

## REFLECTIONS

# Learning from the past, peering into the future: 25 Years of *AI EDAM*

AMARESH CHAKRABARTI

Centre for Product Design and Manufacturing, Indian Institute of Science, Bangalore, India

## 1. INTRODUCTION

This Reflection provides a broad overview of the publications in the 25 years of *AI EDAM*, identifies some of trends in its evolution, and looks into the future to project what we might continue from the past and what we should embrace in the future.

In order to create the overview, I analyzed the titles of all of the papers in 12 specific years of publication (<http://www.journals.cambridge.org/aie>). Although I could have analyzed all 25 years, such comprehensiveness seemed unnecessary for identifying broad trends. In addition, I could have used the keywords in the papers for this analysis, a common approach used earlier by editors in several other journals. However, analyzing the title seemed more meaningful, because the intent of the paper would be better encapsulated in the title than in a set of keywords designed primarily to cover possible areas of interest.

The following years were analyzed: 1987–1988, 1992–1993, 1997–1998, 2002–2004, and 2009–2011. The rationale was to obtain a broad understanding of the evolution of the Journal by looking at papers in 2- to 3-year clusters that are approximately 5 years apart; the 2-year clusters were used from the beginning to the middle and the 3-year clusters for the rest. The rationale was to see the trend in greater detail in the nearer years in order to better understand where the Journal has been heading in recent years.

The titles were analyzed using two sets of categories: research focus and research facet. *Research focus* is the broad focus of the work reported in an article. Generalizing from Chakrabarti and Blessing (2009), the goal of design and manufacturing (DM) research is to develop knowledge with which to help DM to become more successful, where success can be measured in a variety of ways, including improving the well-being of society or increasing the efficiency of an activity. The objectives of DM research therefore are to develop

knowledge in terms of understanding these activities and using this as the basis knowledge with which to support the improvement of research, practice, and education of DM. The following focus categories represent these objectives:

1. “develop understanding” means that the article focuses on understanding an area of activity (e.g., generation of designs) or the status of support in the area of activity (e.g., supporting generation of novel designs),
2. “develop support” means that the article reports the development of support to improve some aspect of an activity (e.g., help generate a larger number of novel designs),
3. “evaluate support” means that the article reports the evaluation of a means of supporting an activity (e.g., whether a proposed support can actually help generate a larger number of novel designs),
4. “develop research method” means that the article reports the development of a method or methodology to help carry out certain research activities (e.g., what is an appropriate research method to test whether a means of support is responsible for generation of a larger number of novel designs?), and
5. “develop pedagogic support” focuses on educating people in an area of activity.

*Research facet* categories are used to represent the major factors that could influence an activity. Blessing and Chakrabarti (2009) mention five major categories of influence on design: artifact, process, people, organization, knowledge (including tools), and economy. Arguing that *both* parts of DM are influenced by *all* of these facets and that research in these areas involves investigating DM and their *relationships* to these facets (Chakrabarti, 2011), the facet categories used are the following:

1. “artifact” means the aspects related to the *object* (i.e., product or manufacturing system) and their influence on the activity (i.e., design or manufacturing) or its success,

Reprint requests to: Amaresh Chakrabarti, Centre for Product Design and Manufacturing, Indian Institute of Science, Bangalore 560012, India. E-mail: [ac123@cpdm.iisc.ernet.in](mailto:ac123@cpdm.iisc.ernet.in)

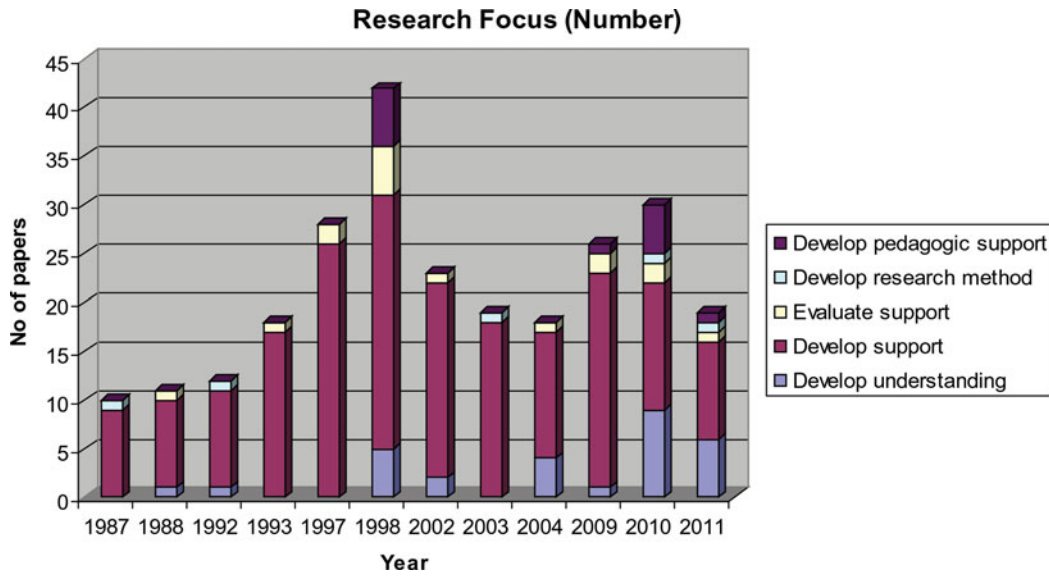


Fig. 1. Research focus on the number of articles. [A color version of this figure can be viewed online at <http://journals.cambridge.org/aie>]

2. “process” means the aspects related to the *process* followed in carrying out an activity and their influence on the activity or its success,
3. “people” means the aspects related to the *people* involved in carrying out an activity and their influence on the activity or its success,
4. “organization” means the aspects related to the *organization* within which an activity is carried out and their influence on the activity or its success, and
5. “economy” mean the aspects related to the *economy* within which an activity is carried out and their influence on the activity or its success.

Figure 1 shows the distribution of the number of articles per year across the focus categories, and Figure 2 shows the same in percentages per year. Note that the dominant focus was on reporting the development of support. A much smaller number and percentage of articles were consistently focused

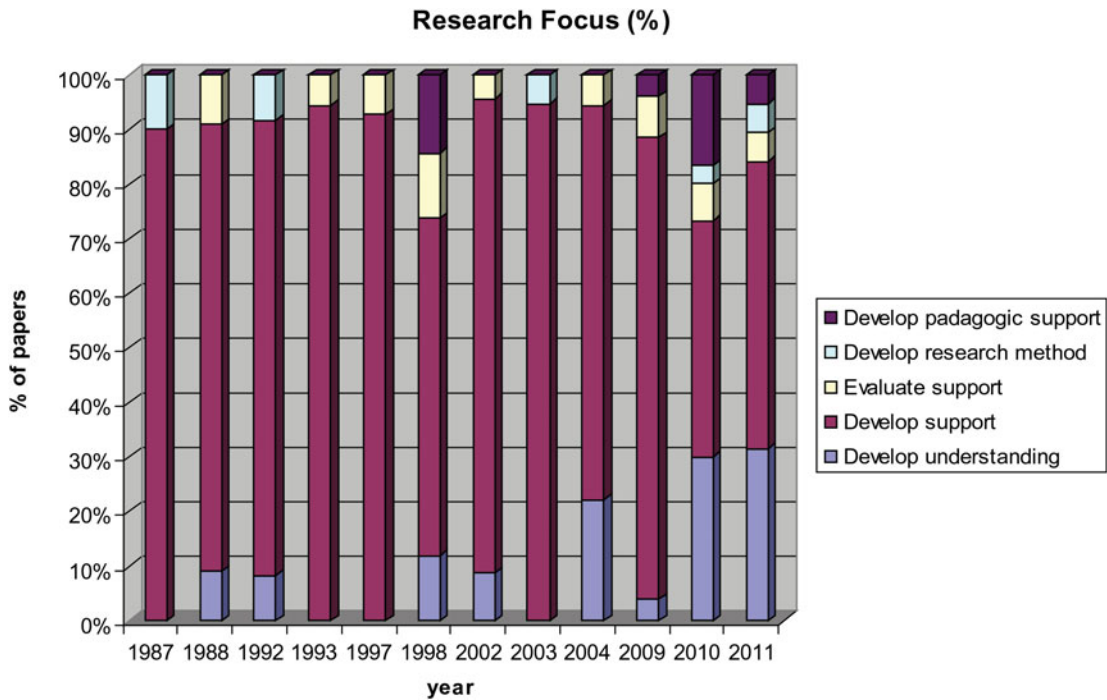
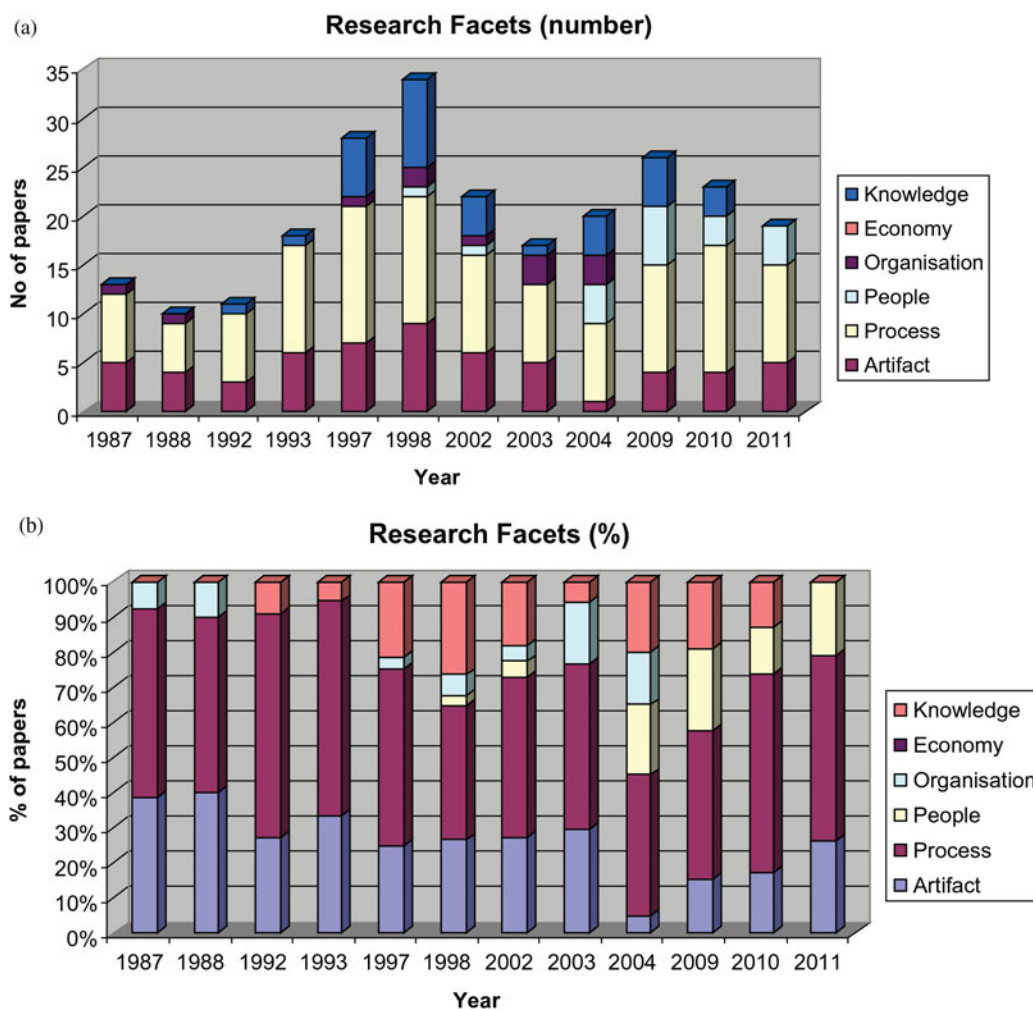


Fig. 2. Research focus on the percentage of articles. [A color version of this figure can be viewed online at <http://journals.cambridge.org/aie>]



**Fig. 3.** Research facets according to the (a) number of articles and (b) percentage of articles. [A color version of this figure can be viewed online at <http://journals.cambridge.org/aie>]

on evaluating support, whereas articles on research methods or pedagogy were more sporadic. One interesting, recent trend was a relatively steady increase in the number and percentages of articles reporting the development of understanding, that is, models and theories of “what is.”

Figure 3a provides the distribution of the number of articles per year across the facet categories, and Figure 3b provides the same in percentages per year. The dominant facets were process and artifact, with a fairly steady, but less dominant presence of knowledge. An interesting development in recent years was a steady increase in articles within the people-related facet, such as those focusing on collaboration, negotiation, trust, and skills. Economy and its relationships to design or manufacturing were not the focus of any article published in the Journal, and organization-related articles appeared only sporadically.

Counting the number of articles (not shown in the figures) belonging specifically to DM reveals that published articles focused almost entirely (>95% on average per year) on design rather than on manufacturing.

## 2. TRENDS

The broad trends that were identified are as follows:

- The consistently dominant area of study in *AI EDAM* has been design rather than manufacturing.
- The consistently dominant areas of focus have been support development (and some evaluation), with a steady, welcome increase in the percentage and number of articles on developing understanding.
- The consistently dominant facets of study have been process and artifact, with a smaller but relatively steady presence of knowledge. More recently, there has been a steady increase in articles within the people-related facet.

A more detailed look into the content of the titles reveals a number of specific trends:

- The earlier decades of *AI EDAM* focused primarily on enabling technologies such as case based reasoning or

qualitative reasoning, and the focus of the current decade has been increasingly on the goals and characteristics of the areas of activity such as multimodal design or design in teams. Overall, the Journal seems to be shifting *from being enabler driven to becoming goal driven*.

- A number of the topics seem to have persisted across the life of the Journal. Some of these in the enabler category are machine learning; evolutionary algorithms; neural networks; knowledge based systems; fuzzy/rough sets; models of function, behavior, and structure, particularly function and feature models, intelligent agents, and constraint management. Some of the goal-driven topics are representing function, designing configurations, capturing rationale, and supporting creativity.
- Although automation remains the goal for some of the articles, there are also an increasing number of articles that use computing for support, interaction, or stimulation and inspiration.

### 3. LOOKING INTO THE FUTURE

Overall, *AI EDAM* continues to remain a design computing journal, as it evolves to become more goal-oriented and broadens its scope to embrace more people-related aspects. It seems to have a number of persistent goal and enabler themes, indicating their generic importance, complexity, or usefulness.

*AI EDAM* also sits within the broader milieu of the design research community, who are both its users and providers. What are the aspects of importance to the design research community that *AI EDAM* does not focus on currently? My analysis indicates that the current articles focus mainly on the *use phase* of a product's life cycle, a little on its *manufacturing phase*, but very little beyond that. *After-use phases* of a product's life cycle are rarely addressed in *AI EDAM* articles. Even within the use phase, very few articles and special issues focus on user needs, desires, and requirements. Among issues

that span the life cycle, the articles focus primarily on performance related issues, rarely addressing costs, for example, life cycle costs, environmental costs, or sustainability costs. Further, the articles traditionally focus on products rather than on product service systems or complete product life cycles.

That brings me to my wish list. I feel we should retain the design computing character of *AI EDAM*, which gives its special niche in the research community. We should also be flexible in encouraging articles that report the development of understanding, because support development must be based on a thorough understanding of the situation that the support intends to improve. Those reporting support development should be encouraged to also carry out and report support evaluation. In addition to continuing with artifact, process, and knowledge related facets, the Journal should encourage articles in people and organizational facets.

We also need to revisit persistent themes to regularly update the readership on their progress. In addition, scouting should continue for new goals and enablers of importance. For the latter, I suggest ecodesign and sustainability, design of product service systems and product life cycles, and human factors and user-centered design.

Finally, *AI EDAM* is and should always be known for its quality. Design research is difficult, because it sits at the cross-roads of multiple disciplines, requiring integration of research methods from many areas. Regular revisits and critical investigation of research methodology in design is a distinct value that *AI EDAM* can offer to its community. Design research methodology therefore constitutes the last, regular area that I would be inclined to add to my wish list.

### REFERENCES

- Chakrabarti, A. (2011). Towards a taxonomy of design research areas. In *The Future of Design Methodology* (Birkhofer, H., Ed.), pp. 249–260. New York: Springer.
- Blessing, L.T.M., & Chakrabarti, A. (2009). *DRM, A Design Research Methodology*. London: Springer-Verlag.