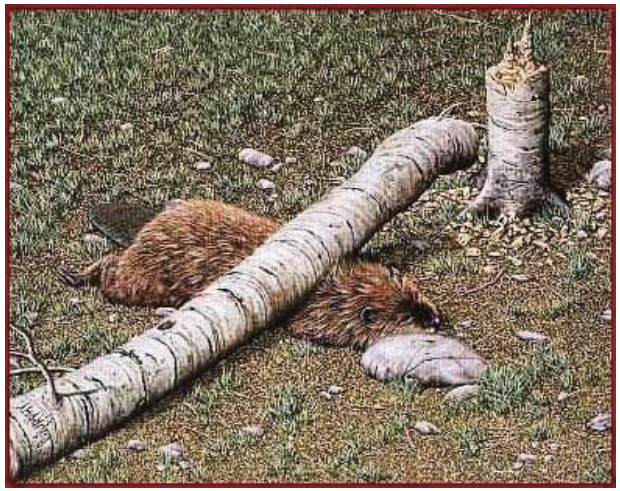

29

安全

30

SDM
System Design and Management

END

東芝エレベータ株式会社

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