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SYNOPSIS

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**Knowledge Representation of Grids in Graphic Design  
and its Application for Analogy-Based Design**

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# Knowledge Representation of Grids in Graphic Design and its Application for Analogy-Based Design

Design as a process of originating and developing a plan for a product, structure or system has close associations with art, architecture and technology. Research is an intrinsic aspect of design practice and is an essential part of problem solving. However, in graphic design practice, research as a knowledge-based activity is still in the pre-paradigmatic phase. Graphic design draws the terminologies and methodologies from other disciplines like humanities, social sciences and engineering but it undoubtedly has its roots in fine arts. Likewise, the basic concept of the research area presented here was triggered by an exposure to the grids discovered in ancient Indian murals and sculptures by Boner (1962). The aim of this research is to understand the state of the art of graphic design processes involving grids and to represent the knowledge gained in a theoretical framework for further applications.

This study is rooted in the field of *graphic design* and so is the area of application. Graphic designers, both students and professionals, are the expected beneficiaries. The topic of interest here is the *transfer of syntactic knowledge across the distant domains of design* and the focus is on *the grid*, a well-known tool in design. The issue of developing a systematic method to transfer grids across domains originated from the need to transfer knowledge from ancient Indian art practice to contemporary design practice. Literature (Trivedi, 2008) (Trivedi, 2010) (Vyas, 2000) (Balaram, 1998) claims that the knowledge<sup>1</sup> from Indian art practice will improve the quality of graphic design practice<sup>2</sup> but hardly any support exists to strengthen this assumption. In case of the knowledge transfer between modern design practice and traditional art/craft practices, the importance of cultural and contextual knowledge is always emphasized through the literature (Martin, 2006) (Vyas, 2000) but the

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<sup>1</sup> The knowledge here includes contextual (socio-cultural) knowledge, procedural knowledge, knowledge pertaining to the use of different tools, techniques and skills, and the design patterns/ cases acquired through design experience.

<sup>2</sup> The quality of design practice can be evaluated by the quality of design product, quality of design process and the factor of novelty.

procedural knowledge is never given enough attention. By focussing on the grids, this work is aimed at developing a method to transfer the procedural and structural knowledge across design domains.

This work is based on another common assumption in design research that the design is a complex process and a systematic, knowledge-based design support will help to understand and improve the design pedagogy and practice. The aim of this research is to provide support for the transfer of knowledge from pre-British Indian art practice to design practice. For the knowledge transfer across the distant domains it is required to build a common knowledge representation system. Knowledge representation system can also help to externalise, articulate and codify the practical and subjective knowledge.

### **Research questions and objectives**

The research inquiry was initiated with the exposure to Boner's work<sup>3</sup> (Boner, 1962) on image making in Hindu temples in India. She had proposed a compositional principle, based on grids, followed in temple wall sculptures across north and middle India. The grid proposed as time division and space division was a complex but effective technique for visual composition. This interesting finding of art history had posed a question for designers. The literature on pre-medieval and medieval art in India shows evidences of use of grid in various forms. Grid is a well-known organizational principle common in both ancient Indian art and design. Today, designers are not involved in making temple sculptures; the society has changed and so has the medium. However, can we use this tool in the completely new context of modern design? This question directed us towards the need to build a systematic approach for cross-domain knowledge transfer. This research is focussed on the knowledge of grids used for graphic design. Analogy-based design is determined as an approach for knowledge transfer. Analogy plays a very important role in design cognition and the analogy-based design support developed in design research has proved to be useful (Goel, 1997). The research question thus formulated as-

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<sup>3</sup> Alice Boner has tried to find a common compositional principle among the temple iconography across the India. In her book, Principles of composition in Hindu sculptures, she had demonstrated her theory with 21 different sites. (Boner, 1962)

*Using a systematic analogy-based approach, how to transfer the time division grid from Indian art to contemporary graphic design (without losing its relevance)?*

To tackle this research question, it is necessary to check the level of understanding about the concept of grid. The literature shows limitations in the articulation and representation of the procedural knowledge of using grids in design process. Analogy-based approach demands a uniform knowledge representation of the concept among the two knowledge domains; hence it is the first important task. The second task is to develop a support for analogy-based transfer of grids and evaluate the support by transferring the time division grids to contemporary graphic design application. The research objectives set here are-

- 1 Understanding the concept of grid within the design domain
- 2 Understanding the awareness of grid within the design community in India
- 3 Systematic articulation of the concept of grid and its application
- 4 Developing the knowledge representation of grids in design process
- 5 Proposing a prescriptive method for cross-domain transfer of grids
- 6 Exploring new possibilities by cross-domain transfer of grids

After an extensive literature review of the grids in design, the main research question has given rise to three sub-questions as listed in table 1. It is required to answer these three questions for answering the fourth research question. The methodological framework used for this research is based on the Design Research Methodology proposed by Blessing & Chakrabarti (2009). The table indicates the DRM based research stages involved in answering each question. The study is either review-based, which involves only literature review, or of a comprehensive nature, where the researcher generates new data, analysis or theory by himself. At certain stages only the initial state of study is conducted due to the restriction of time or scope. According to the types of research proposed by DRM, this work fits in **type 5** (Blessing & Chakrabarti, 2009, pp. 60-62); where the aim is to develop support, but the level of understanding of existing situation is insufficient for the support development.

## Research plan

This particular research is organized into five stages as shown in figure 1. The connection and the flow of information among these five stages are also represented. The four stages from 2 to 5 are engaged in each of the four research questions listed in table 1. The numerical indications on the top of each stage designate the chapter numbers in the thesis which elaborate that stage of the research plan. These stages connect and contribute to each other in terms of knowledge, information, skills and methods.

Table 1: Research questions and the stages involved

Research question	RC	DS I	PS	DS II
How the concept of grid is understood and expressed by design community (in India)?	○	●		
How to represent the state of the art of use of grids in design process?	○	●	●	
How the transfer of grids across various design domains can be supported?	○	●	●	○
How the support for cross-domain transfer of grids can be used to introduce angular grids from image making into contemporary design application?	○	●	●	○

○ = Review-based, ● = Comprehensive, ⊙ = Initial state

RC- Research clarification, DS I- Descriptive study 1, PS- Prescriptive study, DS II- Descriptive study 2

## Understanding of grids

This stage constitutes a comprehensive study including the critical review of available design literature, research literature and acquired raw information from the practicing designers. As this research was focused on the grids in graphic design, the relevant understanding about grids already established in the field was compiled and analysed. This research is carried out in the Indian context; hence it was necessary to take the contextual feedback and interpretation of grids and usage from the design community in India. A survey with a purposive sampling was conducted using an online questionnaire to obtain this feedback. The study of design literature and the feedback from design community was processed to formulate an overall teleological understanding of grids. This stage has provided a deeper understanding about grids in graphic design.

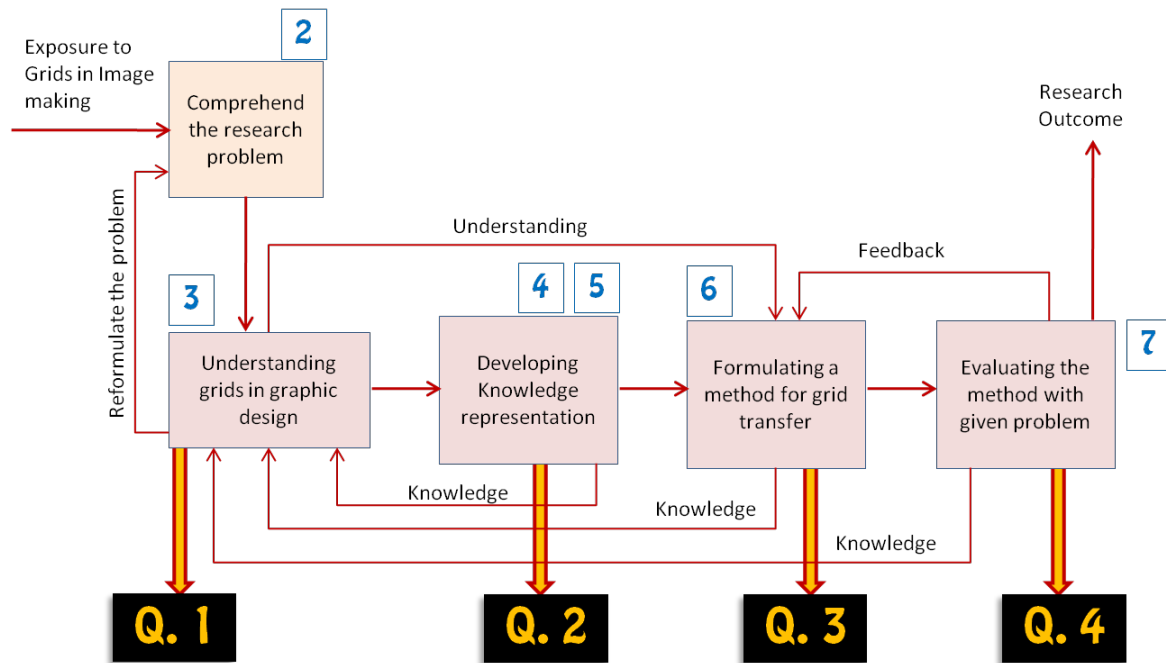


Figure 1: Research plan with five stages

## Knowledge representation

It was realized that the knowledge pertaining to grids in graphic design is neither articulated properly nor is it generalized to formulate any theory. It is mainly operational and evidential. In this stage, such tacit knowledge about grids is externalised, articulated and represented in an abstract framework. The knowledge representation is nothing but a coding system to make the knowledge explicit. The ontological framework of Function-Behaviour-Structure [FBS] (Gero J. S., 1990) (Gero & Kannengiesser, 2002) which has been proved very useful to explain the design process is used here as foundation to develop the representation of the grid in action. Grid here is treated as a designed object created by the designer to assist in visual design. The formation of grid and its use in image creation is found to be nested within the FBS path of image creation (refer figure 2). This representation is further elaborated by defining the function variables, behaviour variables and structure variables. Understanding of these variables can provide a better insight about the cognitive role of grids in image creation.

This representation has helped to analyse the problems in the current definitions of grid and assisted to formulate an efficient definition of grid which can broaden the concept and yet describe it specifically. This representation is the key for any articulation, comparison or transfer of grids in graphic design or in any other domain. With this understanding it is possible to bring the organizational principles across different domains to the same level of





thinking. The ABD method supports only problem driven scenario, whereas in design practice the use of solution driven scenario is also evident (Vattam, Helms, & Goel, 2010). As the requirement of our inquiry, this method is adopted, adapted and used for the transfer of grids in solution driven scenario, where ABD process starts with a potential source of analogy.

Based on this foundation, the method of Compare and Borrow (C&B) is proposed here as a design support for analogy based design. It helps the designer to locate the potential source and target and to identify the potential transfer unit. It provides a stepwise guidance for transferring the knowledge from source to target and finally adapting this new knowledge in the context of the target. This method based on ABD is able to produce creative design products and can introduce new design processes. When applied to transfer the grids, it usually makes changes in the design process; it may or may not change the product form.

### **Evaluation: Image-making of letterforms**

This stage is the last step of this study. The process of C&B for grid transfer is evaluated here with an initial design problem. This study started with a problem to find the application of time division grids in modern design and assess the effect of this grid in new domain. The suitable target domain found for the grid transfer was 'font design activity'. During this evaluation, image making process in ancient India is compared with the font design activity in modern design. The grids are matched and mapped with each other, and the time division grids are transferred to font design. This grid is then adapted to the digital environment of font design to control the Bezier handles of the curves of letterforms. This analogy based transfer resulted in series of font design experiments and many more possibilities for exploration. C&B had provided a methodical approach for this grid transfer and it systematically helped the analogy making and transfer of knowledge. It has made the design thinking explicit hence communicable.

### **Conclusions**

**Research outcome:** This research has produced a much better understanding about grid including its definition, function and variables. The representation of grids is developed which can help designers to articulate their process of design. It can contribute in design theory, design practice and design pedagogy. It has proposed a method for cross-domain

transfer of grids. Being well-articulated and represented, this method can provide the repeatability. Grids are borrowed from traditional image making to contemporary digital type design resulting in new methodology for font design. In font design experiment, the spine of a single font is initially created. Using this spine multiple fonts are created by variation in angle of grid. The sample of letterforms designed with a new grid is shown in figure 3.

The result of C&B evaluation is a new font design process with Bezier curves controlled by angular grid. This design approach is different than the traditional type design approach and might experience some resistance from design community. This process has adapted to digital technology hence has future potential to create a computational support. This process has created lots of opportunities for further experimentation.



Figure 3: One of the fonts designed with the proposed grids

The research in graphic design is not yet well established. Its boundaries are still expanding. The concept of design as a science is emerging from the general notion of design as practice. In this research scenario, there are lots of opportunities for exploration of new research problems in graphic design. This research is one such effort to contribute to the knowledge domain of graphic design. The main contributions of this work are-

- 1 The concept of grid as perceived by design community in India is revealed. The understanding of the concept of grid within the design domain has improved. Grid is no longer trivial element of design process. It has been taken to the serious theoretical level where scholarly discussions, experimentations and explorations with new technology are possible.

- 2 A systematic articulation of the concept of grid and the process of applying it is made available for further research.
- 3 The main contribution of this work is in formulating the knowledge representation of grid and its application in developing the support for cross domain transfer of grids. This knowledge representation can help designers to externalise and to communicate.
- 4 A prescriptive method for cross-domain transfer of grids is proposed which can support design activity. Designers can transfer the knowledge across time, space and domains using this method. It has created lots of new opportunities to explore the cross-pollination of grids across different design domains.
- 5 It has contributed to font design domain with a new approach for font design. This approach can be further developed with computational tools. The research has generated sets of Devanagari fonts.

This research bears few limitations in terms of external validation and computational support which can be taken further as a future work. This work concludes with the further scope for field evaluation and further iterations to improve the provided support. Also a lot of exploration possibilities are arising from the initial font design experimentation.

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