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Dear Prof. Yu:

I am happy to inform you that your invited paper "**Decision Traps and Competence Dynamics in Changeable Spaces**" with C. Y. Chiang-Lin, is accepted for the publication in the *International Journal of Information Technology and Decision Making* (http://www.worldscinet.com/ijitdm/ijitdm.shtml). It will tentatively appear in Vol.5, Issue 1, March 2006.
The publisher World Scientific Publishing Co., Inc. may contact you for the galley proof of the paper. Please cooperate with it.
I thank you for your kind support for this new journal and hope you will submit your other research results for the consideration of future publications in the journal.

Sincerely yours,

Yong Shi

Decision Traps and Competence Dynamics In Changeable Spaces *

P. L. Yu[1], and C. Y. Chiang-Lin[2]

Abstract

There are many parameters in challenging decision problems, including the alternatives, the criteria, resources, the perception of decision problems, decision makers and their psychological states, information inputs from the environment and self suggestion, etc. At any moment of time, some of these parameters can catch our attention, called alerted parameters; some cannot, called unalerted parameters. Some parameters are visible, some are invisible. In addition, the parameters themselves can vary over certain ranger or domains. All of these make challenging decision problems very complex. We call this kind of problems as decision problems with changeable spaces (parameters).

We may focus on certain parameters with certain assumed values to find an "optimal" solution, which may lead to solve wrong problem with bad solution. Quite often, our focus may be just a small part of what we know, or just a part of what we are most familiar with. We may often neglect what we are not familiar with, and pay no attention to what we do not know. As a consequence, we may see just a small part of the problem domain (including all parameters and their possible variations over time). The portion (of the problem domain) that we cannot see is our decision blind. Suppose our alerted domain (those parameters and their variations that are currently under our consideration) is fixed in only a small part of the problem domains. Then very likely we could end up with serious mistake. This situation is known as decision trap.

In this article, we will introduce a systematic scheme, based on habitual domain theory, to help us reduce decision blinds and avoid decision traps so that we could make decision with good quality. Then we will also introduce the concept of competence set analysis to help us cope with challenging decision problems. This including: (i) how to effectively expand our competence (resources, skill, know-how, information, ideas, effort, etc.) as to solve a given problem effectively; and (ii) given a set of competence, how to maximize its value by solving a set of value added

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problems. Furthermore we will introduce innovation dynamics which describes the dynamics of how to solve a set of problems with our existent or acquired competence (to relieve the pains or frustration of "certain customers or DMs" at certain situations) as to create value, and how to distribute this created value so that we can continuously expand out competence set to solve more challenging problems and create more value.

1. Decision Making in Changeable Spaces

Each of the nontrivial decision problems we faced every day can be very simple or very complex, static or dynamic. As described in decision theory, any decision problem involves, implicitly and explicitly, the following five decision elements in decision processes, for instance, see [5]-[6]. They are decision alternatives, decision criteria, decision outcomes, decision preference and decision information inputs which are described briefly as the following:

(i) Alternatives are those choices that we can select or control in order to achieve our decision goals.
(ii) Criteria are used for measuring the effectiveness or efficiency of the decision.
(iii) Decision outcomes are measurement in terms of the criteria, which can be deterministic, probabilistic, fuzzy, or unknown.
(iv) Preferences over the possible decision outcomes determine which outcome would be more or less preferred than others.
(v) Information inputs mean any message that is received by the decision maker, which may or may not affect the generation of alternatives, decision criteria, decision outcomes, and decision preferences.

All the decision elements can be interacted mutually. Except for the above five elements, each problem is also accompanied, visibly or invisibly, by the following four environment facets: decision dynamics as a part of the behavior mechanism, stages of the decision process, players involved in the processes, and unknowns in decision making.

From the view point of Habitual Domains (HD) Theory, for each decision problem there is a competence set of ideas, knowledge, skills, and resources for its effective solution. The competence set, like habitual domain, implicitly contains potential domain, actual domain, activation probability, and reachable domain. In this way, the decision problems can be categorized as routine problem, fuzzy problem and challenging problem (see Section 2, for a detailed discassion).

For solving the challenge problem, we not only need to consider the above five decision elements, i.e. decision parameters, but also need to expand the decision parameters as to include:

(i) Perception. Consciously being aware of the decision problems can help us preparing for the needed competences for solving the problem in the early stage of the decision problem. Before the important decision problem transformed to an emergent problem, we can take time to enhance our understanding of the problems and thus improve the quality of the decision making.
(ii) Resources. Beyond the scope of the decision problem itself, there are many available and useful resources which can help us solving the decision problem, for example, the experts.
(iii) Related players in decision making processes. In general, a decision problem contains not only the one player. Individuals or organizations who can affect the decision problems might be considered as players too. Cooperating with these players might be helpful for the decision maker to form win-win strategies.
(iv) Competence set expansion. Through the expansion of the competence set the decision maker has, challenging problem can become a fuzzy problem, even a routine problem. Traditional decision theory ignored that the competence set of the DM is changeable. Accordingly, good feasible solutions might not catch our attention.

At any moment of time, some of these parameters can catch our attention, called *alerted parameters*; some cannot, called *unalerted parameters*. Some parameters are visible, some are invisible. In addition, the parameters themselves can very over certain ranger or domains. All of these make challenging decision problems very complex. We call this kind of problems as decision problems with changeable spaces (parameters).

Before we further discussed above concepts, let us consider the following example:

Example 1: Alinsky's Strategy (adopted from [1])

During the days of the Johnson-Goldwater campaign in 1960s, commitments that were made by city authorities to the Woodlawn ghetto organization of Chicago were not being met. The organization was powerless. As the organization was already committed to support the Democratic administration, the president campaign did not bring them help. Alinsky, a great social movement leader, came up with a unique solvable situation. He would mobilize a large number of supporters to legally line up

and occupy all the restroom facilities of the busy O'Hare International Airport. Image the chaotic situation of disruption and frustration that occurred when thousands of passengers who were hydraulically loaded (very high level of charge) rushed for restrooms but could not find the facility to release the charge. How embarrassing when the newspapers and media around the world headlined and dramatized the situation. The supporters were extremely enthusiastic about the project, sensing the sweetness of revenge against the city. The treat of this tactic was leaked to the administration, and within forty-eight hours the Woodlawn Organization was meeting with the city authorities, and the problem was of course, solved graciously with each player releasing a charge and claiming a victory.

From the above example, note that identifying a solvable situation which can be endorsed by an overwhelming majority is not trivial. Alinsky had to go down very deep to human physiology to obtain such a creative, yet effective strategy.

Without the *perception* of the critical time of campaign, the organization had lost the optimal chance to have the commitments met after the campaign. Fortunately, they could ask for advice from Alinsky, which can be considered as a *resource* not in the decision problem originally. The solution proposed by Alinsky forced the city authorities to become *players* in the decision process and make use of the *competence* of mobilization of the organization. Searching for outer resource, advice from Alinsky, can also be considered as one kind of *competence* expansion.

By taking account of more decision parameters and their changeable possibility, creative alternatives can be proposed to avoid the decision traps. In this article, the portion of the problem domain that we can not see is called the *decision blind*. Suppose our alerted domain (those parameters and their variations that are currently under our consideration) is fixed in only a small part of the problem domains. Then very likely we could end up with serious mistake. This situation is known as *decision trap*. The best method for avoiding or reducing the decision blind is to considering more potential parameters and their space (possible parametric range) and the best method to jump out from decision traps is to expand the competence set of the DMs intentionally. For a business, the competence expansion, or named as innovation, is especially essential for creating market value. In this article, the innovation dynamics will be proposed for the maximization of business value.

This paper is organized as follows:

In Section 2, decision blinds are defined in term of the Habitual Domains theory. In Section 3, decision traps induced by decision blinds are described and some suggestions for avoiding decision traps are made. In Section 4, two kinds of problems in competence set analysis are proposed and some methodologies for

expanding the acquired competence set to the needed competence set are addressed. In Section 5, we propose the innovation dynamics as a dynamic version of competence set analysis, which seeks opportunity to create value on one hand and to effectively finds the competence set needed on the other. Certainly it can also help us reduce decision blind and avoid decision traps. In Section 6 we offer some concluding remarks.

2. Decision Blinds & Decision Parameters

As described in Section 1, for each decision problem there is a competence set of ideas, knowledge, skills, and resources for its effective solution. This concept is derived from the *Habitual Domains* Theory (HD). For further discussion, we have to understand the basic ideas of HD.

Each person has a unique set of behaviors patterns resulting from his or her ways of thinking, memory, judging, responding and handling problems, which gradually stabilize within a certain domains over a period of time. This collection of ways of thinking, memory, judging, etc., together with its organization, interaction and dynamics, is called our *habitual domain* (HD). Indeed our HD is our mental software which drives our brain (a super computer) to think and act.

Our habitual domains (HD) can be stabilized. This can be mathematically proved based on commonly observed facts [2]:

(i) The more we learn, the less the likelihood that an arriving event or piece of information is new to us.
(ii) To interpret arriving events, we tend to relate them to past experiences.
(iii) We tend to look for rhythms in our lives and force arriving events to conform to those rhythms.

Our habitual domains go wherever we go and have great impact on our decision making.

As our HD, over a period of time, will gradually become stabilized, unless there is an occurrence of extraordinary events or we purposely try to expand it, our thinking and behavior will reach some kind of steady state and predictable.

There are four elements of habitual domains:

(i) Potential domain (PD_t). This is the collection of all thoughts, concepts, ideas and actions that can be potentially activated by one person or by one organization at time t.

(ii) Actual domains (AD_t): This is the collection of all thoughts, concepts, ideas and actions which actually occur at time t.

(iii) Activation Probability (AP_t): This represents the probability that the ideas, concepts and actions in the potential domain have been actually activated.

(iv) Reachable domain (RD_t). This is the collection of thought, concept, ideas, actions and operators that can be generated from the initial actual domains.

At any point in time habitual domains (HD_t) will mean the collection of the above four subsets. That is, $HD_t = \{PD_t, AD_t, AP_t, RD_t\}$. In general, the actual domain is only a small portion of the reachable domain, in turn, the reachable domain is only a small portion of potential domain, and only a small portion of the actual domain is observable. Note that HD_t changes with time. If there is no confusion, the subscript t will be dropped.

In studying the expansion of habitual domains, we shall focus only on how we expand the actual domains (AD_s) from its initial sets at an initial point of time, say s (starting time), to another time, t. Let AD_{st} be the actual domain accumulated from s to t.

There are three kinds of expansions of the actual domains ([5]-[6]) as follows:

(i) Zero degree expansion

Starting from the original set AD_s, one can expand the actual domains to a subset of the reachable domains. Mathematically speaking, AD_{st} has a zero degree expansion if $AD_{st} \backslash AD_s \neq \phi$ and $RD_s \supset AD_{st}$. Note, RD_s is a function of AD_s. There are no extraordinary events within the time interval [s, t] to trigger a new conception that is outside of the reachable domain RD_s.

(ii) First degree expansion

By expansion of first degree, we mean that the actual domain AD_{st} is not contained by the reachable domain RD_s, but is still contained in the potential domain PD_s . This is, $AD_{st} \backslash RD_s \neq \phi$ and $PD_s \supset AD_{st}$.

(iii) Second degree expansion

By second degree expansion we mean that through external information inputs or self-suggestion we acquire new concepts or operators which are not contained by our previous potential domains. Therefore, the actual domain AD_{st} is not contained by PD_s. That is, $AD_{st} \backslash PD_s \neq \phi$.

Let the truly needed competence set at time t, the acquired skill set at time t, and the α-core (i.e. the collection of the ideas or concepts that can be activated with probability larger than or equal to α) of an acquired skill set at time t be denoted by

$Tr_t(E)$, $Sk_t(E)$, and $C_t(\alpha, E)$, respectively. Depending on $Tr_t(E)$, $Sk_t(E)$, and $C_t(\alpha, E)$, we may classify decision problems into following categories:

(i) If $Tr_t(E)$ is well-known and $Tr_t(E) \subset C_t(\alpha, E)$ with high value of α or $\alpha \to 1$, then the problem is a routine problem, for which satisfactory solutions are readily known and routinely used.

(ii) If $Tr_t(E)$ is only fuzzily known and may not contained in $C_t(\alpha, E)$ with a high value of α, then the problem is a fuzzy problem, for which the solutions are fuzzily known. Note that once the $Tr_t(E)$ is gradually clarified and contained in $C_t(\alpha, E)$ with a high value of α, the fuzzy problem may gradually become routine problem.

(iii) If $Tr_t(E) \setminus C_t(\alpha, E)$ is very large relative $C_t(\alpha, E)$ no matter how small is α, or $Tr_t(E)$ is unknown and difficult to know, then the problem is a challenging problem.

(iv) If $Tr_t(E)$ is outside of $Sk_t(E)$ for all time t, then we are very likely to be out of business.

The above concepts can be depicted in Fig. 1.

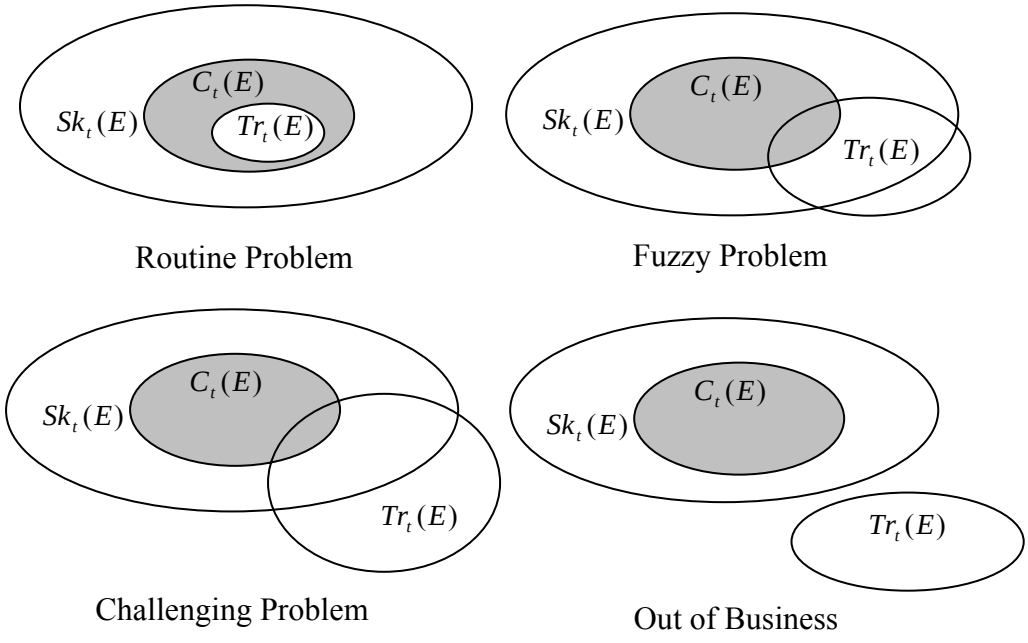

Fig. 1 Routine, fuzzy, and challenging decision problems

Like habitual domains, each decision problem implicitly contains actual domain, potential domain, and reachable domain. If, the DM when making decision often searches for alternatives only in the actual domain rather in the potential domain or reachable domain and, very likely, he/she will have the decision blind (i.e. the portion of the decision problem that are important but not seen or alerted).

The actual domain which we can easily pay attention to is the *alerted domain* and the potential domain and reachable domain which we might be easily ignored can be deemed as *unalerted domain*. The extra parameters we discussed in Section 1 such as perception, resources, related players, competence set expansion, and even psychological states of the decision makers and players can exist in unalerted domains and changeable along the time.

3. Decision Traps

What if the decision trap unwittingly exists in the decision process? We might get stuck in certain domain and cannot break through. Let us consider the following example.

Example 2: Working Horses

For centuries, many biologists paid their attention and worked hard to breed endurable mighty working horses so that the new horse could be durable, controllable and did not have to eat. To their great surprise, their dream was realized by mechanists, who invented a kind of "working horse", tractors. The biologists' decision trap and decision blind are obvious.

What's wrong with the decision maker? Could we provide some suggestions for the DM to reduce their decision blind and help them jump out the decision trap.

Firstly, the decision problem is mistakenly defined. Only when we ask the right question, we can get the right answer. What is the real purpose (objective) of the decision? To breed a "good" horse or to create a working tool (maybe an animal or not) or to increase the supply of food, or even to decrease the starvation. Different objective settings provide different alternatives or, in terms of the HD, different actual domains activate different potential domains and reachable domains. If the question is how to breed an endurable mighty working horse, then the biologist's solution is reached. If the question is how to create a "good" working tool, the DM can search solutions in the mechanist's field. If the question is how to increase the supply of food, the genetic improvement of seeds might be considered. If the question is how to decrease the starvation, then population control may be approach.

By rethinking the objective and decomposition of the decision problems, the decision trap (i.e. kind of habitual domain) can be likely avoided and we could end up with solutions without serious mistake.

Following suggestions can serve as a checklist when facing nontrivial decision problems. Some of them, i.e., suggestions (i) ~ (v), are provided by traditional

decision theory. The others are proposed after considering the changeable decision spaces (parameters):

(i) What are the vital alternatives?
(ii) What are the effective decision criteria?
(iii) What are the possible outcomes of a decision?
(iv) What is the preference structure of the DM?
(v) How will the external information affect the decision?
(vi) What are the evolution and the dynamics of the decision making process?
(vii) How can a complex decision problem be decomposed into a number of sub-problems and a number of stages so as to facilitate analysis of the problem?
(viii) Who are the players and what are their various interests, stakes and habitual domains?
(ix) Could the unknowns and/or uncertainty involved in the decision process be clarified and coped with?
(x) Could the DM expand and/or restructure the HDs so as to increase decision efficiency and effectiveness and shorten the decision cycle?
(xi) Could the perceived and acquired competence sets of the decision makers be expanded and enhanced so as to improve the confidence of decision making and decision quality?
(xii) Could the final decisions be improved furthermore?

Some very interesting discussions on decision traps can be found in [4].

4. Competence Analysis

With the suggestions provided in Section 3, the competence set expansion could be applicable for solving problems with good quality. By adopting competence set expansion, the challenging problems and even the problems out of business (as shown in Fig. 1) can become fuzzy problems or routine problems. In this section, we will introduce the concept of competence set analysis and methods for competence set expansion.

The research of competence set analysis began from Yu, as an application of habitual domains theory. Yu defined competence set for a given problem as a collection of ideas, knowledge, information, skills and resources for decision makers (DM) to solve the decision problem successfully. Once the DM possesses the needed competence set for solving the decision problems, he/she can make the decisions

confidently. Otherwise, the DM might want to expand his/her competence for solving the problem. Competence set analysis is a very important concept as evidenced by the fact that each year, corporations and individuals pour so much time and money in job training and education to obtain necessary competence, schools, and societies certify the quality of specific competence by issuing diplomats, certificates and licenses to qualified people or organizations.

Competence set analysis (CSA) contains two inherent domains: competence domain and problem domain. As shown in Fig. 2, there are two kinds of short-term problems in CSA:

(i) Given a problem or set of problems, what is the needed competence set, and how to acquire or obtain it? Some mathematical models can be found in [3] and quotes therein.

(ii) Given a set of competence, what kind of problems can be solves as to maximize the value of the competence?

The former problem is called the *problem-oriented competence ser analysis*, and the latter is called the *skill-oriented competence set analysis*. In the long-term, we want to expand our competence set over time as to maximize the value of our individual live, or maximize the value of the organization over its time of existence. Further discussion on competence set analysis could be found in [5]-[7].

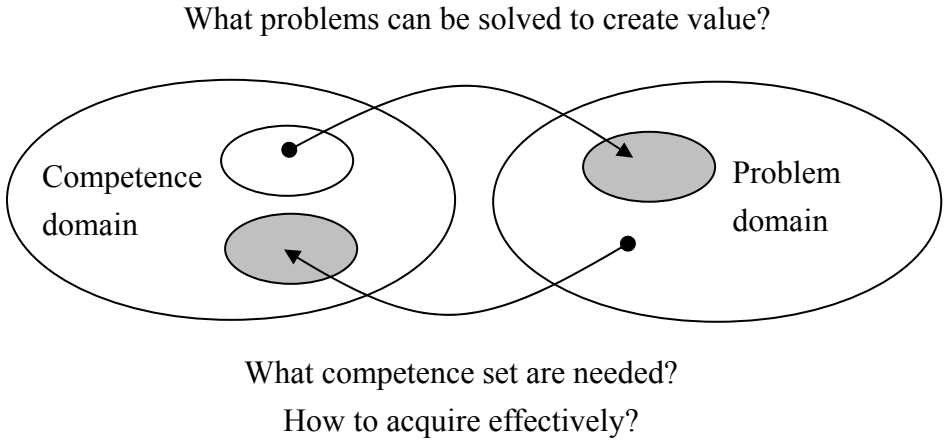

Fig. 2 Two domains of competence set analysis

There are many methods for helping us to improve or expand our competence set and habitual domains and avoid decision traps. We list some of them in the following two tables. The interested reader is referred to Refs. [5] and [6] for more detail.

Table 1. Eight basic methods for expanding habitual domains.

1. Learning Actively
2. Take the Higher Position
3. Active Association
4. Changing the Relative Parameters
5. Changing the Environment
6. Brainstorming
7. Retreat in Order to Advance
8. Praying or Meditation

Table 2. Nine principles for deep knowledge.

1. Deep and Down Principle
2. Alternating Principle
3. Contrasting and Complementing Principle
4. Revolving and Cycling Principle
5. Inner Connection Principle
6. Changing and Transforming Principle
7. Contradiction Principle
8. Cracking and Ripping Principle
9. Void Principle

5. Competence/Innovation Dynamics

After the competence set analysis problems was raised, numerous scholars have been devoted to proposing different methods for competence set expansion. However, almost all of these models were focused on the problem oriented analysis. See [3] and quotes therein. That is, given the acquired competence set and needed competence set for a specific decision problem, how could we effectively expand the existing competence set to the needed competence set.

In businesses operations, an equally important problem is skill-oriented analysis. That is given a set of competence, what kind of problems (including producing products or services) can be solved as to maximize the value of the competence? How a company could maximize the value of its competence by innovation process become vital for its survival and prosperity. The direction of innovation and what kinds of products and/or services must be designed and provided for the customers become important.

According the HD hypothesis (charge structure and attention allocation hypothesis, and discharge hypothesis) [5]-[6], we can infer that the product or service which can

decrease the charge or pain of customers more timely and effectively, can be more competitive and create more market value.

Indeed, to be vital the company, need to grow and transform their competence set as to reduced their targeted customers pain and frustration effectively as to maximize its value of existence. The value can be distributed to the stackholders and reinvest to expand the competence. This forms a dynamic flow of competence set expansion and value creation. We call it as *competence/innovation dynamics*, or simply *competence dynamics*. Let us further elaborate the innovation dynamics in the following paragraphs.

From HD Theory and CS Analysis, all things and humans can release pains and frustrations for certain group of people at certain situations and time. Thus all humans and things carry the competence (in broad sense, including skills, attitudes, resources, and functionalities). For instance, a cup is useful when we need a container to carry water as to release our pains and frustrations of having no cup.

The competitive edge of an organization or human can be defined as the capability to provide right services and products at right price to the target customers earlier than the competitors, as to release their pains and frustrations and make them satisfied and happy.

To be competitive, we therefore need to know what would be the customers' needs as to produce the right products or services at a lower cost and faster than the competitors. At the same time, given a product or service of certain competence or functionality, how to reach out the potential customers as to create value (the value is usually positively related to how much we could release the customers' pains and frustrations).

If we abstractly regard all humans and things as a set of different CS (competence set), then producing new products or services can be regarded as a transformation of the existent CS to a new form of CS. Based on this, we could draw clockwise competence dynamics as in Fig. 3:

Although Fig. 3 is self-explaining, the following are worth mentioning: (The numbers are corresponding to that of the figure.)

Note 1: According to HD Theory, when the current states and the ideal goals have unfavorable discrepancies (for instance losing money instead of making money, technologically behind, instead of ahead of, the competitors) will create mental charge which can prompt us to work harder to reach our ideal goals.

Note 2: Producing product and service is a matter of transforming CS from the existing one to a new form.

Note 3: Our product could release the charges and pains of certain group of people and make them satisfied and happy.

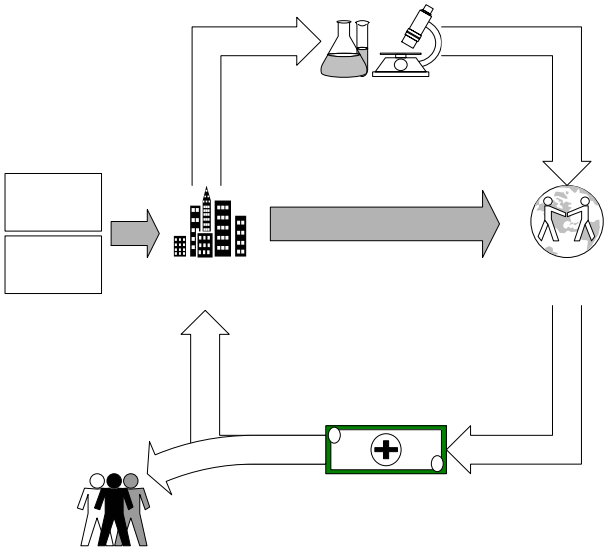

Fig.3. Clockwise Competence/Innovation Dynamics.

Note 4: The organization can create or release charges of certain group of people through advertising, marketing and selling.

Note 5: The target group of people will experience the change of charges. When their pains and frustrations, by buying our products or services, are relieved and become happy, the products and services can create value, which is Note 6.

Note 7 and Note 8 respectively are the distribution of the created value and reinvestment. To gain the competitive edge, products and services need to be continuously upgraded and changed. The reinvestment, Note 8, is needed for research and development for producing new product and service.

In a contrast, the competence dynamics can be counter-clockwise. We could draw counter-clockwise competence dynamics as in Fig. 4:

Note 1: According to HD Theory, when the current states and the ideal goals have unfavorable discrepancies will create mental charge which can prompt us to work harder to reach our ideal goals.

Note 2: In order to make profit, organization must create value.

Note 3: According to CS analysis, all things carry competence which can release pains and frustrations for certain group of people at certain situations and time.

Note 4: New business opportunities could be found by understanding and analyzing the pains and frustrations of certain group of people.

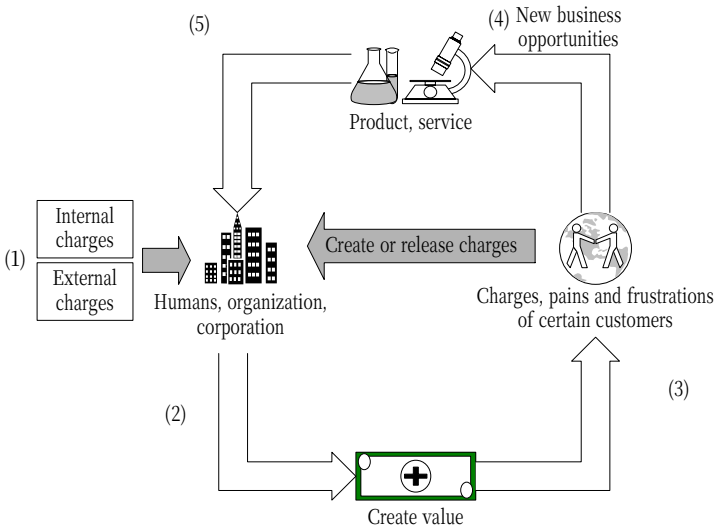

Fig.4. Counter-clockwise Competence/Innovation Dynamic.

Note 5: Reallocation or expansion of competence set is needed for innovating products or services to release people's pains and frustrations.

Innovation needs creative ideas, which are outside the existing HD and must be able to relieve the pains and frustrations of certain people. From this point of view, the method of expanding and upgrading our HDs becomes readily applicable. Innovation can be defined as the work and process to transform the creative ideas into reality as to create the value expected. It includes planning, executing (building structures, organization, processes, etc.), and adjustment. It could demand hard working, perseverance, persistence and competences. Innovation is, therefore, a process of transforming the existing CS toward a desired CS (product or service).

Observe that through the innovation dynamics, we could more broadly check our actual domains, reachable domains to expand the alerted parameters and their corresponding ranges. Therefore, we could reduce the decision blind, and more likely to avoid decision traps by checking through the components and their flows of Fig. 3 and 4.

6. Conclusions

Decision trap and blinds, competence set analysis and innovation dynamics for challenging decision problems have been introduced. Many research problems are open. For instance, how could we effectively bring the relevant *unalerted parameters* (those parameters are not in our actual domains) to our attention (thus, they become part of our actual domain) so that we could avoid decision blinds and restructure the problems, and solve the problems with good quality. In conflicts, how do we activate

the relevant parameters (especially the unalerted ones) so that the players can see the problems differently and find a win-win solutions to resolve their conflicts. Some discussions on this type of problems can be found in [5], [6] and [8].

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