PLANNING AUTOMATION WITH A RELATIONAL MATRIX

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ABSTRACT

The purpose of this paper is to present a relational matrix of process, demands, and tools in automation as a framework in CAD education. Automating process is a closely related sequence of steps from clarifying demands, evaluating tools, operating study, purchasing equipment, training, maintaining, to renewing outdated equipment. Demands reflect a firm's expectation. Clarifying CAD demands is the first step in automating process, and clarified demands explicitly define the goal for automation. The demands include amount of work, content of changes, drawing specification, drawing generating process, data exchange, error-proving procedure, equipment management, training plans, etc. Proper selected tools facilitate automation process and ensure the efficiency and effectiveness in fulfilling a firm's demands. The selection is made according to the considerations associated with software, operating system, and hardware. In order to promote the CAD education in a new era, this matrix is introduced as a framework of automation.

INTRODUCTION

Current Taiwan Status

Eight-seven percentages of architectural firms in Taiwan have staff members less than ten persons [2]. Those firms are so small that their ability in automation-related research and development is very limited. For those firms develop automation strategies to meet their own needs, not only are the strategies have limited application scope but also cannot be shared by other firms without major modifications.

Building Research Institute (BRI), which is one of architectural research institutes in Taiwan, has conducted researches in automation regarding the establishment of standards, typical details, strategies, file management systems, etc. These researches are conducted to meet native demands. Existing research results, associated with current technology, have not updated the curriculum of current CAD education in automation.

The automation-related CAD education in school should reflect current technology and enhance the knowledge for future practice and interaction among architecture firms [4]. Tradition CAD education, which emphasizes drafting and modeling, lacks relevant studies of process, tools, and demands in automation. Today, the scope of architecture practice has broadened that heavy interest has concentrated on issues of automation [5]. The enlarged scope, including the ability to put automation into practice, enlarges the role of an architect as a "knowledge broker" [6]. In order to reflect the changes, CAD education should also emphasize analytic issues in automation and relevant practicing process and tools [3].

Purpose

The purpose of this paper is to present a relational matrix of execution process, demands, and tools in automation as a framework for CAD education. The contents of the matrix are also discussed.

RELATIONAL MATRIX OF AUTOMATION

The efficiency of architectural design process can be facilitated by providing well-planned information structure and manipulation flow. In order to ensure a desirable result, the design related information needs to be substantially categorized, so that tools and operating process can be planned accordingly. The categorization process will consider the inter-relationships occurred among all possible components. The components actually result in a framework, a relational matrix (see Fig. 1), consisting three axes that represent process, demands, and tools. The efficiency of architectural design process can be ensured only if demands are clearly defined, execution process is well planned, and tools are properly applied.

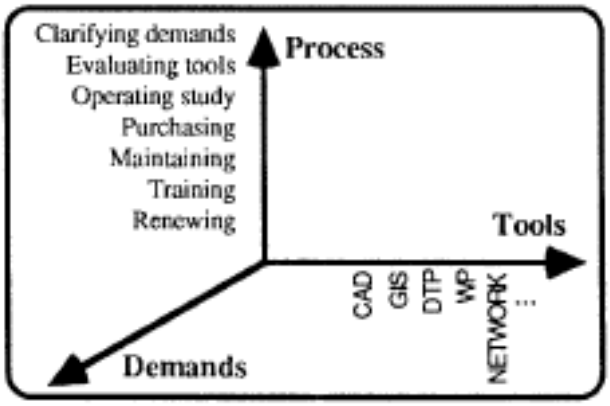

Figure 1. Relational matrix

Automating Process

Automating process is a close-related sequence of steps starting from clarifying demands, evaluating tools, operating study, purchasing equipment, training, maintaining, to renewing outdated equipment (see Fig. 2). The first three steps, which are cross-referred, constitute a decision loop. The training and maintaining steps are executed simultaneously after CAD equipment is purchased. Renewing outdated equipment removes machines that do not meet CAD demands.

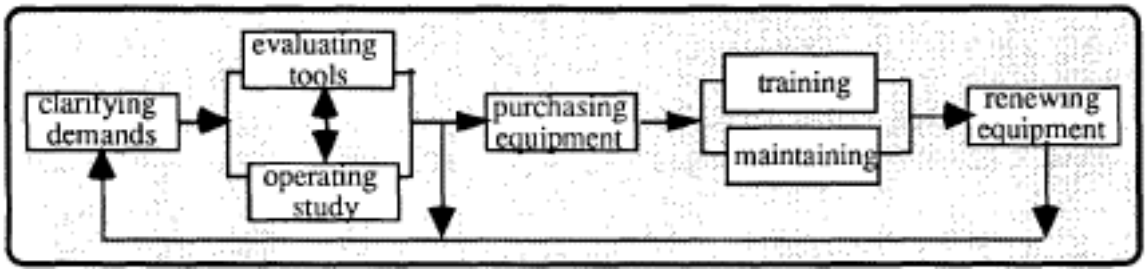

Figure 2. Automation process

Automation Demands

Demands mainly come from the analysis of work types (newly built or renovation jobs, residential or highly functioned buildings [1]) and design process. Clarifying demands is the first step and is very influential for subsequent steps in automating. Since demands reflect a firm's expectation, clarified demands explicitly define goals. The analysis of demands should include items as follows.

1. amount of work: including amount of drawings, drawing examining frequency, drafting process, drawing generating flow;
2. content of changes: including the frequency of minor and major design changes in terms of displacement, rotation, scaling, etc. for walls, symbols, text, etc.;
3. drawing specifications: including a firm's standards for drawing sizes, drawing media, application of symbol libraries, etc.;
4. relationship among drawing data: should drawings be generated individually or from a centralized data base to ensure the consistency (the interrelationships among plans, elevations, sections, details, etc.) among drawing contents?

5. data exchange: including data format and sharing method between internal departments or outside contractors or design firms;
6. error-proving procedures: including the marking, checking, and proofing procedures of revised design or drawing;
7. equipment management: centralized or de-centralized layouts and consequent operational process;
8. training plans: including the management and training of draftspersons and designers.

Tools for Automation

Not only a firm's CAD department needs tools to fulfill demands, but also administration department needs proper tools to support CAD department. Proper selected tools facilitate automation process and ensure the efficiency and effectiveness in demand accomplishment. Tools are mainly evaluated according to price-performance ratio. The evaluation is classified into software, operating system, and hardware. A description of tool types is listed in Table 1.

Table 1. Tools for automation

1. CAD
   - drafting
   - modeling
   - rendering
   - analysis
     - scheduling
     - interference checking
     - building codes
     - bill of material (BOM)
     - structural analysis
     - energy analysis
     - light simulation
2. Geographic information system (GIS)
3. Word processing
   - application & tools
   - OCR
   - style checkers
4. Desktop publishing (DTP)
5. Multi-media
   - animation
6. Graphics
   - utilities
   - clip art
7. Business software
   - desktop presentation
   - integrated applications
   - project & time managers
   - database managers
     - date, calendar
   - charting/graphing & statistics
   - spreadsheet
8. Finance & accounting
9. Database management system (DBMS)
10. Communication
    - net-working
    - connectivity
    - terminal emulation
    - dial-up services
11. Programming language
12. Utilities
    - virus protection
    - security
    - back-up software
    - macro generators
    - system utilities

1. software: considering price-performance ratio, service quality of CAD venders, compatibility with network and different formats, levels in fulfilling demands, customization potentials, user interface, etc.;
2. operating system: considering price-performance ratio, portability, file security, trend, compatibility, etc.;
3. hardware: considering price-performance ratio, vender service quality, compatibility, speed, capacity, portability, etc.

CONCLUSION

Demands, tools, and process constitute a three-dimensional matrix that defines the scope for planning automation. Only properly applied tools associated well-planned process can fulfill demands. In order to meet the CAD education of a new era, this matrix should be introduced as a framework for automating.

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