CREATING SCENARIO FOR NEW PRODUCT DESIGN WITH HUMAN-INTERACTIVE ANNEALING AND DATA CRYSTALLIZATION

Kenichi Horie*, Yoshiharu Maeno*, Yukio Ohsawa*
*The University of Tokyo, Tokyo Japan 113-8563, *The University of Tsukuba, Tokyo Japan 113-8563

ABSTRACT

The importance of Patent is being recognized more than ever because it is considered as the core component for technology transfer to industry. It should be applied strategically for new product design. It is, however, common that Japanese patent claims are described in one sentence with peculiar style and wording and that they are difficult to read and understand for ordinary people. In chance discovery, it is newly recognized that latent structure behind observation often plays an important role in the dynamics of visible events. Such latent structure are composed of invisible events named as hidden events and can be visualized by data crystallization, where dummy nodes may potentially correspond to them. In addition, a new method, human-interactive annealing is developed to reveal the latent structure along with a simplified stable crystallization algorithm. In this paper, we propose designing Patent Map and process with data crystallization and human-interactive annealing, which visualize latent structure of patent claims. For further assistance, Pictogram which contains drawings and short text file are applied. Six new scenarios are emerged and two of them are selected for the development of product in real business.

Keywords: chance discovery, data crystallization, unobservable events, Human interaction, Design

1. INTRODUCTION

The importance of intellectual property, especially patent, is being recognized more than ever because patent is considered as the core component for technology transfer to industry and also defends an exclusiveness of the technology for 20 years in the industry and can be licensed, sold, and transferred as the right. So, it is considered as the most valuable intellectual property in their tangible assets and should be applied strategically for new product design. Patent is described in patent specification which is formatted like legal documents. The most important part of patent specification is where the claims are written, because “the claims specify the boundaries of the legal monopoly created by the patent” (J. Burgunder 1995).Therefore, patent corpus processing should be cantered around patent claim processing. It is, however, common that Japanese patent claims are described in one sentence with peculiar style and wording and that they are difficult to read and understand for ordinary people. The peculiarity is caused by structural complexity of the sentences and many difficult terms used in the description. The structure analysis of patent claims and term explanation for them are researched. (A. Shinmori et al. 2003) But they are not well visualized for better understanding of them.

A *chance discovery* is defined as detect, understand, and use events that are significant for a decision by human being (Chance discovery Consortium, Y.Ohsawa and P. McBurney 2003). The process of chance discovery and scenario design is in mutually involving relationship between human process and computational process (Y.Ohsawa and P.

McBurney 2003, Y.Ohsawa 2003, M. Carroll 2000). In *chance discovery*, tools for visualizing the relation among events/items based on data such as *KeyGraph* (Y.Ohsawa 2003, N. Okazaki and Y. Ohsawa 2003), has been introduced. By looking at the diagram as a patent map, user is supposed to understand the meaningful sequence of events, by connecting closely located items and furthermore to discover the new finding and/or create new scenarios.

In a *chance discovery*, it is newly recognized that latent structure behind observation often plays an important role in the dynamics of visible events. Such latent structure are composed of invisible events named as hidden events and can be visualized by a breaking-through method, *Data crystallization* (Y.Ohsawa 2005), where dummy nodes may potentially correspond to them. In addition, a new method, *human-interactive annealing* (Y. Maeno and Y. Ohsawa 2006a) is developed to reveal the latent structure along with a simplified stable crystallization algorithm.

In this paper, we address an issue to understand the *human-interactive annealing* process with *data crystallization* method. Then, we propose designing Patent Map on which latent structure of patent claims is visualized by *Data crystallization* and *human-interactive annealing* and process for aiding human to emerge hypothetical scenarios for new products.

2. KEYGRAPH AND DATA CRYSTALLIZATION

The objective of data crystallization is to detect (not only rare but) unobservable significant events. In this paper, we show an approach of integrating *two* new methods for the breakthrough from the currents state of arts in chance discovery.

The first is a method of visualizing data with inserting artificial dummy items. These dummy items mean unobservable events, of which the entity is totally unknown. The second is the human's process of discovery, where the chance may not be included in data. This human-interactive annealing method is developed for human to tune the granularity level of information for understanding and to discover unobservable chances in them. In Data crystallization, we employ KeyGraph as a tool for event map visualization prevalent in chance discovery (Y.Ohsawa 2003).

2.1 KeyGraph: the basic tool for visualizing Maps

KeyGraph is a tool we developed for visualizing relations among events. If the environment here means the existing activities a criminal group, KeyGraph shows the relation of members on their co-existing frequencies (See (Ohsawa 2003, Ohsawa 2006) for details). In Eq. (1), let data D_1 express a set of meetings, putting a period (``.'') at each end of meeting.

Here, "member1" in Eq. (1) can be regarded as "member1_attend" i.e., an event that a member appeared in a meeting place. Regarding each item in the data as an event rather than as an object is meaningful in interpreting KeyGraph as a scenario map, where the sequence of events should be grasped from the connections among nodes.

D_1 = member1 member2 member3.

member1 member2 member3 member4.

member4 member5 member7 member8.

member5 member2 member3 member7 member8.

member1 member2 member7 member8 member9.

member5 member7 member8 member9. (1)

KeyGraph (Ohsawa 2003, Ohsawa 2005), of the following steps, is then applied to *D*1. Then Fig.1 is obtained as a result.

***KeyGraph-Step* 1:** The M_1 most frequent events in the data (e.g., “member1” in Eq. (1)) are depicted with black nodes. The M_2 most strongly co-occurring events-pairs get linked with black lines. Here, the co-occurrence is computed on the Jaccard equation in Eq. (2), where Freq(X) means the number of baskets (lines in Eq. (1)) including elements of X. member1, member2, and member3 are connected with solid lines in Fig.1. Each connected graph forms one *island*, implying a basic context shared by its members.

***KeyGraph-Step* 2:** M_3 events co-occurring with multiple islands the most strongly, e.g., member9, are obtained as *hubs*. A path of links connecting islands via hubs is called a *bridge*. If a hub is rarer than black nodes, it is coloured in a different colour (e.g. red or white) than black. We regard such a hub as a candidate of *chance*, because it can be meaningful for a decision to jump from an island, corresponding to a context represented by the cluster of events, to another island.

$$\mathrm{Ja}(e_i, e_j) = \frac{\mathrm{Freq}(e_i \cap e_j)}{\mathrm{Freq}(e_i \cup e_j)} \quad (2)$$

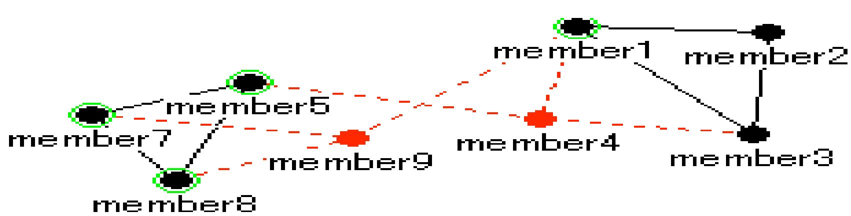

Fig.1 An output of *KeyGraph*: *Islands* are obtained from D_1, including sets {member1, member2, member3} and {member5, member6, member7} respectively. The nodes in the islands show frequent events, and member4 and member9 show rare hubs bridging islands.

Fig.1 helps in making a scenario of criminal behaviours, such as “member1, member2, and member3 are working together, and member5, member6, member7 form another group. When they meet member9, member9 gives commands to both groups from a higher level of organization,” via recollecting information about the members from the memory of intelligence analysts. The appearance of a bridging member can be a central topic to the analysts. Discussion of analysts by looking at the output diagram of KeyGraph may resolve the uncertainty about which member4 or member9 is the real leader, because human can reflect their knowledge acquired from the real interaction with the external environment.

2.2 Data Crystallization: Extending Key Graph for analysis of hidden events

Data crystallizing aims at presenting the hidden structure among events including unobservable ones. This is realized with inserting dummy items, which may correspond to unobservable events, to the given data on past events. The existence of unobservable events and their relations with other events are then visualized by applying KeyGraph. The core of data crystallization is represented as follows:

2.2.1 The algorithm of data crystallization

Hidden_0 := {}; line_0 :={}; {M1 , M2} : given values

For all i, j ∈ {0, 1, …, N} such that j G.E. i do

if line_i and line_j are same then Insert (D, i, j);

H: = KeyGraph (D, M1, M2, M3, = M1/2);

For j =1 to N do

If j ∉ H then Delete (D, j);

Here, D is the data-set given. N is the number of lines (co-occurrence units) in the data. A dummy item gets inserted to each line of D. If two or more lines have the same set of items, the same dummy item is inserted to all those lines, sufficed with the line-number of the first of those lines. To this data-set with inserted dummy nodes, KeyGraph is applied. Formally, D is to be analyzed by the function KeyGraph (D, M1, M2, M3). The value of M1 represents the number of nodes to be visualized by KeyGraph. M2 is the number of links in each island, and is set larger (smaller) if user likes to see a small (large) number of large (small) islands. Then, dummy items which did not appear on the bridges of KeyGraph get deleted from D.

Insert (D, i, j) means to insert dummy_j, the dummy node for the j-th line, to the i-th line of data D and from data D. The second and the third lines of the procedure mean to insert dummy_i to the dummy_j-th line, and, if there is a line (the i-th line) of the same set of items as the j-th line, dummy_j is inserted to all those lines. Delete (D, j) means to delete dummy_j, the dummy item for the j-th line, from all its appearances in data D. H represents the set of the line-numbers where the dummy items, which appeared on the bridges of KeyGraph, are positioned in the data.

Data crystallization works in the way like the crystallization of snow. A dummy item plays a role of a particle of dust connecting molecules of water in the air. The increase in M2 corresponds to the decrease in temperature. In the case of snow, a well-structured crystal is made because the temperature is decreased gradually and water molecules are collected via dust participles.

For showing a simple example, let us take series of meetings in a team of 21 members, as the target data to analyze. In Da, in Eq.(3), a part of data on the participants is listed, obtained in Step 2) for the concern with the real leader in the team. In Eq.(3), each line corresponds to a meeting.

D_a = Prof.U Prof.K Prof.O Prof.J

Prof.Q Prof.M Prof.A Prof.N Prof.I

Prof.U Prof.K Prof.J Prof.I

Prof.I Prof.J Prof.G

Prof.O Prof.A Prof.U Prof.I Prof.N

Prof.N Prof.L Prof.U Prof.M

Prof.F Prof.G ...

(3)

Fig. 2 is the result of KeyGraph, for M1=20, M2=20, and M3=20, from Da. Even though KeyGraph search 20 hubs bridging among islands, we find all islands separated i.e., no hubs among them. That is, the team looks like a set of groups irrelevant to each other. Thus, we should investigate hidden levels. The dummy nodes are inserted, denoted 1_x for the x-th line, to obtain Db below.

D_b = Prof.U Prof.K Prof.O Prof.J dummy1_1

Prof.Q Prof.M Prof.A Prof.N Prof.I dummy1_2

Prof.U Prof.K Prof.J Prof.I dummy1_3

Prof.I Prof.J Prof.G dummy1_4

Prof.O Prof.A Prof.U Prof.I Prof.N dummy1_5

Prof.N Prof.L Prof.U Prof.M dummy1_6

Prof.F Prof.G dummy1_7 …. (4)

Fig.3 is the output of KeyGraph for D_b in Eq. (4). Some dummy nodes appear in the graph, bridging among islands. For example, dummy1_5 between Prof.A and Prof.O means some hidden thing relevant to the fifth meeting (the fifth line in Eq. (4)) made a significant bridge for the structure.

From the new figure obtained by data crystallization, we can obtain newer findings. For example, dummy1_1 means there might have been some powerful leader who just sent a command such as “do meeting for this problem!” to the members of the first meeting. He/she may not have appeared in the meetings, but his command can be regarded as the first voice of the meeting i.e., he/she was the hidden leader.

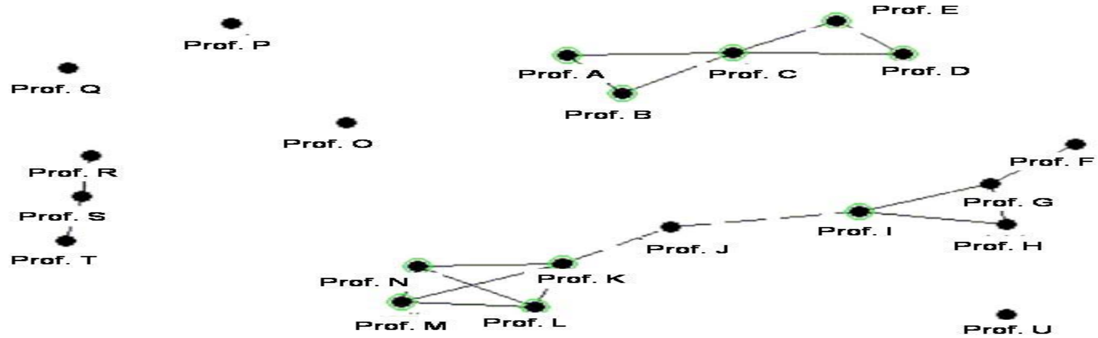

Fig.2 The original KeyGraph for members of a group

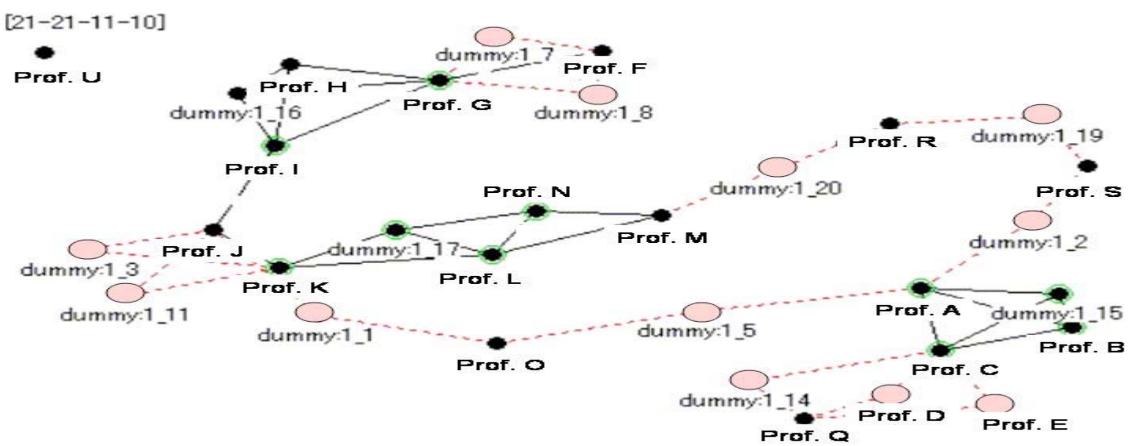

Fig.3 The output for data with first-order dummies (1_x)

Obtaining the diagram in Fig.3, we obtain the new dataset as in Eq.(5), by leaving dummy items appearing in Fig.3. The two dummies as dummy1_4 and dummy1_6 are discarded, because they do not appear in Fig.3.

D_c = Prof.U Prof.K Prof.O Prof.J dummy1_1

Prof.Q Prof.M Prof.A Prof.N Prof.I dummy1_2

Prof.U Prof.K Prof.J Prof.I dummy1_3

Prof.I Prof.J Prof.G

Prof.O Prof.A Prof.U Prof.I Prof.N dummy 1_5

Prof.N Prof.L Prof.U Prof.M

Prof.F Prof.G dummy 1_7

… (5)

In (Ohsawa 2005), Ohsawa presented a method to automatically decrease M2, corresponding to the temperature in winter. The expected result is that various granularity of crystallized structure can be obtained. For example, in the application of Ohsawa's data crystallization to the data on peoples' meetings, relations were shown between lower-level leader such as the leader of a small subgroup and top-leader such as the dean of a school faculty. However, according to the experiments, his method worked only for a small number of items in the data as the example in (Ohsawa 2005). For a larger number of items, meaningless dummy nodes appear in the output of graph of data crystallization. Although Ohsawa proposed to combine the talent of human to the data crystallization algorithm, it was a sheer extension of existing double helix process of chance discovery. For real application of data crystallization, because dummy nodes do not have names corresponding to real entities in the real world, human demands to see more simplified structures.

3. REFINMENT BY HUMAN-INTERACTIVE ANNEALING

3.1 Human-Interactive Annealing

The human-interactive annealing is a new technique presented by Maeno and Ohsawa (Y. Maeno and Y.Ohsawa 2006a, Y. Maeno and Y. Ohsawa 2006b). The process is similar to the annealing in materials science and simulated annealing. A graph, i.e., scenario map as mentioned above, is used to represent crystallized unobservable events. The annealing process is a combination of two complementary elements; human's interpretation and the crystallization algorithm in the computer. The two elements are illustrated in Fig. 4. The unobservable events are made visible, owing to the computational algorithm. The horizontal axis is the number of iterations. The vertical axis corresponds to the *temperature*.

Here, the temperature is a single control parameter representing the depth of human's prior understanding. When the understanding of the problem should to be richer, the temperature shall be set higher, resulting in more complex higher-order hidden structures to be visualized. This leads to the discovery of novel and unexpected scenarios. On the other hand, when the understanding should become simplified, the temperature shall be set lower. Then the user should try to understand the basic structures from the graph. This iteration in the annealing process is continued until human is satisfied by the posterior understanding.

As the temperature increases, the following three structural changes occur on the graph. These are embedded in the annealing process and independent of the stable deterministic crystallization algorithm.

1. Weaker inter-cluster links, i.e., connecting dummy events and clusters, are destroyed

2. Weaker intra-cluster links, i.e., connecting events within a cluster, are destroyed

3. The events are divided into larger number of clusters

In this annealing-based crystallization, the computer basically analyzes the occurrence frequency and the co-occurrence of events. As in Fig. 4: In the heating step, up to the specified peak temperature, the number of edges between visible events decreases i.e., weak associations are destroyed and crystallized unobservable events disappear. Then, a cooling step comes after the heating step, where event structures are solidified as temperature goes down. The number of crystallized unobservable events between clusters of visible events, corresponding to islands in KeyGraph, increase on an event graph. The clusters are connected to each other to form a single large structure. The crystallization is followed by human's interpretation, where it is checked whether the termination condition is fulfilled, i.e., if the user is satisfied with his/her understanding.

3.2 The algorithm and human-interaction

The crystallization algorithm in Eq. (4) using human-interactive annealing is developed to achieve a simple, stable, and deterministic nature. It aims at resolving the complexity of the algorithm in Section IV, and the ambiguity of possible interpretation of the event graph. The basic idea of this crystallization algorithm shares the basic principle with the method in Section IV, i.e., dummy events are inserted to the basket data to represent unobservable events artificially. A dummy event is a symbolic expression of a hidden structure containing unobservable events. Observed basket data D shall be the input. The contents of the basket data are a set of events, grouped under a specific subject. In an event graph, unobservable events can be visualized as a structure representing bridges between clusters.

Initially, the number of clusters $|C|$ is calculated using the specified temperature, which corresponds to the human's prior understanding. If the algorithm is to be repeatedly used with the human's interpretation, the temperature is initialized to be a small number and increased. Then the crystallization algorithm follows, consisting of the following five steps.

The first step is *event identification*. The all visible events in the basket data are picked up. The set of unique visible events is denoted by E. An individual event is denoted by e_i $(i \in [0, |E|-1])$.

The second step is *clustering*. The event set E is classified into vertex groups under a specified number of clusters $|C|$. Here, the values of Jaccard coefficients in Eq. (2) for all pairs of events are calculated and define the closeness of each pair. Based on this distance and the value of |C|, we employed the k-medoid clustering algorithm. This step may employ other clustering algorithms such as k-means.

The third step is *dummy event insertion*. A dummy event DE_i is inserted into the *i*-th basket, as dummy *k_i* has been inserted in the previous algorithm in Section IV. The index i can be used to identify the basket where the corresponding dummy event was inserted. The dummy event may represent a set of hidden participants to the basket. It may also correspond to the subject to the basket.

The forth step is *co-occurrence calculation* regarding the dummy events. The co-occurrence between a dummy event and the clusters is evaluated according to Eq. (4).

$$Co(DE_i, C) = \sum_{j=0}^{|C|-1} \max_{e_k \in c_j} Ja(DE_i, e_k) \quad (6)$$

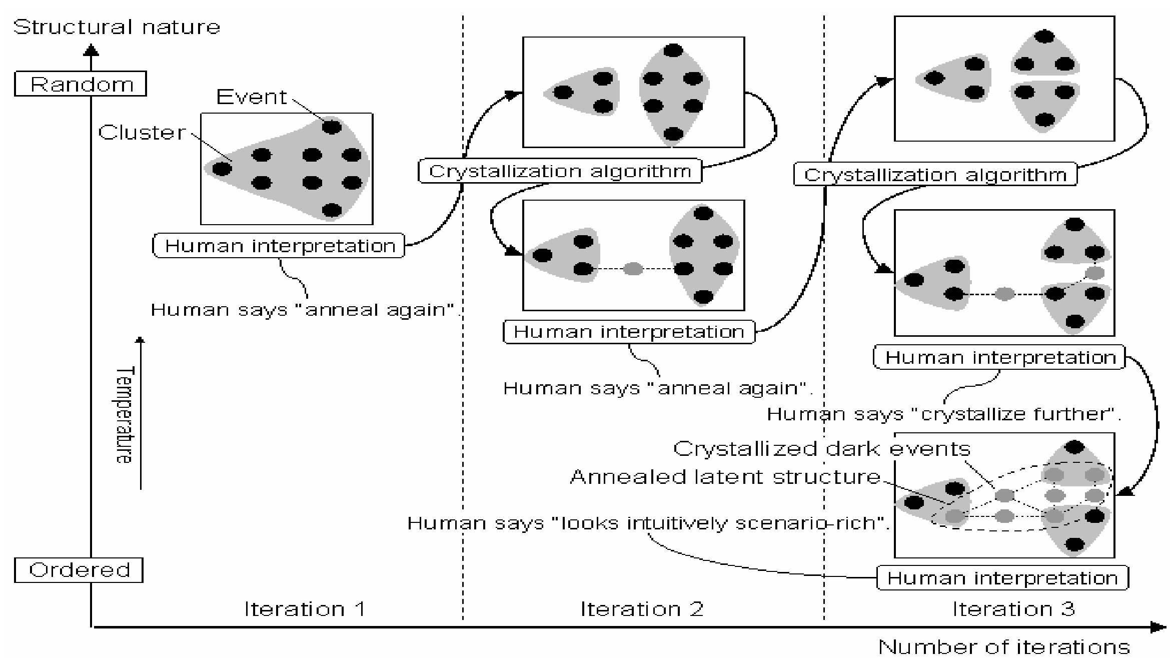

Fig. 4 Human-interactive annealing; iteration of human's interpretation and computer's crystallization of data (2006 IEEE COPYRIGHT)

The fifth step is *topology analysis*. The dummy events are sorted in the order of co-occurrence in the forth step. That is, dummy events of high co-occurrence with multiple clusters (being a bridge) are picked up. These dummy events are the unobservable events suggested by the algorithm. The number of links, drawn on the graph, depends on the temperature corresponding to the depth of human's prior understanding.

4. APPLICATION OF HUMAN-INTERACTIVE ANNEALING TO PATENT WITH PICTOGRAM

4.1 Experiment condition and process

4.1.1 Experiment conditions

We adopted the data crystallization and human-interactive annealing for 742 claims of 106 Japanese patent claims about "marking systems" and "Inspection". In order to trace the technology progress by year, we add data of "Registered year of patent" to the end of line of each patent claims. We prepare 742pcs of *Pictogram* (Fig.6) for all patent claims, which are composed of abstract of patent claim and drawings. Then, event map (Fig.8) is prepared, on which latent structure of patent claims and hidden nodes is visualized by KeyGraph (Fig.5) and *Pictograms* are clipped and pasted on corresponding nodes (Fig.7). Now, we called the event map for patent claims with pictograms as Patent Map. The experiments are executed by the six steps below for two hours with five examinees, which are compose of one sales manager, two sales engineers and two engineers.

4.1.2Process for creating new scenarios for product design

We newly propose the process for 3 phases with 6 steps for presenting the Patent Map, generating concepts about observed events, synthesizing them guided by hidden events and then, creating new scenarios for products design.

[Phase of presenting Patent map]

Step1: Show examinees event map (Fig.5.).

[Phase of generating concepts about observed events]

Step2: Instruct them to interpret events underlying each cluster, and write corresponding concept titles, on the shared white board through group discussion (Table.1).

Step3: Instruct them to create scenarios with words in each cluster and write them on white board through group discussion (Table.1).

Step4: Show them *Pictogram* (Fig.6.and Fig.7*)* pasting to corresponding patent numbers and have them reinterpret the cluster referring to them, which are drew circles on the Patent Map(Fig.5), when the group discussion starts standing still.

[Phase of synthesizing concepts guided by hidden events]

Step5: Show them other *Pictogram* pasting to the corresponding hidden event numbers and instruct them to consider as many hidden events, i.e., "Hidden events1", then "Hidden events2" and so on, to connect 6 clusters on the Patent Map (Fig.8), in creating new scenarios. For example, subjects may create a scenario "change the speed of conveyer with the progress of the film on the belt - then the back end checking may be realized" by combining No.5.cluster of "technology for back end inspection system" and No.6.cluster CCD inspection" via the four hidden events(a double headed arrow) at "Hidden events1"in Fig.8.

Step6: Select new scenarios which can be agreed by all of them and evaluate them in the view points of feasibility of development, which of marketing and novelty.

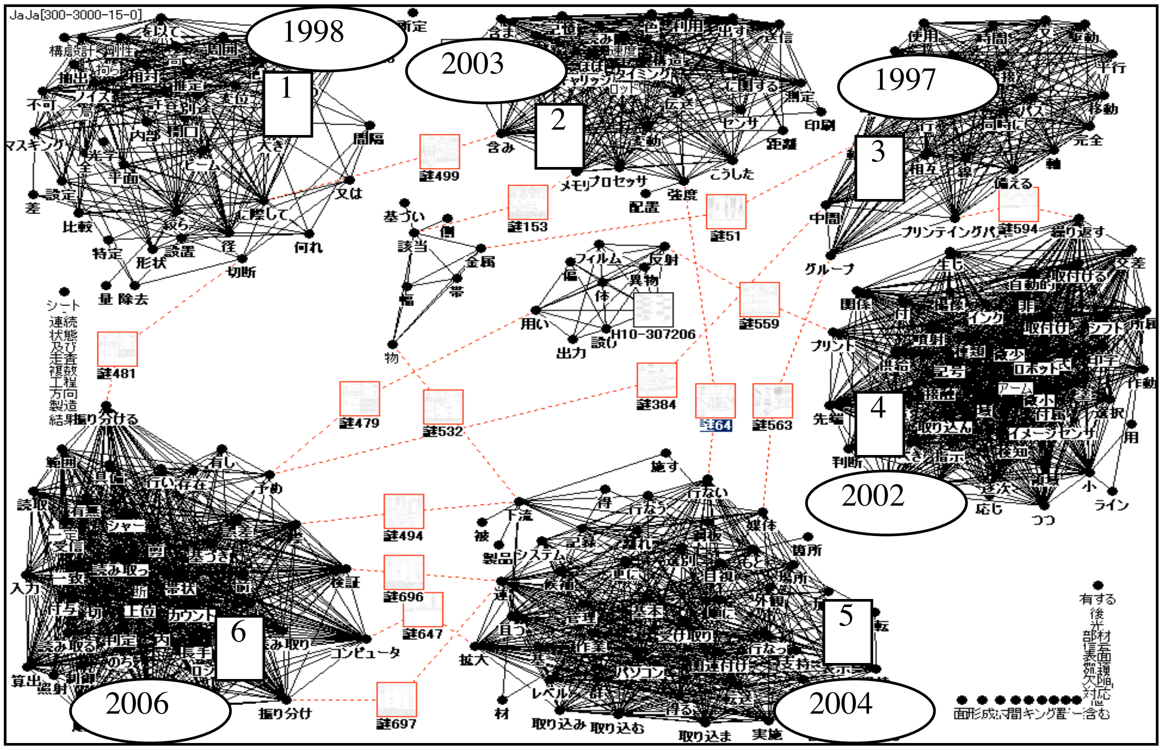

Fig.5 Event map with hidden events

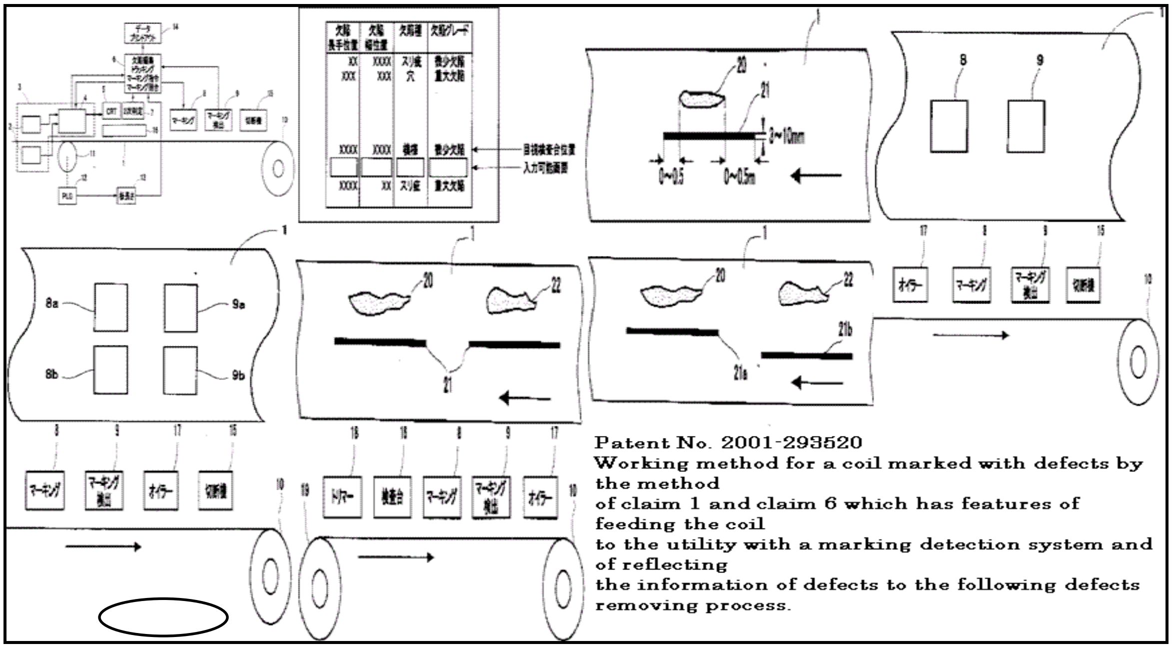

Fig.6 Sample of *Pictogram* (drawings, charts and text of Patent)

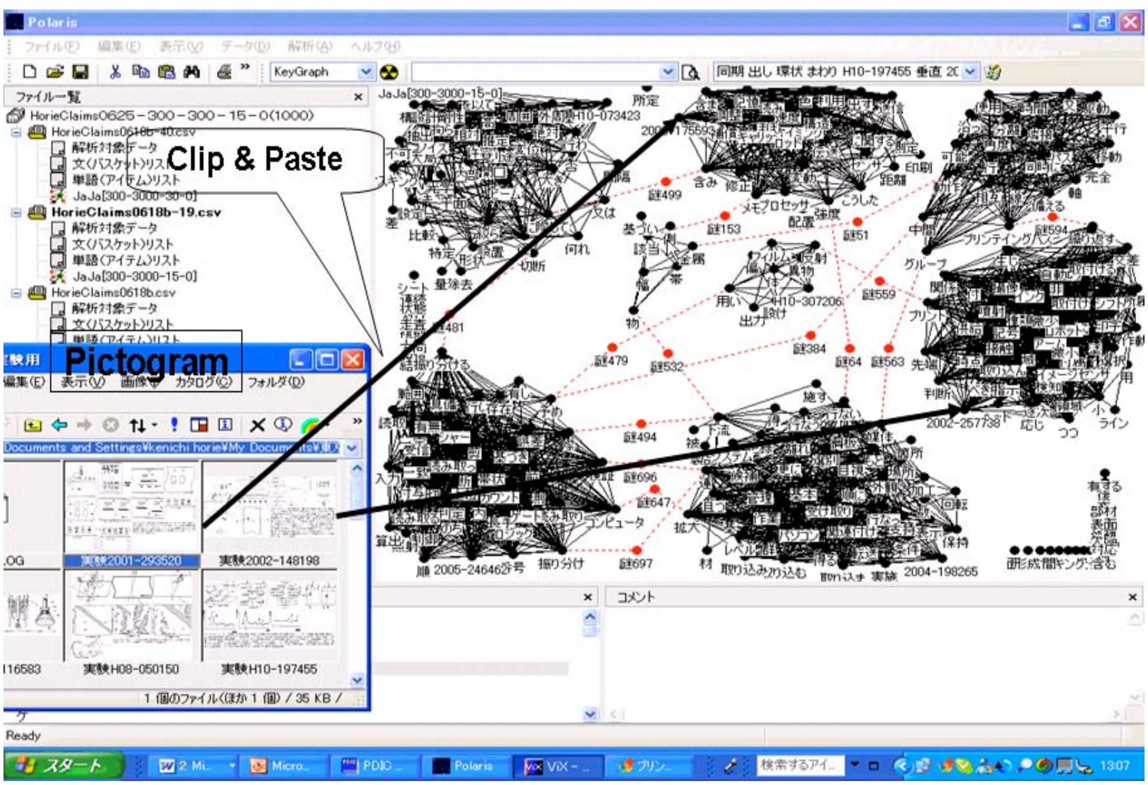

Fig.7 Pasting *Pictogram* on event map

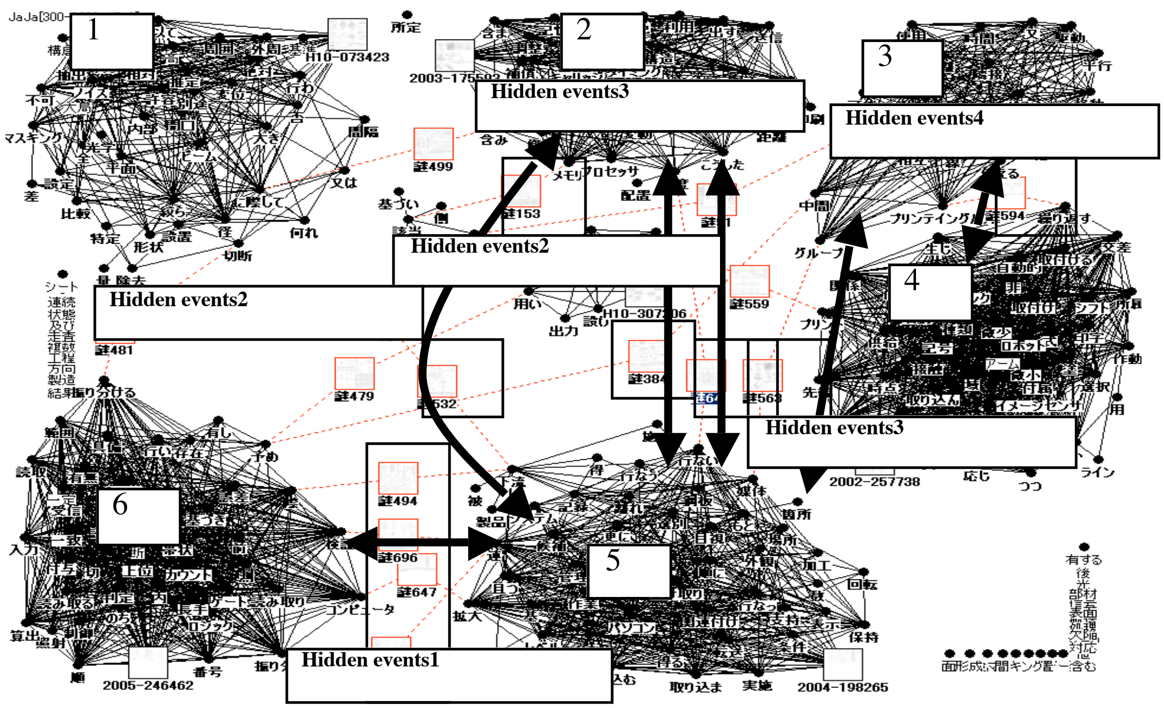

Fig.8 Six clusters with hidden events with Pictogram on Patent Map

4.2 Experiment result

4.2.1 Creating Concepts of each cluster

Each cluster on the Patent Map was smoothly interpreted and each title was named by examinees after Step2 (Fig.5. and Table.1.).

4.2.2 Creating scenarios of each cluster

Each scenario of six clusters was created at Step3 (Table1.). It was very difficult and took a long time for examinees to create scenarios of each cluster. They tried to combine words for basic blocks and sentences repeatedly and frequently exchange each opinion about sentences. And, they finally completed to create scenarios which all of examinees think fit to their interpretation of each cluster

4.2.3 Reinterpreting clusters and correcting scenarios

Each scenario was reinterpreted with Pictograms on patent number in each cluster at Step.4 and only two scenarios of No.2 and No.6 were corrected (Table1.). Drawings and charts on each Pictogram aided examinees in their different expertise to interpret the meaning of each cluster precisely.

4.2.4 Analyzing technology trend of patent by year

The year of patent registration on each cluster were listed(Table.2).The core technology of 106 patents could be transited chronologically.

1. Technology for driving mechanism of marking system

2. Technology for structure of marking system

3. Technology for ink marking system

4. Technology for control of marking system

5. Technology fro back end inspection system

6. Technology for control CCD inspection

That is, technology for inspection process was focused on type of mechanism of marking system, overall structure of marking system and control method of marking system at front end of manufacturing process. Then, attention of the inspection process was moved into back end process. CCD inspection system at back end process was improved with new control system.

4.2.5 Creating new scenarios

Examinees followed the guidance of Step 6.and started to create hypothetical new scenario for patent from group of dark events No.1.to No.4.(Fig.8)

Table1. Cluster title and scenarios

Cluster No	TITLE	SCENARIO
1	*Technology for structure of marking system*	System with structure which is able to remove specific shape from unmasked planate area by irradiating laser beam in specific interval through focused aperture lens
		Control system which transmits a position of defects on the product by measuring the distance of them from the feed speed
2	*Technology for Control of marking system*	Control system which transmits a position of defects on the product by measuring the distance of them from the feed speed
		<u>Correction:</u> Control system which transmit the positional information to its back end equipment, which identify the position of defects on the product from the relative velocity difference
3.	*Technology for driving mechanism of marking system*	Marking equipment which moves on a parallel with the travel direction of film on roll and is able to mark multiple defects appeared on the same axis of them at a time by lying its multiple marking heads next to specific area of the film in each segment
4.	*Technology for ink jet marking system*	Robotic system equipped with arms, of which ink jet heads are automatically moved to a position of defects on the product and mark the defects by ink out of touch after detecting an area of the defects one by one with image by image sensor
5	*Technology for back end inspection system*	System which manage the information about a position of defect picks by computer in advance and separate the controversial defects in the position selectively by visual inspection at back end process of steel
6.	*Technology for Control of CCD inspection*	System which is able to judge whether or not marking defects at end process by allocating number to each position of the defect after acquiring its image with image inspection system in advance.
		<u>Correction:</u> Control system is able to judge whether or not marking defects with allocation number of each defect information after reading a signal from inspection system with multiple camera at front end
		<u>Correction:</u> Computer system which is able to assign products in allocated gates by reading number issued by image sensor beforehand.

Table2. Analysis of Applicant name and application year

Year	N0	Title
1997	3	*Technology for driving mechanism of marking system*
1998	1	*Technology for structure of marking system*
2002	4	*Technology for ink jet marking system*
2003	2	*Technology for Control of marking system*
2005	5	*Technology for back end inspection system*
2006	6	*Technology for Control of CCD inspection*

Remarks N0: CLUSTER number Year: Year of patent registration

Six new scenarios were emerged from six clusters referring to Pictograms of hidden events numbers on the event map at Step 5 (Fig.8). All examines initially paid attention to “Hidden events1”, which connected No.5 cluster titled as “Technology for back end inspection system “and No.6 cluster titled as “Technology for control of CCD inspection”. Then, they moved their attention to “Hidden events2”, and “Hidden events3” following the procedures described in Step5. New scenarios were continuously created referring to “Hidden events3” and “Hidden events4” (Table3.).

Table3. Analysis of Applicant name and application year

4.3 Evaluation of scenarios

HIDDEN EVENTS	CLUSTER	NEW SCENARIOS
Hidden events1 Hidden events No. 494,647,696,697	1	Marking system which is available to mark around zonal defects by using logic which divide position of the defects into segments and transmit the information to the marking processor in case they are appeared over the range between sensor and mark
Hidden events2 Hidden events No. 64,153,632	2	System which identify defects of a product with marking and detect the mark after cutting at back end so as to increase the efficiency of visual inspection.
	3	Barcode management which make visual inspection effectively with barcode at back end by processing the information about the position and classifications of defects with it and marking it nearby defects.
Hidden events3 Hidden events No. 51,563,632	4	Marking system with multiple heads on multiple axes towards traveling direction, which is prevented from missing to mark around defects
	5	Mark the information of defects of each segment after dividing into segments on the surface of film in roll.
Hidden events4 Hidden events No.	6	Adhere thermal cured resin around defects on the surface of film and change the color of it with laser or thermal element for

Six new scenarios are evaluated as view points of feasibility of development, which of marketing and novelty. Two of them below are selected from 6 new scenarios (Table.3) and decided for the development of new product by all examinees.

1. Scenario 4:" *Make multiple marking ink jet heads against travel direction of works to improve slippage loss of defects inspection."*

2. Scenario 6: "*Adhere thermal cured resin around defects on the surface of film and change the colour of it with laser or thermal element for marking resin.*"

5. Conclusion

Two hypothetical new scenarios for new product design were created from the Patent Map with Pictogram after human-interactive annealing process (K. Horie et al. 2006).

742 claims of 106 patents for marking and inspection were divided into six individual clusters clearly as latent structure with human-interactive annealing process. These six clear division of clusters aided examinees to classify the attribution of technology and interpret each cluster explicitly (E.Goldberg 2002) (Fig.5. and Table1.). It was, however, very difficult and took longer time for them to find out matching words and create scenarios suitable for the attribution of technology. Our proposal method for pasting Pictogram to the corresponding patent number after scenario creation (H. Kelly 1980, O. Eris 2004) aided them not only to interpret each cluster more precisely as multilateral datum, but also to promote the cross disciplinary communication among examinees in different expertise(R. Fruchter et al. 2005).

Furthermore, additional data of patent registered year to 742 patent claims expressed core patent technology by year on the Patent Map and leaded examinees to understand the transition of patent technology chronologically.

Finally, showing another Pictogram on hidden event numbers at the beginning narrowed the degree of ambiguity and/or disharmony of conceptual combination (W. Graver 2003, F. Costello and M. Keane 2000) among dark events and their connected clusters, and had them perceive how to reintegrate them dimly.

It was confirmed that the application of human-interactive annealing and data crystallization process was performed well for creating hypothetical new scenarios for patent. The tasks below, however, should be solved for the efficiency of creating hypothetical new scenarios.

1. Improve the visualization of words on each cluster to show the relation of them easily.

2. Prepare multilateral datum of nodes on clusters, which connected to dark events to narrow the degree of ambiguity of dark events.

3. Modifying and improving these tasks of human-interactive annealing and data crystallization process, the other application for real business can be expanded to consumer behaviours analysis in marketing, marketing strategy, analysis of disciplinary boundaries, etc.

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