

How the Metacognition Skills Work in Decision Making Processes of the Project

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Abstract--A project is the continuous effort of various decision makings such as goal setting, WBS creation, resource acquisition, human resource allocation, and countermeasure against risk. This study focuses on how we use 'Metacognition' which is a "Knowing about Knowing" skill in order to improve such decision making in the project¹.

I. INTRODUCTION

Metacognition is the thinking activities which controls our cognition, attitude, and action in problem solving and decision making from higher dimensions as shown in Figure 1 [12].

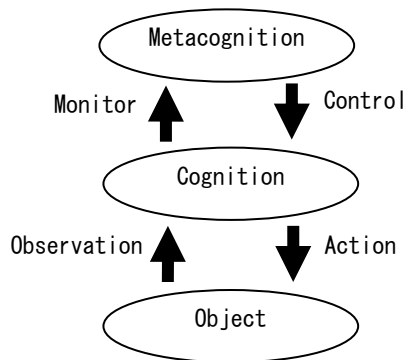


Figure 1 Metacognition

We usually don't pay attention how we solve the problem or make decision in the project. It would be necessary to have some framework to navigate our metacognition level of monitor and control in mind. This study introduces the following five comparative axes of thinking as the additional framework to the existing representational model as shown in Figure 2 which is known in the previous study [7].

1. Deductive and Inductive
2. Diverge and Converge
3. Subjective and Objective
4. Cause and Result
5. Introspect and Extrospect

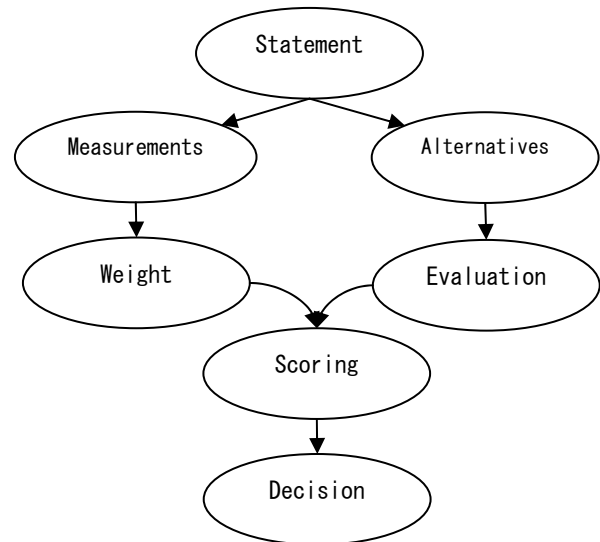


Figure 2 Decision Making Process Model

II. DEDUCTIVE AND INDUCTIVE

Deductive is a way of inference by means of experiential tacit knowledge called 'Heuristics'. It can be applied in decision making both consciously and spontaneously in a moment but may not always be effective according to the context [6]. Habu, who is the top professional shogi player, says this below [4].

"All the experiences in the past are memorized in an unconscious area of the brain and they come up automatically and 70% of intuition results in a correct decision."

Heuristics are precious tacit knowledge based on our experiences, which is based on the 'past' fact, but it is also true that the decision making using just a hunch may cause a bad result. Shogi player uses both top-down approach with heuristics and bottom-up approach with context, which is based on the 'current' fact, to decide the move.

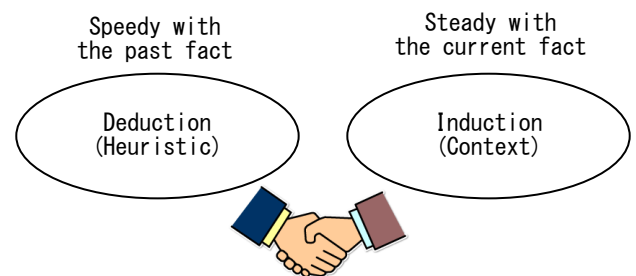


Figure 3 Complementary relation of Deduction & Induction

¹ Decision making is tightly related to the emotional feeling as well as the intellectual thinking; however this study focuses on the dry side of our decision rather than wet side.

Damasio demonstrated the existence of gut feeling by the following card game [3].

- Examinees win or lose money according to the draw from multiple packs.
- A certain pack had worse cards than others.
- Examinees normally recognized what was happening after about fifty draws
- But examinees unconsciously avoided drawing from that pack after the 10th draw or so
- This unconscious intuition can be detected through perspiration and heart beat.

Damasio called this signal "the Somatic Marker". Decisions in sports, car driving or shogi matches relies heavily on such intuition which cannot be explained logically. It is sometimes difficult to explain why some project measurement is more important than the other, even if it can be assured with full confidence.

But there can also be a lot of fallacy in intuitive decision making which is called 'Bias'. Kahneman and Tversky introduced the cognitive biases which cause the gap between intuition and economical rationale in their prospect theory [9]. Most of the improper diagnosis by medical doctors or false accusation in the law court results from lack of questioning or investigation due to prejudices.

There are also the examples of bias in an IT project as shown below. An analytical approach takes longer time to apply but it is necessary to avoid fallacy due to inevitable human nature.

- Over-investment in the security system by frequent reports of privacy protection policy violation in mass media.
- Give more priority to the requirement from the person whom meets with frequently than the final decision maker.
- Give more priority to the quantified values such as time and cost than the qualitative values such as quality and security.
- Underestimate the probability of unclear risk.
- Neglect the risk by the implementation of new ideas
- Give more priority to the current problem/benefit than the future risk/benefit.
- Jump to the idea based on the unverified naïve theory
- Ball park estimate will be the upper limit of price negotiation. (Anchoring)
- Keep going the hopeless project trying to recover from the fallacy. (Sunk cost effect)

When we recognize uncertain information like illegible hand-writing, we apply heuristic to guess with top-down approach. On the contrary, heuristics also can be prejudice and restrict learning from experiences. When one recognizes the anomaly which cannot be explained with existing heuristics, the information will be spontaneously selected, complimented and edited to keep consistency in one's

memory [1]. It would be a pitfall for the experienced project managers who have many heuristics. All decision makings in the project, such as time/cost estimations, identification of risk, cause of the problems and solutions, heavily rely on the past experiences. But every heuristics should be verified before applying to each specific case.

III. DIVERGE AND CONVERGE

Thinking processes can also be classified as Diverge and Converge. Diverge is creativity of the ideas. In a project, we need to come up with many ideas such as project measurements, probable cause and result, and possible solutions. It is natural for human being to think within the existing frame because of the association between synapses in the brain. So we need to switch context consciously by using framework to get wide range of ideas in a good balance. Table 1 shows several frameworks used for context switching in a various situations. 4P can be used for product sales, 4M is for manufacturing, 3C and BSC are for business management and QCD+SE is for project management.

TABLE 1 FRAMEWORKS USED FOR CONTEXT SWITCHING

Balanced Score Card	Accounting, Customer, Process, Human resource
4P	Product, Promotion, Place, Price
4M	Man, Machine, Material, Method
3C	Company, Customer, Competitor
QCD+SE	Quality, Cost, Delivery, Security, Environment

On the other hand, we need to have reasonable priorities to converge the alternatives according to the situations. Table 2 shows the typical examples of priorities used in the project. For example, when we choose project statement, we begin with listing-up our concerns, then converging to the appropriate theme with seriousness and urgency. And we list-up several solution ideas, then, converging to the most reasonable one with effectiveness and efficiency [10]. Another example is risk management. At first, we need to identify probable risks as much as possible, after that, choose the most severe one with seriousness and probability. And we list-up several ideas of countermeasure, and then pick the most reasonable ideas and put in to practice. In this way, decision making is an alternate process of diverge and converge.

If one use incorrect priorities for converge, decision making may go wrong. For example, if you choose a project that seem to be easy, inexpensive and instant to complete, serious and urgent issues will grow during that project and bring in more problems which have to be dealt with in the end. The longest way round is the shortest way home, which means easy and inexpensive are not proper priorities in some cases.

TABLE 2 PRIORITIES FOR NARROWING-DOWN THE IDEAS

Type of Decision	Priorities to be used
Concern to be considered	Seriousness & Urgency
Risk to be responded	Seriousness & Probability
Action to be taken	Effectiveness & Efficiency

Priority setting would be the most controversial part in group decision making. But it's very important for project to visualize the order of importance for each measurement in ordinary time, because it would be more difficult to set a good priority in emergency situations.

Priority plays an important role in the destructive innovations as well as in the alternative selections. A paradigm shifts caused from the change of priority has generated a number of destructive innovations as shown in Table 3.

TABLE 3 DESTRUCTIVE INNOVATIONS BY CHANGING PRIORITIES

Destructive Innovation	Former Priority	New Priority
Personal Computer	Performance	Price
Theory of Constraint	Cost & Utilization	Throughput
QB House ²	Service & Comfort	Time & Cost
Asahiyama Zoo	Visitors	Animals
iMac/iPod	Technology	Design
Module architecture	Design Flexibility	Custom Flexibility

In the decision making process model in Figure 2, the framework will be used to come up with project measurements and alternatives. The priority will be applied to define weight of each measurement.

IV. SUBJECTIVE AND OBJECTIVE

In PMBOK [15], a project is defined as a temporary endeavour undertaken to create a unique product, service, or result. And it is normally distinct from the daily operation. But even a checkout routine at a supermarket can be a project if it is done toward any specific goal. Thus the project is a positive effort with measurements to be achieved in a certain time frame, and project management is a support activity to make sure its intent is realized.

Autonomy and Intrinsic motivation cannot be expected without any clear vision in the project. A project manager should proactively be involved in the process to create a project statement. Every project should be initiated from someone's will to fill the gap between 'SHOULD' and 'ACTUAL'. 'ACTUAL' is always one and only, but 'SHOULD' are vary among individuals as shown in Figure 4.

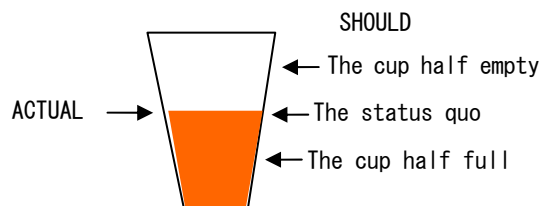


Figure 4

There are two kind of project statement representation. The one is the problem-solving, and the other is the goal-achievement. When one sees the 'ACTUAL' state from the 'SHOULD' stand point, it will be represented as problem-solving. If one sees from the opposite direction from 'ACTUAL' to 'SHOULD', it will be goal-achievement. For examples, the "Revenue Up" goal can be paraphrased as the "Revenue Low" problem. Or "Cost reduction" project may be initiated due to a "High cost" problem. The problem solving may be done by investigation of the current situation to find the real cause. On the other hand, the goal achievement will be done by estimation from the past experiences. Thus the representation of project statement may affect the approach of a project execution.

Another separation of subjective and objective in the decision making is the weight of project measurements and evaluation of alternatives. The weight of each measurement has to be defined by in-depth hearing of subjective needs from the project owner. On the other hand, the evaluation of each alternative has to be done objectively based on the factual information to get deep understanding of every stakeholder.

It should take a long time to figure out one's real needs and priorities to set an appropriate measurement and weight. The conflict may occur in evaluation process to get to the mutual consensus as well. There are several previous studies that confirm the effectiveness of the Consensual Conflict Resolution (CCR) for the quality of group decisions [2] [5] [8] [14]. CCR uses six instructions summarized below:

- Present your position lucidly
- Avoid win-lose stalemates
- Withstand pressures to yield
- Avoid voting, averaging, bargaining, coin flipping and try to share more information
- View conflict as natural and helpful not as hindrance
- View initial agreement as suspect and think beyond obvious

Every difference in recognition comes from the personal specific experiences of success or failure. If such knowledge can be shared in the team, decision making would be much better than the one without confrontations. If there is any unknown, ambiguous or inconsistent matter in the customer's requirement, you should stick to that point until full agreement is reached, instead of jumping to premature solution.

V. CAUSE AND RESULT

After defining the project statement according to the gap between 'SHOULD' and 'ACTUAL', a project manager should know the cause-result relation network to come up with the alternatives as shown in Table 4.

² 10 minutes barber shop near the railway stations.

TABLE 4 CAUSE-RESULT RELATION NETWORK

Question	Cause	Statement	Result
HOW	Implementing Action		Accelerative Action
WHY	Driving/Blocking Factors	Goal/Problem	Value/Harm Factors
HOW	Preventive Action		Adaptive Action

One can use two kind of ‘WHY’ questions for this attribution analysis. If the statement is “Revenue Up”, one will ask “Why revenue is low?” to know the cause of the statement. Another question will be “Why revenue should be up?” to know the intention of the statement. Thus a ‘WHY’ question is used for clarification of the cause-result relations around the statement. However it is not easy to find the cause and result if one doesn’t have enough experiences in the domain. Information gathering and the hypothesis verification would be the key for this cause-result finding process. Even if one has a lot of heuristics in the domain, enough inspection and verification should be done not to fall into the pitfall of bias.

After the identification of cause and result of the project statement, then one can use ‘HOW’ question to know the way to change the current situation. The goal implementing action and the problem preventive action can be taken from the driving/blocking factors of the statement, and the goal accelerative action and problem adaptive action can be taken from the value/harm factors.

For the revenue up example, market, share and price would be the causal factors, so one can think of the ideas such as “demand creation” to grow market or “shorter lead time than competitors” to get more share as implementing actions. If “shareholder satisfaction” is one of consequential factors of revenue up, “dividend distribution” might also be necessary as an accelerative action.

If the statement was the problem of “A PC having hard disk crash”, the possible cause can be “A computer virus”, and a preventive action of “Installing anti-virus software” will reduce possibility of this problem. The consequence of this problem is “losing important data”, then “backup data” as an adaptive action will reduce the severity of this problem.

Thus the cause-result relation can be used to create alternatives to implement the project statement or avoid the potential problems.

VI. INTROSPECT AND EXTROSPECT

Systems approach can be classified into Introspect & Extrospect as shown in Table 5 [13]. Introspect is a breakdown approach to know the inner structure of the system. Extrospect is a relative approach to know the outer environment of the system. “What will be if the snows melt?” The answer to this riddle of introspect type will be “Water”, meanwhile the answer of extrospect type may be “Spring”.

TABLE 5 INTROSPECT & EXTROSPECT

	Introspect	Extrospect
Orientation	Breakdown of Inner Structure	Relation with Outer Environment
Application	Natural Science	Social Science
Approach	Understand the whole with parts	Understand the parts with whole
Ex.1:Tree	Root, Trunk, Branch, Leaf	Weather, Soil, Species
Ex.2: Sentence	Word, Character	Book category, Author
Ex.3: Human	Organ, Cell, Anatomy	Life style, Social community

A person with introspective type has problem-solving skills like software debug but lacks the extrospective view such as value proposition of the project. Before initiation of the project, the project manager should confirm the business expectation of the IT system with extrospective point of view

as well as the implementation details like function, cost and delivery date. IT project manager also need to know the inter-relation between a set of systems which they say IT ecosystem.

TABLE 6 TYPES OF IT SYSTEM

Type	Purpose	Examples
Mission Critical	Automation	Ordering, Manufacturing, Accounting, Payroll
Information	Decision Support	Demand Forecast, Simulation
Infrastructure	Information Sharing	Mail, Groupware, Portal

Nowadays excessive information is a serious matter for any organization since it causes low productivity and high administrative cost. A project manager has to consider the additional administrative cost as well as the value generated by a new system. Another extrospective view of IT project is lifespan of the system. Since computer system does not have learning abilities like the human beings, obsolescence begins as soon as the program logic is fixed. Even if the system is

designed as flexible as possible to the change of business model, legal law and institution, unexpected change would shorten the system’s lifetime.

A project manager has to have both introspective and extrospective point of view to keep a good balance of project measurements.

VII. CONCLUSION AND FUTURE RESEARCH

This study used the five comparative axes as the metacognition framework of decision making. Deduction applies the heuristics configured with the past experiences. It is surely effective to play chess or shogi which has the eternal rule but IT projects are always different and unique, so the induction, which is the hypothesis verification process using the latest fact, would be necessary. This process is formulated as the decision making process model. The rest of four axes have correlations each other and can be mapped in this model as shown in Figure 5.

Experienced project manager may know the basic principles like below through their own experiences.

- Have own SHOULD and share it with clear message
- Know what is known and unknown
- Think alternatives before act
- Select the best alternative according to the situation
- Stop and think again when goes wrong

The frameworks will give the outline view of these principles to help them understand why they are important, and also be used as the navigation support map in metacognition world to improve one's decision making process.

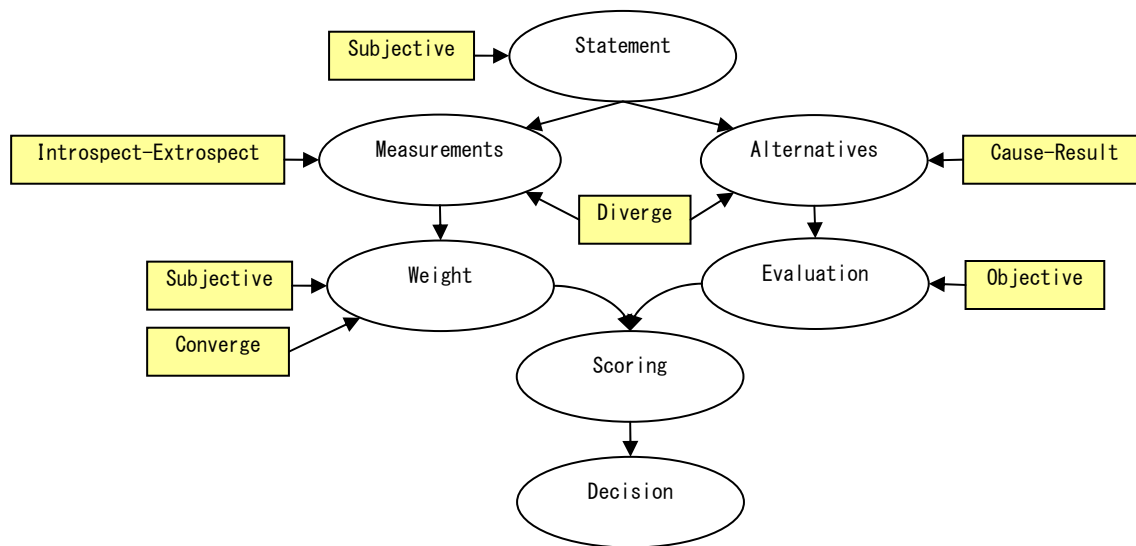


Figure 5 Four Axes in Decision Making Process Model

This study doesn't include the examination of any specific hypothesis. The following points should be considered in the future study.

- The correlation between the expression of project statement, either goal achievement or problem solving, and the incubation of project measurements and alternatives.
- The distribution ratio of introspect/extrospect type of R&D and Sales organizations or Pre/Post graduate of MOT students.
- The correlation between the project measurements setting and introspect/extrospect type.
- What kind of questions can be used to get each of introspective and extrospective information from the project owner?
- How the cause-result network can be used to get better alternatives?

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