

Why-why analysis with five Layers methodology for IT Projects
-Recommendation for both members and their organizations to solve problems together-

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Abstract

Why-Why analysis is known as a quality control tool to inquire the root cause of a problem. "5-Why" analysis in Toyota Production System (TPS) is a kind of Why-Why analysis. Though "5-Why" analysis is effectively used in factories adopted TPS, it is not effectively used in the others, especially IT Projects. I systematized the five layers methodology to adapt "5-Why" analysis for IT projects. The methodology is based on experience around TPS factories, "Toyota Production System" written by Taichi Oono who is a founder of TPS and the other books about TPS.

Every IT project has a lot of small problems though every Project Manager (PM) and team member (TM) has been working hard. They have many causes for a problem but don't have all causes. A part of causes must be resolved by the other stakeholders. It is necessary that not only to make PM and TMs work harder but also to make measures of each stakeholder clear after the analysis for the small problem. The measures are based on their philosophy. Everyone learns how to implement their philosophy together from the small problem.

This paper is based on TPS Working Group in IT-SIG of Project Management Association of Japan (PMAJ) has researched "5-Why" analysis in focusing on human skills for 7 years.

1. Introduction

The "5-Why" analysis in TPS is a methodology to inquire the root cause behind surface causes of a problem. The root cause guides us to establish measures to protect organizations including the project from the same problems in the future. (See to Reference [1] and [6]).

1.1 "5-Why" analysis easy?

If "5-Why" analysis is easy, anyone would use effectively it anywhere. Actually, "5-Why" analysis is so difficult that many people misunderstand it as following;

.After anyone asks "Why" 5 times, the person can get the root cause. : Only experts can do it.

.Everyone traces back the standards process with "Why". : The root cause doesn't exist in only the beginning process.

People in projects have to research "5-Why" analysis transcending the difference.

1.2 Deference between projects and factories

The following are three common points between projects and factories, "A person works hard", "A person makes products or deliverables" and "It is job in the company". However, there are three differences between projects and factories as follows;

.Repeated: Products in factories are repeated. But Products in projects are unique.

. Detail: Factories have detailed work standards with levels of seconds or minuets. But projects have sequences of work or work standards with levels of hours.

. Observation: People in factories can observe the same repeated action as the person did after the problem occurred. But People in projects can't observe the same action as the person did after the problem occurred since the product of the project is unique.

People in projects have to apply "5-Why" analysis transcending the difference.

1.3 Unique actions and repeated actions in IT projects

Actions in IT projects are unique since projects are unique. Is no repeated action in IT projects? There are some things to be used repeatedly in IT projects as following;

- .Skills and experiences of team members impact on quality of IT projects.
 - .Standards and norm from organizations are necessary to complete the objectives of the project.
 - .Stakeholders is indispensable for IT projects since projects come from requests of several people.
- Therefore, repeated actions in IT projects exist as following;
- .To decide how the person applies skills, knowhow and experiences to the project.
 - .To obey the norm: Standards, Norm and Systems.
 - .Contribution of stakeholders.

“5-Why” analysis in IT projects focuses on not unique but repeated actions like one in factories.

1.4 Three phases for “5-why” analysis in IT projects

I systematized the five layers methodology to adapt "5-Why" analysis for IT projects transcending three different points; Detail, observation and repeated. The methodology is based on experience around TPS factories, “Toyota Production System” written by Taichi Oono who is a founder of TPS and the other books.

- . Phase1: Problem identification phase (See to 2.)
- . Phase 2: “Five Why’s” phase [Phase 2-1: Five questions (See to 3.), Phase 2-2: Five layers (See to 4.)
- . Phase3: root cause verification (See to 5.)

1.5 Roles for analysis

There are three roles in “5-Why” analysis.

- .Asker: The person must have the skills for the “5-Why” described in this paper, but don’t need the technical skills around the problem;
- .Executer (described as “I” in this paper): “I” acted around the problems at the time and at the place. “I” must have been in trouble and then “I” show the actual honestly.
- . Expert (If need): The person has the technical skills around the problem and proposes ideal actions without protest.

At first, the asker separates the problem from the executer “I”. Then, everyone is even against the problem. Everyone focuses on the process or action to the problem. Keep everyone respectful, comprehensive and persistent! In other words, “Never blame”, “Never be partial” and “Never give up”.

2. Phase1: Problem identification phase

2.1 No problem is problem

Everyone must have at least a problem because everyone is not perfect and everyone must progress.

If the problem has been resolved, the person who had the problem must search another problem.

Executer “I” identify the smallest problem with the following three conditions;

- . The problem is in the organization where “I” work.
- . “I” am in trouble because of the problem.
- . “I” can concretely explain the details of the problem.

Sometimes a problem includes some situations. Executer “I” choose only one of the situations. For example, executer “I” choose the only one situation "The 45th bug in the program#123" among the many situations of the problem “Those computer programs have too many bugs in testing process”.

2.2 Division of the problem

A problem in IT projects is bigger than a problem in factories since the standards in factories are level of seconds as the above1.2. executer “I” divide the problem to several parts and select one of them by guts

feeling of executer “I” own self. “I” repeat a-few-times division and selection. For example;

1st division of “The 45th bug in the program#123”; Design – Making – Testing => Select Making

2nd division of “Making”; Programming – The first testing program – updating program – The final testing program => Select The final testing program

3rd division of “Final testing program”; Selecting testing items – Testing – Audit the result
=> Selecting testing items

The problem expresses “The testing items around program#123 with the 45th bug for final testing program in making process are inappropriate”.

2.3 Action expression

Appropriate expression of the problem is important for effective analysis. We focus not on the situation of the problem, but on the action around the problem.

(1) Situational expression

In many cases of inappropriate expression of the problem, the situation around the problem is expressed as a problem. The expression is called “situation expression” in this paper. Situation expression consists of the item as the subject and the verb for the situation.

For example;

- . Requirement is unclear in the design process. : Subject=“Requirement” + Verb=“to be unclear”
- . Quality is bad in the programming process. : Subject=“Quality” + Verb=“to be bad”
- . Progress is late in the testing process. : Subject=“Progress” + Verb=“to be late”

(2) Action expression

A founder of TOYOTA MOTOR CORPORATION, Kiichiro Toyoda said in 1936; “TOYOTA must bear responsibility for every car released by TOYOTA. It means including all parts. Circumstance to ban everyone in TOYOTA from pinning the guilt on the other is the most significant thing to acquire self confidence for our own products.” This means that everyone must bear responsibility for his/her own job and that everyone must solve a problem as his/her own. (See to reference [14])

The focus of the expression is action around the situation of the problem since executer “I” can change the action. The expression is called “action expression” in this paper. Action expression consists of “I” as subject and verb for action. For example against the examples for situation expression;

- . “I” designed as requirement was unclear. : Subject=“I” + Verb=“designed”
- . “I” was programming as quality was bad. : Subject=“I” + Verb=“was programming”
- . “I” tested as progress was late. : Subject=“I” + Verb=“tested”

The action expression of the problem must be as detailed and definite as possible. (See to reference [13]) “The testing items around program#123 with the 45th bug for final testing program in making process are inappropriate”.

The action expression also helps executer “I” feel regret and disappointment as in; executer “I” won’t do such a thing again’. The feeling and the emotion of executer “I” become force driving the “5-Why” analysis like “Kaizen”. (See to reference [2])

3. Phase 2-1 Five questions in the Five Why’s phase

3.1 Five questions - 4W1H

Askers ask executers to research the actual. Askers must keep their attitudes pure as following;

- .Discuss with only information shown by executers (Without prejudices)
- .Focus on the action (Askers experienced the action as if they had been the executer “I” own.)
- .Problems become opportunities. (There is a Learning space. There is Not a court BUT a laboratory.)

3.2 Five questions - 4W1H

The most important skills for askers are question skills. Askers get the detailed information around the problem from all in respect each other. The analyst must not behave to ask “Why did you do that?”. (See to reference [9] and [10]) The asker simulates to do the same action around the problem depending on the information. It is virtual action like “Genchi Genbutsu” in TPS words. (See to reference [2]) Therefore, Mutually Exclusive Collectively Exhaustive (MECE) questions are necessary to get enough information.

We have always used 5W1H - Who, What, Where, When, Why and How - as MECE questions in reporting on business. We define five questions as 4W1H except “Why” from 5W1H. (See to Table 1)

Table1: Questions and answer of 4W1H

Questions	Answers	
4W1H	A part of speech	Kinds
Who (people)	Noun (Fixed)	Proper noun (skills/roles)
What (items)	Noun (Fixed)	Inputs, tools, manuals, criteria, (invisible) knowledge & memories
Where (Place)	Noun (Fixed)	Place, system environment, conference
When (time)	Noun	Date, time, period
How (method)	Adverb	Method, procedure, attitude

3.3 Actual action (as did), Ideal action (to do essentially) and Why

The actual action as did is unique. Only the executers who acted around a problem at that place answer against the 4W1H questions since only they know the actual action.

If the executers were in the same situation as the problem, they would do the same inappropriate action. All search for the ideal action to be essential in 4W1H around the problem in order to avoid it. They propose the ideal action as long as human can do and provide without any constraint like cost, schedule, quality or so on. Afterwards, they all agree that the ideal action is necessary and sufficient.

The Type I analysts ask the reason why the person do with the actual action in 4W1H deferent from the ideal action.

3.4 4W1H format

We have developed the original 4W1H format for everyone to make asking the questions and analyzing easier. (See to Reference [11]) The 4W1H format consists of “Why” at the center and 4W1H blocks around “Why” for MECE. The 4W1H block is composed of five columns. In the four columns of them a question and an answer for both the actual action and the ideal action are described. The last column is OK/NG column. It is marked OK when the answer of the actual action is equal to the answer of the ideal action or is marked NG when the answer of the actual action is different from the answer of the ideal action is described. The 4W1Hs with NG are candidates for subsequent “Why”. (See to Figure 1)

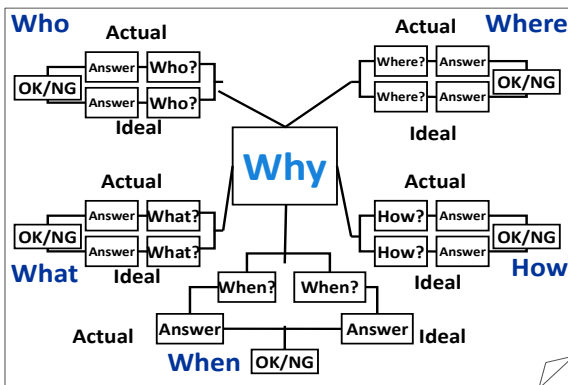


Figure1: 4W1H format

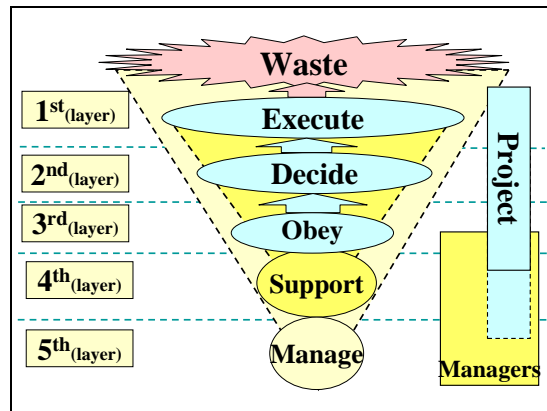


Figure 2: Five layers model

4. Five layers model

Essentially, executers freely choose subsequent “Why” in the “5-Why” analysis. But, the freedom might be an obstruction for analysis.

Mr. Taichi Oono who is an originator for TPS said; ‘One “Why” makes people answer their own question about the essence of both their motivation to work and the benefit of company as going concern’. (See to Reference [1]) Practitioners said; ‘Workers in factories have to analyze a problem until three times and then leaders or managers have to analyze a problem at 4th and 5th “Why”’. (See to Reference[8])

We define the five layers model to choose subsequent “Why” without straying off course and to drill deep down to the cause of the problem. (See to Figure 3.)

We describe definition and how to choose subsequent “Why” with each layer. (See to reference [15])

4.1 1st layer: Execute

We understand the action in the actual action at that time. We make “Why” from the action expression in detail using executer “I” as subject and “execute” as verb. [See to 2.3. Action expression]

‘Why did “I” execute the in appropriate selection of the testing items around program#123 with the 45th bug for final testing program in making process?’

‘Because “I” chose the only testing items directly related with the revise about the bug found in the first testing program after “I” excluded the testing items to confirm the influence from the revise.’

4.2 2nd layer: Decide

Executer chooses one of the most interesting candidates for subsequent “Why”, which are marked NG in the OK/NG column on 4W1H format of the 1st layer.

Asking “Why” about “execute” at 2nd layer doesn’t mean to drill deep down to the cause of the problem. The asker focuses on the time before “I” executed. “I” thought “I” could execute while avoiding the problem. But executer “I” couldn’t avoid the problem. The decision to be able to complete the action as avoiding the problem was wrong. In actual action, the decision around the most interesting NG column in the 1st layer may be the most incorrect. The analysts ask the reason of the wrong decision. The following shows the 2nd “Why” example after “How” of 4W1H in the 1st “Why”.

‘Why had “I” decided to be able to execute the correct selection though “I” excluded the testing items to confirm the influence from the revise?’

‘Because “I” had a lot of successful experience though “I” excluded the testing items to confirm the influence from the revise.’

4.3 3rd layer: Obey

There is norm in every IT project. The norm includes rules, project plans, management systems, technical standards or so on. The norm is provided or approved by organizations related to the project and the norm has the aim to achieve a leading vision and philosophy for the organizations.

Therefore, decision in projects must obey the norm. In addition, organizations can defend projects from the external forces of organizations since the projects obey the norm. There are three cases depending on the situation or maturity of projects and norm.

In first case, verb is “obey”. This is when the norm to avoid a wrong decision exist and “I” knew the norm.

In second case, verb is “know”. This is when “I” didn’t know the norm to avoid wrong decision even though the norm exists. Executer “I” must know the norm before “I” obey the norm. “I” couldn’t obey the norm if “I” didn’t know the norm. Then, analysts focus on not “obey” but on “know”.

In third case, verb is “propose”. This is when there is no rule to avoid a wrong decision.

People using the norm must continuously improve the norm by themselves because any norm is not perfect. The project must propose new norm to avoid a wrong decision to organizations. The project must get approval from organizations at that time.

The following shows three cases of the 3rd “Why” example after “What” of 4W1H in the 2nd “Why”.

- i) “obey”; the project had the appropriate rule of regression testing. ‘Why didn’t “I” obey the rule?’
‘Because executer “I” couldn’t understand effect of the rule nor identify items to obey enough.’
- ii) “know”; executer “I” didn’t know the appropriate rule of regression testing. ‘Why didn’t “I” know the norm?’
‘Because “I” haven’t had an opportunity to study the rule.’
- iii) “propose”; the project didn’t have the appropriate rule of regression testing.
‘Why didn’t “I” propose the revise of the rule?’
‘Because “I” didn’t have enough of an opportunity to propose it.’

4.4 4th layer: Support

It is necessary, but difficult, for everyone in projects to obey all of the norm in organizations perfectly.

Projects have to cooperate with organizations. (See to Reference [12])

Organizations have responsibility for customers and society. Therefore, organizations must not only show the norm of projects, but must also provide support to obey the norm of the projects. (See to Reference [4])

and [9]) It is not enough to say “You must obey the norm of the projects”. The following are four types for support from managers;

- i) Education: Make “I” understand purpose and effect of the norm and have motivation to obey the norm?
- ii) Reminder: Remind “I” to obey the norm at the appropriate time.
- iii) Verification: Verify procedures for “I” to obey the norm in the project.
- iv) Follow-up: Follow up with the project to obey the norm together according to the skills of the members.

Executer “I” must get support from managers who are the closest person(s) to the projects in organizations to obey or know the norm or propose new norm.

The following shows the 4th “Why” example after the 3rd “Why”.

Only “I” couldn’t obey the rule nor get enough opportunity to study the rule or propose the points to revise the rule.

‘Why didn’t “I” get support from managers such as education, reminders, verification or follow-up before “I” had to obey/know the rule or propose the points?’

‘Because managers and “I” had believed in successful experience around “I” too much.’

4.5 5th layer: Manage

Organizations establish the norm for projects to obey depending on their own purpose, direction and philosophy. What projects always obey all norms is necessary for organizations to shape their own purpose, direction and philosophy. (See to Reference [3] and [7].) Projects can contribute to obey all norms toward organizations. (See to Reference [5].)

It is necessary, but difficult, that everyone in projects obeys all norms perfectly and that managers have supported the project perfectly. Organizations must manage to maintain circumstances where projects and managers have done these perfectly.

The project has risks for organizations to manage projects and managers in detail from above 4th layers of analysis. Then, executer “I” must recommend the risks to be better and better. Executer “I” didn’t get enough support from managers to obey/know the rule or propose the points. Executer “I” could recommend how the organizations could identify the risks.

The following shows the 5th “Why” example after the 4th “Why”.

‘Why didn’t “I” have recommendation to the organizations?’

‘Because executer “I” thought that the boss and the sponsor identified the risks from the monthly reports with too few problems from projects.’

Therefore, “I” will ask for the boss and the sponsor to confirm that the number of problems in project is too few on the report. Managers and “I” have always maintained to avoid the failures as obeying the norm with the boss and the sponsor together.

4.6 Selection of NG and the norm

Executer chooses one of NGs in each layer and progresses the layer. After executer analyzes why in 3rd layer, executer confirm that the norm identified in 3rd layer is effective for the other NGs in 1st and 2nd layer. In many cases, the measures which executer obeys the norm are effective for almost all NGs because the norm covers not only one NG but also many NG linked the NG of the action. Executer continues to analyze Each NG which the norm doesn’t cover until executer analyzes all NG.

5. Root cause verification

Many Managers usually believe in executer “I” resolve all causes. But only executer “I” can’t resolve all causes. Therefore, all stakeholders must analyze their own problem linking to the problem.

5.1 Related Why-why analysis for the other stakeholders

A part of the causes must be resolved by the other stakeholders. (See to Figure 3.)

At first, the managers have to identify small problems which are not enough just to support executer “I” through the analysis of the executer “I”. “I” of the managers must analyze the problems with five layers.

Next, organization’s administrators have to identify small problems which are not enough just to support the managers who must support the executer “I” in the analysis of the organization’s administrators. “I” of the organization’s administrators must analyze the problems with five layers.

Finally, this relation has reached the executives including the CEO or the president. “I” of them must analyze the problems with five layers because they have the responsibility of the organization including the executer “I”, the manager and the organization’s administrator with accountability of the problem.

The following shows the “Why” example for the manager, organization’s administrator and the executives after the 3rd “Why” example.

‘Why didn’t “I” of the manager give the executer “I” enough support to avoid the problem?’.

‘Why didn’t “I” of the organization’s administrator manage executer “I” and the needed support from managers?’

‘Why didn’t “I” of the executives manage the organization’s administrator or the manager support which they needed in order to support the others?’

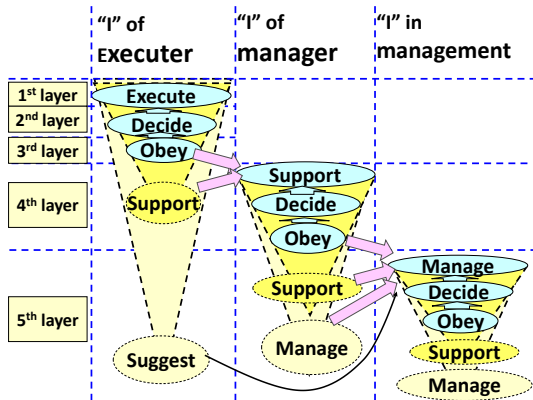


Figure3: Relation of “I”

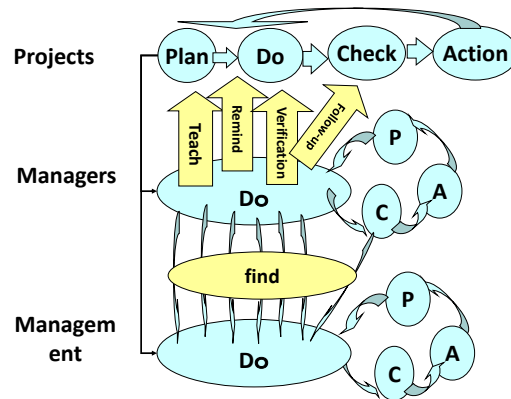


Figure 4: Linked measures

5.2 Relation from projects to organization

Every “I” against each organization’s layers can establish each measure according to each “5-why” analysis. Executers must identify measures against all causes and plan to do the measures. After they have done the measures they check the results and effectiveness and act to revise or plan the measures. They execute Plan-Do-Check-Act cycle (PDCA cycle) continuously.

The measure of the managers has to support PDCA cycle of the PM and the TMs. The manager establishes PDCA cycle for the measure and executes it continuously. A PDCA cycle links to the Do of the PDCA on the next layer. Finally, it reaches the PDCA of the executives and top management must govern their PDCA cycle and also establish PDCA cycle to do the governance. (See to Figure 4.)

6. Conclusions

“5-Why” analysis leads the executer and everyone in the organization to avoid the same failure. At the same time, “5-Why” provides the space to learn how to implement the philosophy of the organization.

Persons who analyze those small problems have learned each new PDCA cycles through the analysis.

The measure can cover not only the small problem but also the other small problem related with the norm.

Therefore, the measures are effective for many people in every layer of organization. Everyone has learned each new PDCA cycles. It means learning organization.

6.1 Philosophy in TPS tools

Toyota Way 2001 is a philosophy of Toyota Motor Corporation. TPS tools originate Toyota Way 2001. The following examples link to “Respect” and “Team work” in Toyota Way 2001.

i) *Poka-Yoke: Tools avoid mistakes* (See to Reference [6] and [7]).

The *Poka-Yoke* makes the probability and influence of a mistake decline while understanding that humans make mistakes. It is based on “Respect” of Toyota Way 2001.

ii) *Hoshitori-Hyou: Figure to share skills of everyone* (See to Reference [6]).

The *Hoshitori-Hyou* on a wall makes everyone understand the diversity. It is based on “Respect” of Toyota Way 2001.

iii) *Andon* as a TPS tool: System to call for the leader. (See to Reference [6]).

The *Andon* makes the trouble resolved with the worker and leader soon and keeps the worker challenge high performance based on a good condition with quality first. Because the worker can get supports from his/her leader in a bad condition. It is based on “Team work” of Toyota Way 2001.

“5-Why” analysis must be based on Toyota Way 2001 since TPS tools are the measure of “5-Why” analysis.

6.2 Learning organization

Projects with accountability for the problem and organizations with responsibility for the problem do “5-Why” analysis for the small problem.

Executers do the measures with their maximum power. Organizations support and manage the actions.

Everyone learns how to implement the philosophy of organizations from a small problem through “5-Why” analysis for based on the philosophy.

Everyone has been continuously improving the actions like Kaizen. It's a journey.

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