

## Investigation of Team Synergy in Collaborative Design Case study: International Engineering Design Workshop

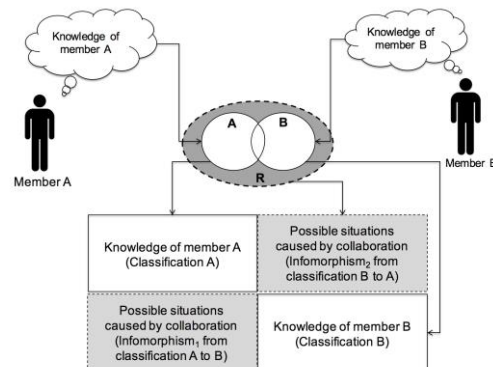
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A novel method to construct mathematical models of collaboration mechanisms in context of design process is proposed. In design process, miscellaneous knowledge is required for achieving desirable goals. Collaboration is a crucial method that contributes designers to create prime solutions by sharing their knowledge within a team. During a collaboration, valuable novel knowledge that is not held by the members could emerge due to synergistic effect. Hence, collaborations which derive powerful synergistic effects are required in teamwork. However, the mechanism of generating such knowledge is implicit and difficult to obtain the effects.

The proposed model has ability to illustrate all possible situations which may occur from the collaboration. Hereby, fruitful collaboration can be visualized by using the proposed model.

Assume a situation in which two members who have different academic backgrounds work jointly in a group. Each solid circle indicates a set of knowledge held by a member. Due to the different disciplines, each knowledge is different with another. That is why the two circles do not overlap entirely with each other.

Due to synergistic effect in the collaboration, team performance cannot be calculated as a simple union of the abilities of each member ( $A \cup B$ ). Possible solutions domain of the team can be indicated as grey area ( $R - (A \cup B)$ ). This situation can be represented by using classification of Channel Theory as shown below the circles in Fig 1.



Here, we can deduce the situations, which are possible to obtain from synergistic effect by using infomorphism. Consequently, team synergy can be investigated with the proposed scheme.

To show the usefulness of the proposed model, international engineering design workshop is discussed as a case study. The proposed model is adopted to the step of team formation. The model has

ability to visualize all possible situations, which may occur from the collaboration. Thus, we can utilize the model to select proper members. During the workshop, the participants are grouped in team. The teams are assigned to propose a new system to raise awareness for traveler about “arts things” in the old city. Finally, each team need to make a presentation for showing their created system.

In this workshop, the participants are Thai and Japanese students from engineering course and media design course. The model of collaboration between them is structured based on the proposed model is structured. Knowledge of students from engineering course is performed as a classification of engineering knowledge. Meanwhile, knowledge of students from media design course is performed as a classification of media design knowledge. From the model, there are abundant situations obtained from the collaboration. It implies; the collaboration between students from engineering course and media design course should be effective.

During the workshop, the participants need to take part with brainstorming sessions and make presentations many time. However, the participants come from different backgrounds, they were not familiar with each other. Thus, to improve relationships within their own team, the teams have played some games before the brainstorming sessions such as Paper Tower and Marshmallow Challenge.

In the beginning of the workshop, the participants were instructed to observe art works in the city. The

instructor told the participants to take photographs of their interesting things and show them other members to discuss in the brainstorming steps.

After the survey step, the participants made group discussions with the members of the team to propose a system for supporting awareness about arts things. The group discussion was conducted with KJ method. KJ method is a fundamental tool to organize ideas and data through a brainstorming. During the the process of KJ method, members were sharing their observed information by using the photographs, short notes and sketches, which were taken in the survey step. After the brainstorming steps, the teams made presentations for showing their collaboration’s outcome. In the last day of the workshop, each team made a final presentation of their proposed system. The results showed; the participants could accomplish the desired goal greatly.

As the results, we can say the proposed model can represent explicitly several situations, which may occur in a collaborative design process. This scheme could be used to assist us to recognize all possible situations and support awareness for team manager when constructing a team member.