Visual Brainstorming in Concept Project Development in the Power Industry

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1 Introduction

Visualization as a method of dealing with complex tasks is an area of increasing interest for concept specialists. Experts are inspired by the work of designers and architects, which involves the creation and analysis of visual constructions. Complex tasks tend to share the following characteristics: the unique, challenging nature of the problem, a complete lack of new ideas to address it, tight deadlines, huge amounts of data to be analysed and the participation of many experts from different spheres.

The technological modernization of the power industry and other knowledge-intensive industries is an example of such a task. Innovative projects in a high-tech industry are characterized by the following three features: the long lead time it takes to adopt innovations, which means a long investment lag; secondly, a lot of interdisciplinary links (technologies – economy – environment – human resources); and finally, the overriding priority of technological reliability over business outcomes [1]. All these imply strict requirements imposed on the project rationale.

Visualization [2] significantly saves time and resources spent on problem solving. It also considerably increases the chances of finding an original solution. This study presents the results of project solution developments achieved by applying information visualization.

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2 Description of the Visualization Method

Development of a concept project requires a systemic approach, that is, the project should be conceived as a single whole. The integrated picture of a project provides a foundation for the correct solution being formulated and found by different specialists. This integrated picture of the system can be represented by a visual image which is elaborated through brainstorming.

Visualization means graphic modelling of systems, for instance, with the help of schemes, diagrams, mind maps, pictures, and storyboarding. Visualization provides an answer to the question: 'What does the structure of the object look like?'

If we are constructing a visual image of an object, it means that we visualize it in order to illustrate its distinctive associative features which, in their turn, will enable us to reveal and analyse its meaningful and functional qualities. The visual image is an answer to the question: 'What does the object look like?'

Visual brainstorming is a method of solving a problem by considering visualized information. That is, the team involved in the process has to 'switch' between the space of the initial information about the problem and the image of the problem, which allows them to see the problem from different angles and thus discover the solution (Table 1).

The visualization method stimulates the team's collective intelligence more efficiently [3].

- The group's intellectual potential increases when the participants can work with information presented in graphic schemes.
- Visual forms complement verbal forms by providing more opportunities for comparison and construction of mind maps.
- People are more actively involved in the task since they have a general picture to which they can add their own details.
- Graphic materials expand the collective memory, which means that it takes less time to improve the group's productivity.

Let us consider the impact of this method by using an achievement strategy as an example. Suppose there is a desired goal which can be represented by a circle and supplied by the appropriate heading. The achievement process means movement towards the goal through a range of steps involving resources and tools [4, 5].

Table 1 The fact area and the association area

| **Space of the problem, facts and logic**	Describe the problem and the restrictions to its solution	Make a plan and choose the tools	Detailed analysis	Analysis of the solution image. Check that the solution conforms to the restrictions
Space of the image, associations	Visualize the description, reimagine the problem	Visualize the information in accordance with the tools	Visualize the connections and search for options	Specify the solution, search for a more precise image of the solution
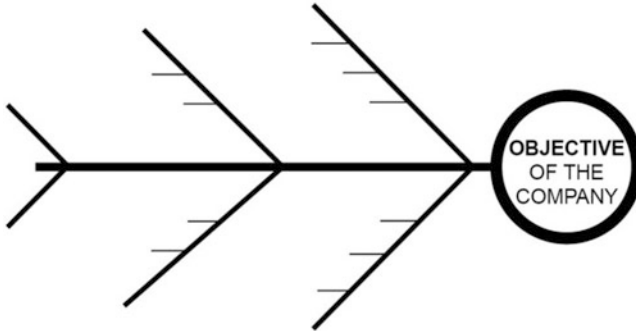
Fig. 1 Ishikawa diagram: classical concept [6]

To show the achievement process, we organize the instruments and resources into a well-ordered structure, reflecting this movement. The question to be asked here is the following: What scheme or diagram can be used to visualize the process of achieving the target? The most suitable type of diagram is the Ishikawa diagram (Fig. 1). Let us analyse the potential of its visual image.

As we can see, the diagram's elements are arranged horizontally, from left to right, which corresponds to positive, successful movement. The target is shown in the circle on the right, by the 'head' of the 'fish' (supplied with an appropriate heading); the main arrow (the 'spine' of the 'fish') is directed at the target and includes additional arrows with smaller 'bones'. The lines are directed towards the target and illustrate the integrated achievement system.

Now the task is to put all the relevant information into this logical structure. If there is no information, then brainstorming begins. What is the heading for the main arrow? Obviously, it should be the strategy. Why are the symmetrical 'bones' necessary? In the case described here, these 'bones' can identify the measures to be taken. They can then be divided into two equal groups, each comprising some more specific steps. Then the 'bones', for tools and resources, are completed (Fig. 2).

This diagram reminds us of a fish skeleton, which explains why it is called 'a fishbone diagram'. Using its characteristics, let us move to the association area and make a deeper analysis of this image. Where does the fish live? What are the peculiarities of its habitat? What prevents the fish from moving forward (for us, this movement corresponds to achieving our goal) and what helps it? What are the threats faced by the fish? What are the opportunities it has? The answers to these questions help us get a more detailed picture of the environment in which we are trying to meet our target (Fig. 3). Let us add some more details to the picture.

Next to the arrows, there is a place for stickers with environmental factors. It is also recommended to supplement this visualization with the quantitative characteristics of each object group. We create, therefore, an integral picture of the system by constructing and analysing the information's visual image. This picture can serve as a basis for making a detailed analysis of the strategy for the achievement of our goal.
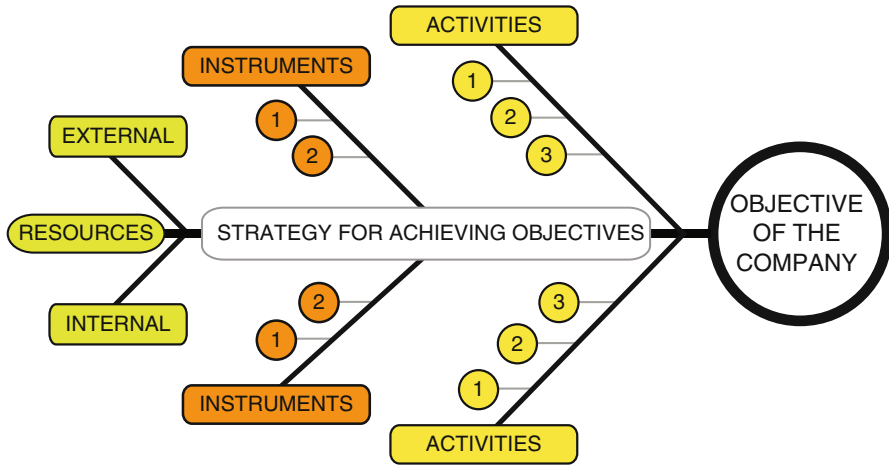
Fig. 2 Ishikawa diagram: information systematization

Fig. 3 Ishikawa diagram: environment

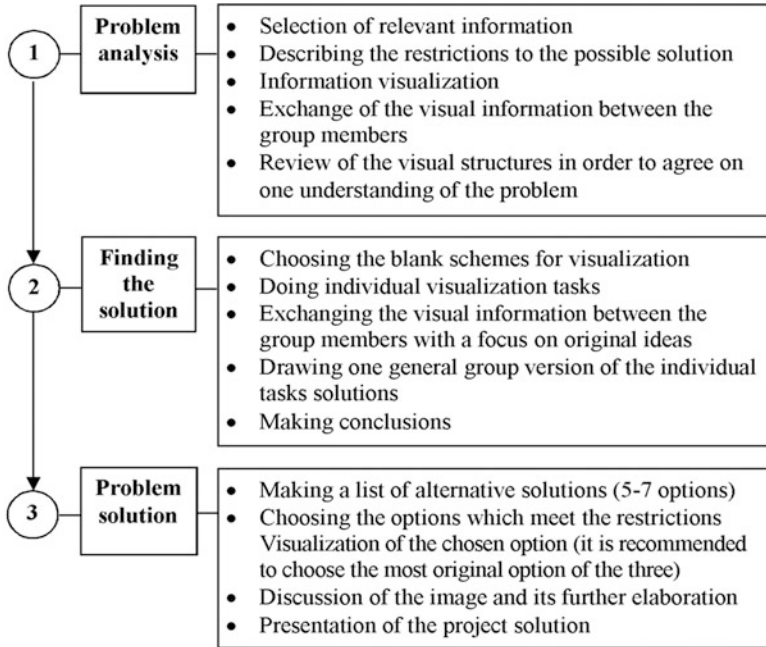|		
1 —	**Problem analysis**	• Selection of relevant information • Describing the restrictions to the possible solution • Information visualization • Exchange of the visual information between the group members • Review of the visual structures in order to agree on one understanding of the problem
2 —	**Finding the solution**	• Choosing the blank schemes for visualization • Doing individual visualization tasks • Exchanging the visual information between the group members with a focus on original ideas • Drawing one general group version of the individual tasks solutions • Making conclusions
3 —	**Problem solution**	• Making a list of alternative solutions (5-7 options) • Choosing the options which meet the restrictions Visualization of the chosen option (it is recommended to choose the most original option of the three) • Discussion of the image and its further elaboration • Presentation of the project solution

Fig. 4 Stages of practical implementation of the visual brainstorming method

3 Practical Application of the Visualization Method

Thanks to the universal character of visual language, it is possible to grasp the meaning of what your team members have drawn much more easily: this allows the team to spend their energy more efficiently. Visual images bring you to new levels of understanding of the information you are already familiar with.

The skills of information processing are essential for successful implementation of this method (selection of relevant information, representation of the information in the form of structural links, transforming characteristics of the image into the features of the system in question, etc.).

Stages of practical implementation of the visual brainstorming method are demonstrated in Fig. 4.

4 Testing the Method

Practical application of the visual brainstorming method in developing concept projects can be illustrated by the project 'New Leaders for Modernization of Power and Other Hi-Tech Industries'. The project is based on the idea of a partnership between the leading universities and large businesses by creating an integrated

technological platform. The project is expected to generate a range of the following commercial products: a system of management training meant for those professionals who have innovative competencies and the tools for stimulating innovation processes in energy companies.

The strategic session involved and included promising managers of energy companies and master's degree students. Summarizing the results of the session, the group had to answer the following questions:

1. Who can this project be sold to?
2. What are the stages of project development?
3. What is the cost of project implementation?

The work was divided into several stages: for the warm-up, the participants carried out the task 'Visual Dictation', which involved making quick sketches of various terms. The goal was to practise the skill of transforming a verbal term into a visual image put on paper.

To encourage the team to answer the questions, the moderators provided blank schemes to be completed with the relevant information. The tasks were done on a paper roll by using felt-tip pens and sticky notes.

Who can this project be sold to? The participants were divided into two teams to construct a customer profile according to the scheme given. The resulting customer profiles were recognizable but also had some unique features. Moreover, the values of the potential customers were revealed [7]. After finishing the work, each group presented their 'customer portraits' and suggested formats for implementing the project in question.

What are the stages of project implementation? To describe the stages, it is essential to understand the nature of the changes the project undergoes by applying the visualization method (see Table 1). Visualization makes it possible to generate innovative solutions, sometimes left unnoticed when following only conventional logic.

The group's collective intelligence can prove to be helpful in finding a more capacious image. Each participant draws an image to reflect the project's features in the best way. Then the participants take turns to present their images explaining why they think these images are suitable. As a result of the presentations and discussion, the group chooses the optimal option. In our case it was the image of an octopus (its characteristics include an ability to multitask, to develop, to regenerate; it also has powerful tools to achieve its targets and a safety system).

Now it is necessary to draw the growth of an octopus from a cell to an adult species, which includes four stages of development: a cell in a test tube, a baby octopus in the fish tank, a young octopus in the ocean and an adult octopus. Each stage of development corresponds to specific growth conditions, environmental factors, and threats and opportunities for project implementation (see Fig. 3). This script can be presented as a table by converting the images into more conventional project characteristics that analysts are familiar with.

Table 2 The formalized result of the visual brainstorming session: the marketing concept of the project

Products	Specialists with innovative leadership competencies	Set of tools for intensification of innovative processes and upgrading the human resources of an energy company	
Markets	Labour	Consulting services	Educational programs
Market segments	Unique specialists	Development consultancies for transformations	Exclusive staff training
Consumers	Government Business entities Universities Research centres Analytical agencies	Business entities Corporate universities Research and educational centres	Gifted bachelor's and master's degree graduates Promising young specialists Managers seeking self-development

In this manner, we get the answer to the second question: a description of the project implementation stages, the threats and opportunities for each stage, the structure of resources and the results of the project implementation expressed in the values of each client group involved.

What are the costs of project implementation? To calculate the costs, it is necessary to specify the functional properties of the project and the resources it requires. Visualization of this question is done in the following stages: project functions; finding the optimal image which would reflect the functions; constructing a more detailed large-sized image; the scheme of resource management and the work of the specific functional parts of the project; and the calculation of costs.

The answer to the third question is the following: the organizational scheme of the project, the implementation stages and the calculation table reflecting the analysis of the cash flow for the project ('New Leaders for Modernization of Power and Other Hi-Tech Industries').

After combining all the visual images, the participants of the strategic session, supervised by the moderators, presented their marketing concept according to the scheme 'products – market segments – consumers' (Table 2).

5 Conclusion

The visualization method described in this chapter is aimed at switching from the usual 'verbal' forms of work with information to working with visual images of the system. This launches the process of devising original solutions for complex problems with a high degree of uncertainty. The method is particularly suitable for teamwork: it increases the efficiency of the collective intelligence along with the objectivity of project solutions.

As experience confirms, in the power industry, this technique can be productive not only in projects developed for specific enterprises but also for complicated tasks

shared by the whole sector. For example, when launching programs of energy demand management, described in Ref. [8], the following questions should be addressed:

- Who is the program sponsor: the energy company, consumer or the state?
- What program should be chosen as a pilot?
- What additional financial and legislative initiatives should be adopted?
- How should regional manufacturers of energy-efficient equipment be supported?
- Who is responsible for the results of the program implementation?
- How should demand management programs be connected to the strategies of energy companies and so on?

Thus, the visualization method can be applied as an effective brainstorming tool when developing innovative projects of technological modernization in the power industry. It can also be used for training managers.

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