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PANEL #3

SOFTWARE ENVIRONMENTS

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A KNOWLEDGE BASED SOFTWARE
ENGINEERING ENVIRONMENT TESTBED

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The Carnegie Group Incorporated (CGI) and the Boeing Computer Services Company (BCS) are jointly developing a knowledge based software engineering environment testbed. The goal of this multi-year experiment is to demonstrate dramatic improvements in software productivity by applying Artificial Intelligence (AI) techniques to the software development process. The resultant environment will provide a framework in which conventional software engineering tools can be integrated with AI based tools to promote software development automation.

Objective

The objectives of the testbed are:

- o to demonstrate the integration of multiple techniques for a system that improves both the software development process and the quality of the software being developed;
- o to determine, through experimentation, the benefits that may result from AI technology;
- o to evaluate alternative functional implementations; and
- o to provide a preliminary development facility for building advanced software tools.

The primary emphasis of the testbed is on the transfer of relevant AI technology to the

software development process. The primary experiments relate to AI issues, such as scaling up, inference, and knowledge representation.

Approach

The approach being used is two-fold:

- o to explore the use of AI tools and techniques for a software engineering environment framework; and
- o to explore the use of AI tools and techniques for specific software engineering tools.

The environment will provide functionality for Project Management, Software Development Support and Configuration/Change Management throughout the software lifecycle. For purposes of the experiments, the development environment is considered to have three dimensions: the functional areas mentioned above, the life cycle phases, and a dimension of potential AI techniques. These potential techniques can be grouped into three major categories:

- o knowledge representation, which deals with modeling software project concepts and links;
- o inference mechanisms, which deal with the ways this knowledge can be used to solve user development problems; and
- o knowledge based interface, which deals with intelligent display, explanation, and interaction with the user.

Figure 1 illustrates the three dimensions of the experiment.

Status

We have proceeded in a breadth-first manner, performing experiments in each cell of the matrix in Figure 1 rather than concentrating on any particular cell. During the first year of the project CGI has:

- o created a model of software development by representing software activities;
- o developed a module representation formalism to specify the behavior and structure of software objects;
- o integrated the model with the formalism to identify shared representation and inheritance mechanisms
- o demonstrated object programming by writing procedures and applying them to software objects (e.g., propagating changes in a development system);
- o used data-directed reasoning to infer the probable cause of bugs by interpreting problem reports;

- o used goal-directed reasoning to evaluate the appropriateness of a software configuration; and
- o demonstrated knowledge based graphics by converting software primitives to low level graphic primitives.

Plans

Plans for the next phase include completing experiments in the remaining cells of the Figure 1 matrix along with some additional general AI experiments, including:

- o use of knowledge based simulations to perform rapid prototyping or to try alternative project schedules;
- o use of natural language interfaces for user interaction;
- o use of a blackboard architecture to permit "experts" to confer with each other to solve problems; and
- o use of distributed processing that would permit separate systems to act upon goals sent to them by others.

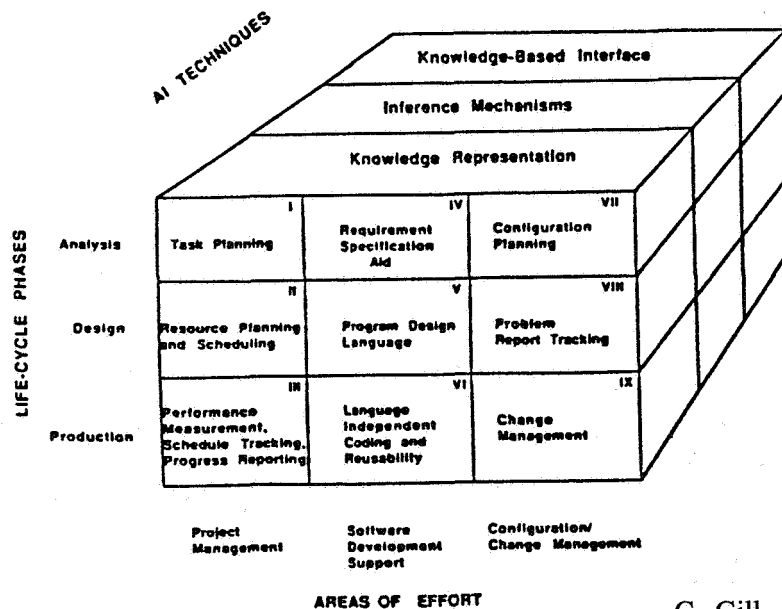


FIGURE 1: ENVIRONMENT FUNCTIONALITY

THE VIEWGRAPH MATERIALS
for the
C. GILL PRESENTATION FOLLOW



Boeing Computer Services
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A KNOWLEDGE-BASED SOFTWARE ENGINEERING ENVIRONMENT TESTBED

Presentation to

NASA

TENTH ANNUAL SOFTWARE ENGINEERING WORKSHOP

Chris Gill

Boeing Computer Services

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Introduction

- **Need large gains in software productivity**
 - **AI shows promise**
 - **Promise has not been demonstrated**
- **Series of experiments**
 - **AI applied to Software Engineering**
 - **Integration of tools**
- **Joint venture**
 - **BCS**
 - **CGI**
- **Multiyear project**
 - **First year complete**
 - **More experimentation needed**



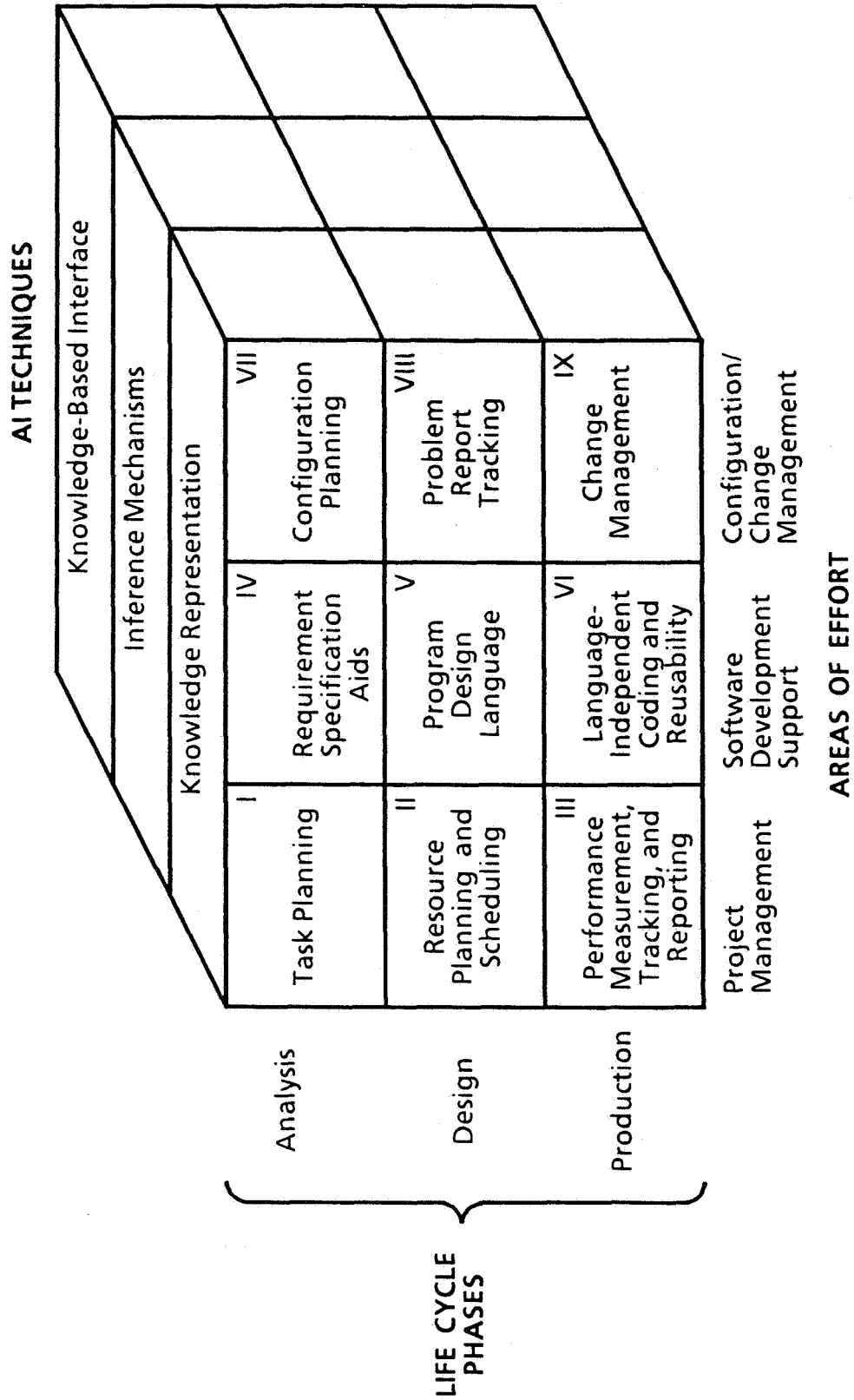
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Objective

- Determine benefits of AI applied to Software Engineering
- Demonstrate improvement in software development process
- Demonstrate improvement in software quality
- Develop testbed for experimentation



Approach





Status

- **Module representation formalism**
- **Object programming**
- **Data-directed reasoning**
- **Goal-directed reasoning**
- **Knowledge-based graphics**



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Plans

- Knowledge-based simulation
- Natural language interface
- Blackboard architecture
- Distributed processing



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Conclusions

- Tremendous promise
- Leverage of integration
- Need to use on real projects