Computer Productivity Initiative: Revised

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I. Proposal Narrative

1. Curriculum Structure

The curriculum structure was derived from a model of the activities to be undertaken in the productivity project. Fig. 1 shows the process flow for the productivity project in terms of activity modules.

Students participating in module M1 are given a problem statement selected by the executive committee and are concerned with understanding the project and in identifying the major issues to be resolved and a set of task activities which should be undertaken to resolve these issues. It is in the performance of this module that the students will interact with the customer and domain experts brought in for consultation. The resolution of these tasks are achieved by tasking other courses within the curriculum with impact studies, prototyping and simulation and theoretical analysis or by internal analysis. Students involved in module M2 generate a software specification for a software study. This study can be a prototype or simulation whose purpose is to address specific issues raised in module M1. For example, the design of an effective user interface for the Crane Operator for ship loading/unloading might be the subject of a prototype study. Or simulating the traffic load on a radio LAN. During module M3, students implement this software study. Students involved in module M4 study the results of all the studies and define a set of feasible solutions. The results of this analysis is presented to the customer and domain experts and the potential productivity improvements are assessed. Module M5 generates the specification of a system to address the original problem posed as input to M1. This specification addresses computer hardware and software components, non-computer hardware (such as cranes, sensors) and the interfaces among these components (this comprises the systems architecture for addressing the productivity project). In addition, M5 also produces cost/benefit and performance analysis, prototypes and simulations, operator and training manuals and a management plan for the implementation of the systems solution. An important aspect of this final report is the identification of the anticipated productivity gains to be realized if the project were put into production.

The implementation of the curriculum involves two sets of courses as shown in Fig. 2.

The *core courses* consists of the following three courses:

- *Project Design Lab* (CS400, a new course): This course implements activi-

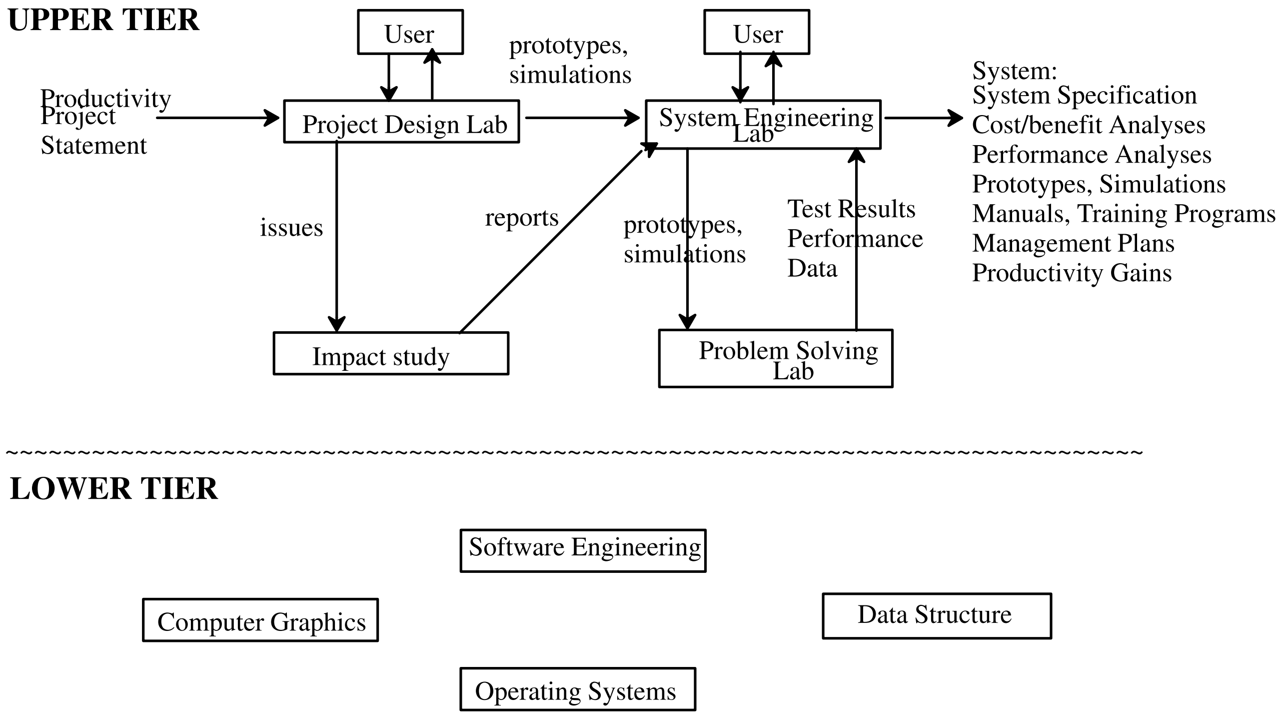
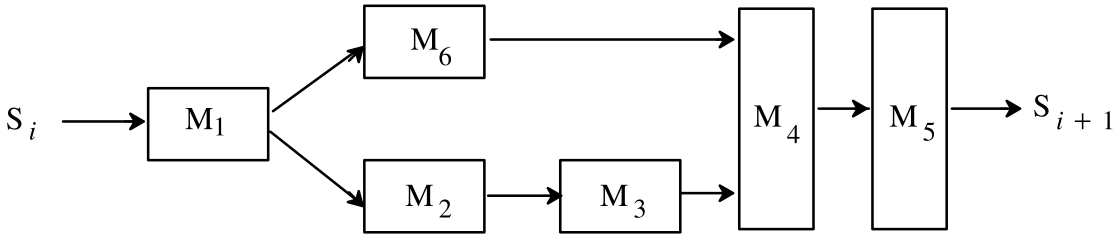


Figure 1: Process Flow for Major Course Modules



S_0 – Productivity Project Statement
S_i – Solution system specification after *i* iteration
M_1 – Issues and task planning
M_2 – Software specifications and implementation planning
M_3 – Management of software development
M_4 – Cost, performance and benefit analysis
M_5 – Design and engineering of system and its implementation
M_6 – Non–Software Impact Studies

Figure 2: Productivity Project Curriculum Structure

ties modules M1, M2 and M3.

• *Systems Engineering Lab* (CS401, a new course): This course accomplishes activity modules M4 and M5.

• *Impact Study* (attached to CS300, an existing course): Students in this class will use the Productivity Project theme as the focal point for their reports. The specific areas of the project to be evaluated will be received as products from the Project Design Lab. The impact report is a semester long effort of detailed research into the obvious and subtle impacts of using computers in the customer's operation. In the VIT problem, for example, typical reports may be: "International Business", "Integrating Different levels of Technology", "Automation and Unions", "The Impact of the Educational Level of Users on the Computer Interface".

• *Problem Solving and Experimentation* (attached to CS250, an existing course): Students in this class will learn problem solving skills. In the formal closed lab they will be introduced to UNIX and Window tools through. They will practice these skills by performing software experiments using the prototypes and/or simulations produced in CS400. The kinds of experiments performed would involve collecting performance data from simulation runs, making small changes in the prototypes, etc.

The *related courses* consists of existing courses whose contents will not be modified but which will draw inspiration from the Productivity Project, using it both as the background for examples and a fertile ground for experimentation with principles learned. Thus, these courses are not directly involved with the project. However, we believe there will be benefits for these related courses courses in that realistic examples drawn from the project will make these courses more relevant for the students.

2. National Impact and Plan of Transfer

The project revisions discussed above, while reducing benefits to participating undergraduate students, do simplify the effort required for other universities to incorporate the materials developed here into their individual undergraduate programs.

To facilitate transfer to other institutions, we will produce both a collection of curriculum support modules and estimates based on our experience here at ODU of support requirements for institutions using the materials. In addition as stated in the original proposal, we also plan disseminating the results of our experience at major education conferences such as those run by the Software Engineering Institute and SIGCSE and through publication in technical and educational journals.

For the two courses which are likely to be new, CS 400 (the project design lab) and CS 401 (the systems engineering lab), we will produce a collection of curriculum modules to facilitate the offering of similar courses at other institutions. For support classes (e.g. CS 250 and 300), we will provide samples of assignments and student work related to this effort. Two types of material will be produced: material of general utility (that is, independent of any individual project) and material based on a particular project. General material will include items for each course such as:

- Student handouts (e.g., a sample syllabus, course schedule)
- Lecture notes and overheads,
- General project support material (e.g., samples of procedures for students to use in acquiring requirements, conducting customer interviews, conducting various reviews)
- Instructional material to support the use of available project support software (we anticipate use of several software packages to support the project)
- A reading list of papers appropriate for undergraduate students in these courses.

In addition, material based on a particular project will be provided:

- Background text discussing the particular problem to be solved to be used as reading material for students
- Informal video tapes of such items as interviews with the "customer" and customer facilities which are related to the project
- Sample assignments given to individual students and to student teams (these include both assignments given directly to students in CS 400 and 401 as well as assignments given to students in supporting courses)

- Sample student work (e.g., problem statement, problem analysis, impact studies, requirements, high level design, simulators)
- Support software unique to the project (e.g., simulators of alternative designs or executable prototypes).
- A "lesson-learned" document, including advice to users of the material and recommended changes.

So that institutions can understand the costs of incorporating courses such as these into their curricula, we will also produce several estimates based our experiences. These include staffing, equipment (workstations, video, software), maintenance, and space requirements. For example, based on our initial analysis, we expect that this project in "steady-state" will require one full-time instructor, two teaching assistants, a half-time systems programmer, and $3000 per year for outside speakers. These estimates will be refined based on our experience.

II. Educational Facilities Support

In evaluating the supporting technologies for the revised curriculum, we have dropped XTV since its primary use was to support those aspects of the project which are not part of the revised proposal. These changes have resulted in the foloowing revised facilities support needs.

The CPI requires additional support in three main areas:

- Productive group interaction.
- Video technology.
- Access to computing.

Group Interaction: We propose to give the students the opportunity for productive group work, and also to train them in this area using two technologies.

- Computer projectors. This technology allows the display of a workstation or a window thereon to be projected on a large screen for group viewing. This is an excellent tool for small or medium size groups for

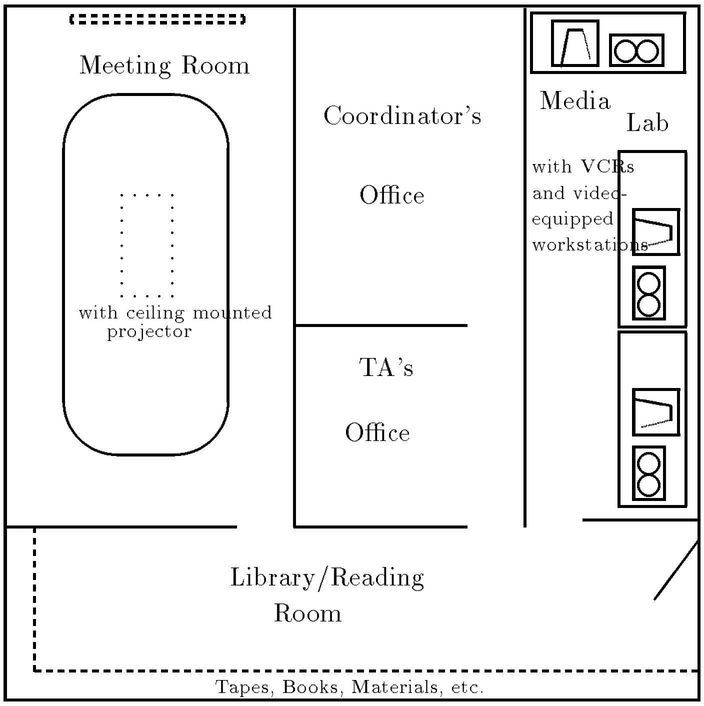


Figure 3: Proposed Productivity Laboratory

document reviews, code walk throughs, and presentations. When combined with video technology, the projector will allow the presentation of video sequences and hypermedia documents which incorporate video. This combination of equipment will provide the instructor with an effective instructional technique to describe actual screen or tv images as they occur. One is required for the meeting room.

- Video recorders and camcorders. These allow the review of sessions of group interaction by the instructor and the groups themselves as a learning aid.

Video Technology: The CPI makes heavy use of video technology to connect the "real world" and the campus. Experts' lectures and customers' interviews are taped, archived, viewed, and incorporated into hypermedia documents. Students are taped in group activities and their performance critiqued. Presentations are composed on workstations and transferred to videotape for remote presentation.

Access to computing: The CPI will exceed the capacity of the existing computer laboratories. In order to adequately support the CPI, we will require 3 additional workstations for undergraduate access. These will all incorporate VideoPics cards to allow video tape to be transfered to the system and displayed on a monitor.

Added Space: The university has pledged to add 900 square feet of space in support of the CPI. The space will be used as follows.

Library/Reading Room: This room will also contain video transcripts, audio recordings, and paper documents in support of the Productivity Projects.

Media Lab: Three workstations equipped with VideoPics cards allow access to the video documents as well as other network facilities.

Meeting Room: Workstation and Projector. Available to groups of up to 15 working on Productivity Projects.

TA office: Space for the TAs who support the Productivity Projects.

Project Coordinator's Office: Space for the project coordinator.

Equipment Worksheet

The rationale for the equipment listed in the Table III.1 (next page) is provided below:

Workstations: These are to equip the Media laboratory and the two meeting rooms. They will be equipped with VideoPics cards which will enable the viewing of video tape on screen. Taped segments can be incorporated into the hypertext requirements documents.

Projector: These projector is mounted in the ceiling and is able to project images under workstation control onto a large screen.

Video Equipment: The VideoPics cards and use of camcorders and VCRs are described above.

Software: This software, including CASE tools, will complement the capabilities of DHC.

Network: Productivity Projects will require additional storage space, especially since video and audio files are to be created. Documentation will be heavily emphasized and so another laser printer will be required.

Table III.1. Productivity Laboratory Equipment						
Equipment	total		year 1		year 2	
	Qty	Amt	Qty	Amt	Qty	Amt
Multi-Media Support						
Camcorders	2	2,000	2	2,000		
Projector	1	18,000			1	18,000
VCR/TV Combination	2	2,000	2	2,000		
Workstations w/ video cards and memory.	3	30,000	2	20,000	1	10,000
Network Support						
Large Disk Storage Unit	1	4,000	1	4,000		
Tape Backup Unit	1	2,000	1	2,000		
Laser Printer	1	3,000	1	3,000		
Project Development						
CASE Tools, Books, Journals, Document Preparation s/w.		10,000		5,000		5,000
Total		71,000		38,000		33,000