



S T A T U S R E P O R T S

To The
SYSTEMS ANALYSIS PROJECT ADVISORY COMMITTEE
And
MAPPS USERS GROUP

October 20, 1989
Institute of Paper Science and Technology
Atlanta, Georgia



October 17, 1989

TO: MEMBERS OF SYSTEMS ANALYSIS PROJECT ADVISORY COMMITTEE AND MAPPS USERS GROUP

Attached for your review are the Status Reports for the projects to be discussed at the Systems Analysis PAC meeting scheduled for October 20, 1989, in Atlanta. A meeting agenda can be found inside the booklet.

We look forward to seeing you on October 20. Best regards.

Sincerely yours,

Richard L. Ellis, Director
Engineering and Paper Materials
Division

RLE/at
Enclosure

Institute of Paper Science and Technology, Inc.

AGENDA

SYSTEMS ANALYSIS PROJECT ADVISORY COMMITTEE MEETING

**The Institute of Paper Science & Technology
Atlanta, Georgia**

Friday, October 20, 1989

8:00am	Opening Remarks	Yeske
8:15	Division Organization & Staff	Ellis
8:30	Introductions	Rushton
8:45	Technical Presentations	Jones
10:30	Coffee Break	
10:45	Review of Projects	Rushton
11:45	Lunch / Tour IPST	
1:45pm	Committee Meeting	
4:00	End of PAC meeting	

SYSTEMS ANALYSIS

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SYSTEMS ANALYSIS

STATUS REPORT

FOR

PROJECT 3471

TO THE

SYSTEMS ANALYSIS PROJECT ADVISORY COMMITTEE

AND

MAPPS USERS GROUP

October 20, 1989

PROJECT SUMMARY FORM

DATE: October 20, 1989

PROJECT NO. 3471: Systems Analysis

PROJECT LEADER: James D. Rushton

IPST GOAL:

To develop and support a marketable computer modelling capability covering the full spectrum of mill types and problems of interest to companies associated with the pulp and paper industry.

OBJECTIVE:

To develop a program for and to support the process simulation requirements of IPST member and associate member companies; to offer a competitively priced process simulation program to non-member companies on a fee basis to partially support the budget requirements of the Process Simulation and Control Group.

CURRENT FISCAL BUDGET: \$ 150,000

SUMMARY OF RESULTS SINCE LAST REPORT: March, 1989 - October, 1989

INTRODUCTION:

Despite the move to Atlanta, this six month period has been very busy and productive. A number of potential joint venture projects have been initiated which could literally change the scope and direction of the MAPPS program. We will discuss these in more detail later in this report.

Work has continued on the validation of the performance attribute system in MAPPS using data from a Champion newsprint mill.

NOTE: Applications of this newsprint simulation work and earlier work on the effects of fiber repulping will be discussed at the October, 1989 PAC meeting.

New developments in refiner modelling include the refining of chemical pulps (i.e. fiber swelling) and the effects of chip pretreatment on the energy consumption and fiber properties in mechanical pulping. We expect to test pretreatment models once the CTMP pilot unit described below is in operation. We are also planning to begin work on the modelling of multi-ply forming systems, gap forming systems, and chlorine dioxide substitution processes. Several of the potential joint venture projects we are considering may also give us the opportunity to develop a dynamic version of MAPPS, as we proposed during our last PAC meeting.

PERSONNEL

We are pleased to announce that Agneta Mimms joined the Group on July 24, 1989 as Assistant Engineer, filling the position vacated by the resignation of Mike Schreiter. Agneta obtained her M. S. degree in chemical engineering from Chalmers University of Technology (Sweden) in 1987 and, in addition, has taken a number of chemical engineering and pulp and paper courses from the Chemical Engineering Department at Georgia Tech. Prior to joining IPST, Agneta worked at TraTec (formerly DiscAmerica) developing a course on Kraft pulping for TAPPI and at the Process Automation Division of Combustion Engineering where she designed graphic screens and other data display techniques for the MOD 300 DCS. She and her husband are residents of Atlanta.

Although the Group is, by the current budget definition, "fully staffed," we are now being overwhelmed by our present work load, which includes our faculty responsibilities. Before the additional projects discussed in this report can be tackled, we will need to hire additional personnel. We would appreciate any assistance and support you can give us in pleading our case with the IPST administration and with the identification of qualified persons who could fit into our Group.

NEW USERS:

Despite the fact that Gary Jones has presented numerous papers describing PAT's and that we have sent more than 50 packets of information out describing the MAPPS package, we have only picked up two new users since the last report, both of which are in the "non-paying" category. They are the Australian Pulp and Paper Institute (Monash University) and N. C. State University.

Although our mission is not necessarily that of generating income, we would at least like to be self-supporting. We need your support in spreading the word about MAPPS to the industry, particularly within your own company, and especially if your company is not a current MAPPS user. **HELP!**

BUSINESS PLANNING AND MARKETING ISSUES**CTMP Pilot Consortia**

One of the exciting outcomes of the new relationship with Georgia Tech has been the opportunity to participate in a Consortia between Georgia Tech, IPST, Georgia Power, Combustion Engineering and IBM. The CTMP unit was given to Georgia Tech by Mead Corporation and installed at the Georgia Power Technology Applications Center (TAC). The CTMP Pilot Plant is a two-stage pressure-atmospheric refining system and includes equipment for chemical pretreatment and inter-stage washing. The process control system, as supplied, was an adequate but rather antiquated analog system.

To assure that the CTMP Plant would be a "world class" facility, Georgia Tech and IPST submitted a joint development proposal, "The Integration of Process Management, Distributed Control and Process Simulation Systems for Optimal Control of the Operation of a CTMP Pilot Plant Facility," to Combustion Engineering and IBM. Incidentally, IPST had previously begun discussions with IBM prior to the "big move" to explore ways to integrate MAPPS with IBM's Realtime Plant Management System (RPMS) as a consequence of one of Gary Jones' papers presented at the 1989 PIMA Conference in Cincinnati.

We are pleased to be able to announce that both CE and IBM have made commitments to supply their systems, the Taylor Mod 300 DCS and the RPMS, respectively, for the CTMP Pilot Plant. In addition, Georgia Power TAC will provide a conditioned control room with a glass front and raised floor to accommodate these process control and management systems. The Process Simulation and Control Group must now "put up or shut up." We now must find the resources to develop end user and data acquisition interfaces so that the steady state version of MAPPS can run as a part of this platform. Initially, we will concentrate on interfacing with the RPMS but, for maximum marketability, we would also like to develop an interface to the MOD 300 as well. Ultimately, the development of a dynamic version of MAPPS for the facility for process and process control training and "realtime" optimization would expand the utility of the pilot plant.

In conclusion, the Group's expected participation in the facility will encompass not only process experimentation but training, simulation and optimization, model development and demonstration of integrated software and hardware concepts.

Working Arrangement with SACDA, Inc.

Last year SACDA Inc. expressed an interest in working with IPST to integrate a MAPPS library of modules into MASSBAL MK II, their steady state simulation package. With all of the personnel changes and anticipated moving problems, we have not been able to arrive at a way to propose a cooperative effort that would be financially feasible. This year, we again broached the subject with SACDA and, as a result of a recent meeting in London, Ontario with Cecil Shewchuk and Eric Leaver, we are once again considering a working arrangement between SACDA and IPST whereby MAPPS would be integrated into TRAINER, SACDA's dynamic simulation product and possibly MASSBAL MK II as well.

Because the TRAINER is set up to handle both sequential and simultaneous solution techniques, the most feasible and mutually beneficial arrangement would be the integration of the MAPPS module library into the SACDA trainer. Financially, this approach would introduce the MAPPS module library into the lucrative training simulator market and also give the Institute access to a new dynamic simulation product. Years of development work to configure a dynamic version of MAPPS would thus be eliminated or substantially reduced. A dynamic MAPPS product would increase the opportunity for utilizing MAPPS models, particularly PAT's at the mill level.

In addition, the arrangement would combine the computer science, interface development and documentation management of the SACDA group with the MAPPS process expertise and allow us to take advantage of SACDA's marketing efforts to generate income for IPST. Access to the TRAINER customer market would also provide us with additional opportunities for consulting and applications development.

Because MASSBAL MK II uses a simultaneous equation solving technique, integration of MAPPS modules into MASSBAL would likely require considerably more programming effort. However, SACDA still has a strong interest in an IPST process module library as an optional component to the steady state MASSBAL Mark II program. If we determine that the effort is feasible, the benefits outlined above would apply to our steady state version of MAPPS as well.

If a total cooperative effort were to evolve, we would likely propose that MAPPS be "frozen" in its present form, i. e. Version 3.2. IPST would, of course, continue to provide support to its present uses but new developments, even the PAT's release, would be merged into the SACDA products. With this approach, we could possibly eliminate several significant MAPPS deficiencies such as the lack of a user-friendly interface, lack of a cad-program and output data analysis and lack of an integrated optimization feature. We would then refocus our efforts in areas where IPST expertise is strong namely in process modelling and applications development.

Pricing structure for MAPPS modules could be worked out so that the total income to IPST from a complete module package would be equivalent to the current MAPPS licensing fee structure. The downside, for new or existing users, is that SACDA's pricing structure is considerably higher than the MAPPS licensing fee and a combined SACDA/IPST package may be even more expensive. A survey has been distributed to MAPPS users and other interested parties to determine the industry perspective on these and other potential arrangements.

Working Arrangement with GEMS

We have also been asked, by a representative of a member company that has both GEMS and MAPPS licenses, if ISPT would be willing to work on a joint development project with the University of Idaho. The idea would be to develop a "new" program having the best features of MAPPS and GEMS. Several times in the past year, the subject has at least been aired with Lou Edwards. However, until now, we had no real incentive to pursue the discussion. One problem is that, since Lou has no staff other than graduate students to work on GEMS developments, a joint effort would likely add to, not reduce, our workload. In addition, since a joint effort would presumably make all of the combined modules available to both parties, IPST would likely have less to gain, in terms of new process models, than GEMS.

MAPPS Interface Development

At the last PAC and User's Group meetings, an integrated interactive interface for MAPPS was given top priority by PAC and users. Subsequent to those meetings, we established a verbal agreement with a "moonlighting" software developer to create the new interface. The work was to be paid for by granting the developer a royalty for each copy of the interface sold as a part of MAPPS. We thus hoped to gain an interface without having to put up any "upfront" money or resources. It appears that the adage, "You get what you pay for," is right again. For personal and professional reasons, the developer has withdrawn leaving us, six months later, just where we started.

If we are to develop an interface, we must either hire additional programmer's with interface development skills or contract the work out to "professionals." Although we have no official contacts, we hear that such development costs will likely range between \$ 100,000 and \$ 200,000. As pointed out above, the problem could be eliminated, at least for new developments, by merging MAPPS with MASSBAL MK II. However, IPST would no longer have control over the "look" of the program.

If we are to pursue the interface development, the most likely platform would be a windows environment, using either the UNIX or OS/2 operating systems on 386 PC's. Alternately, we could use a mainframe environment. However, in either case, the integrated program would probably not work in the DOS environment, by far the most predominant operating system for our current users.

New Release of MAPPS

As noted in the last PAC Status Report, we had hoped to be able to release a new version of MAPPS with full implementation of PAT's to coincide with the 1989 TAPPI Engineering Conference. Obviously, we missed that deadline and, if we do decide to continue with the current format, getting a new release ready before the end of the year will be difficult. Although the software itself is in good shape for a release, the time and resource consuming task is the required complete revision of the documentation. To date, only the Module Documentation Manual has been revised so much remains to be done.

To overcome the constraints of DOS, the expanded program will have to be released in an overlaid version so that all modules in the MAPPS library can be run. Even then, the maximum number of modules and streams allowable will be reduced to 100 if all the modules are included. If this is too severe a limitation on the size or complexity of the processes users wish to model, an optional approach would be to release a compiled version which is a compromise between fixed array sizes and the size of the module library, i. e. the number of modules included.

Consulting Agreement

Through a contact which initially came through Dr. Jeff Hsieh (Chemical Engineering Department, Georgia Tech), we are currently trying to finalize an agreement to set up our first process consulting assignment. The assignment would involve a MAPPS modeling application and, as it is currently configured, would require 50 percent of Agneta Mimms' time for several months.

Student Paper Contest

As noted in the minutes of the last meeting, a Student Paper Contest on "The Use of MAPPS for Pulp and Paper Application" was initiated this year. Although it has been publicized by two direct mailings and articles in the Tappi Journal, we have not been overwhelmed with entrants. Unless things change very soon, the contest may die from "lack of interest."

Continuing Education Courses

Two MAPPS CE courses were conducted at the Georgia Tech Computer Technology Center during the week following the TAPPI Engineering Conference. "Introduction to Process Simulation with MAPPS" was presented on September 18-19 followed by "MAPPS for the Advanced User" on September 20-21. We had seven people for the introductory course and, initially, six for the advanced course before hurricane HUGO took the WESTVACO people away. Considering the fact that we completely revised both courses, they went reasonably well, with most of the problems related to the hardware.

Trade Shows

We have rented a booth at the 1990 TAPPI Annual Meeting and Exposition to be held here in Atlanta in Spring, 1990. The original plan for the booth was to demonstrate the newly released version of MAPPS. Depending on the progress made on a new version or on some of the other projects discussed in this report, we will use the booth to maximum advantage.

MAPPS SUPPORT

MAPPS support requirements for the reporting period have been relatively light. Unfortunately, with the dislocations associated with the move and new personnel requirements, we do not have a computer to run MAPPS-TALK on. In addition, permanent telephone assignments have been unavailable so we probably have been out of touch with our users. We hope that all of these problems will be corrected soon.

Training Courses

After our move to Atlanta, we conducted a MAPPS Training Course for one of our relatively new users. We did not have a place to hold the course and Georgia Tech, with the help of Dr. Hsieh and a number of his grad students came to our rescue. The course was held on the fourth floor of the Ch. E. Building on the Tech Campus and we moved computers, furniture, manuals, and audio visual equipment to the room with great difficulty. We think that the course went over relatively well. At the very least, we had some very good, but expensive, snacks.

Maintenance Issues

We have had no pressing maintenance issues (Thank Goodness!) since the last report. Our UNIX machine and the Ethernet we are all connected to it with is up and running. We are looking for software to ease the pain of dealing with UNIX. If you know of any good stuff for software development or more general uses, please tell us about it.

CONTINUING DEVELOPMENT OF MAPPS

Some of the issues related to the continuing development of MAPPS have been discussed above. Regardless of which option we elect to pursue, we will continue to develop and improve our process modules and the applications to demonstrate their use.

Simulation of Fiber Repulping

MAPPS was used to simulate the effects on sheet properties of multiple repulping of kraft fibers refined and pressed under a range of conditions. The results, in good agreement with the data of McKee and Bobalik, were presented at the Tappi Contaminant Problems and Strategies in Wastepaper Recycling Seminar in Madison (April 1989) and appeared in October Tappi. Some of the results which were unexpected and could not be explained by Bobalik will be discussed.

Forming Techniques

Work is beginning on the simulation of multi-ply forming systems. We hope to be able to simulate dual layer headbox forming, secondary and tertiary headbox forming, multiple fourdriniers and other techniques or equipment involved in the forming of multi-ply sheets. The issues involve the design of the headboxes, specification of jet and wire geometry, the degree of mixing of the jets or of the jet and a partially dewatered mat, the ability to track the properties of the "top" and "bottom" of each ply and the ability to predict the properties of the multi-ply sheet. MacMillan-Bloedel has volunteered to provide data for the validation of the multi-ply forming models which would then be used to simulate their liner and corrugated machines.

We also want to develop models for gap forming such as twin wire formers and various other combinations of forming such as roll formers, blade formers, pre-formers, and other configurations which may be combined with a fourdrinier in a single-machine configuration. Fiber and filler retention and distribution and the resulting sheet properties are substantially different than those of conventional fourdrinier machines and we need to be able to compare and contrast these competing forming methods.

The concepts involved in simulation of the CD variations during forming are also being worked out. A two dimension headbox model based on pressure node theory must be developed to predict the variation in flow across the slice. The jet and sheet can then be split into "n" discrete segments across the width of the machine and each segment can be tracked separately through the forming, pressing, drying and even calendering operations. This technique will be fairly straightforward if it can be assumed that no interactions between the segments occur after the headbox and slice (perhaps a rather shaky assumption in the sheet forming zone).

Simulating Refining of Chemical Pulps

The refiner model has been expanded recently to include the effects of swelling during refining and the subsequent effect on bonding and sheet strength. The energy-per-impact theory of Leider and Nissan (Tappi 60(10):85) has also been integrated into the HYRFN1 module to simulate refining of pulps over the entire yield range from SGW to kraft pulps. Energy-per-impact is influenced by the net power input, plate and fiber geometry and flocculation (which depends on refining consistency, fiber length and other factors).

The fiber length and width distribution models and the K-factor and CSF models already in place have been shown to be applicable over the entire yield range. The additional effect of swelling increases as lignin is removed and is simulated using the fiber stiffness factor attribute.

These new models have been used to show that sheet properties such as tear, burst and density develop differently depending on the refining history. For example, refining two species separately followed by mixing prior to papermaking result in different properties than if the pulps are first mixed and then refined. These models are being tested against data reported by Manfredi and Claudio-da-Silva Jr of Aracruz Celulos, (PIRA International Conference "Advanced Refining Technologies" Birmingham, UK (1986).

Simulating the Effects of Chip Pretreatment

Other refiner developments include the effects of chemical and thermal pretreatment on chip refining. A pretreatment module is being developed to simulate the penetration of temperature and chemicals into the chip prior to the refiner. The glass transition temperature is determined depending on the moisture content and composition of the chip. Although the yield and kappa number are reduced, the primary effects are on the improved separation of fibers, the increased energy consumption to refine to the same freeness and the effect (positive or negative) on the bonding potential of the fibers. Some of these effects will be discussed at the meeting.

Validation of the new pretreatment models is expected to take place when the CTMP plant is in operation. A detailed experimental plan will be required to test the concepts in the models. However, complete validation of this model may not be possible due to the complex interactions and the requirements for intermediate sampling.

DOE PROJECTS

We reported on the proposed DOE project, "Optimizing Fiber Processing in the Pulp and Paper Industry," at our last meeting. We appreciate the support that a number of you gave us and hope that the project will be funded soon. Since our last meeting, we have been asked to participate in another project through the International Energy Agency which will also likely be funded by the DOE.

Optimizing Fiber Processing Project

This project, in addition to demonstrating how energy use can be optimized while constrained by product quality, will serve to validate the performance attribute system of MAPPS. DOE has indicated that the project has been included in next year's budget and that attempts are being made to provide funds to begin work this year. In the meantime work has continued on the validation of the PAT's in a newsprint mill. A preliminary validation study was completed tracking property development through the kraft, groundwood and newsprint mill. These results were presented at the Tappi Engineering Conference in Atlanta and the Tappi Process and Product Quality Division Symposium in New Orleans (October).

There was good agreement between the pulp and calendered paper data and the simulation results. Much work still needs to be done, however. Many of the samples taken before the move to Atlanta had to be refrozen and shipped to Cantonment, FLA. The test equipment at the Institute is still not yet in operation and we suspect that many of the samples may have spoiled. If the mill agrees, we may decide to re-sample the operation and begin testing all over again. At any rate, it appears that it will be some time before complete test results are available.

Originally, the project, as proposed, was to include millwide simulation models of a newsprint and a linerboard mill. However, since we already have done a great deal of work with newsprint, we may decide to switch to a fine paper mill. MacMillan-Bloedel has agreed to serve as the mill test site for the linerboard modeling effort. The choice of the other mill site has yet to be determined.

IEA Project

The Pulp and Paper Committee membership of the International Energy Agency is comprised of the U. S., Canada, Netherlands, Sweden, Spain, the United Kingdom, Finland, Norway, New Zealand, and Belgium. Early this year, Sweden (specifically STFI) was asked to "float" a proposal on process control for the Committee to consider. The proposal that evolved was "Annex VIII; Sensors, Control and Modelling for the Pulp & Paper Industry." Briefly, the proposal was to consist of developing and demonstrating statistical methods to analyze process control data with the objective being improved process control with all the benefits that implies. The DOE asked IPST to participate as the U. S. representative for this proposed project with the idea that DOE would provide the funding required.

Initially, we proposed to DOE that our contribution to the project could be the development of a dynamic version of MAPPS to be used for simulation, analysis, and optimization of process control strategies. DOE accepted this idea and asked us to participate in a technical meeting with the other IEA members to discuss a joint development project. The primary participants in this meeting were the U. S. (IPST), Canada (PAPRICAN), Sweden (STFI), and Norway. After considerable discussion, the original STFI proposal was thrown out and a process control project involving one or more mill demonstrations evolved. The official proposal has not yet been written but the project will likely consist of:

1. Variability Analysis - PAPRICAN is working on a package for variability analysis of process control data. They will complete the development of the software and hardware and then set up a mill demonstration, probably at some TMP pulpmill yet to be named.
2. Dynamic MAPPS - IPST will develop a dynamic version of MAPPS (or alternately work with SACDA, etc.), model a specific mill application, and set up a mill demonstration of the model. Since we are already involved with the CTMP Pilot Plant, we will likely try to find a TMP pulpmill for the demonstration.
3. STFI - STFI will work with both IPST and PAPRICAN on the above items. Specifically, they will (1) investigate methods for handling missing data for the variability analysis package, and (2) provide assistance to IPST in the development of process and process control models.
4. Norway - Norway plans to participate in some way but they have not yet proposed a specific idea for their involvement.

PROPOSED JOINT PROJECT WITH GEORGIA TECH RESEARCH INSTITUTE

We are working with Dr. Robert McDonald, Georgia Tech and Dr. Randy Case, Georgia Tech Research Institute to develop a joint proposal for expert systems development. The initial idea was to develop a system for "Industrial Operations Management Support." This system would try to combine management decision making for such areas as maintenance planning, personnel scheduling, process operations, and product scheduling into one "shell" which could then be customized for any mill. After several proposal attempts and meetings, the consensus grew that this was perhaps too much to tackle; also, it would not really draw much expertise from IPST since most of the focus would be outside the process window.

At the last meeting, it was decided that we should re-focus the proposal to address the process areas, i. e. the huge volumes of data available, what data is needed by who and when, and how to use process data to assist in decision making.

Such an approach fits much better with our other projects and would also utilize IPST's process expertise. For instance, we visualize that a dynamic version of MAPPS could utilize process data to make predictions about parameters that either cannot be measured or cannot be measured in a timely manner. The expert system could then use such predictions to assist operators or management in making process decisions or tune the process operating parameters or even establish process control setpoints. The expert system could also serve as the user interface and process data interface for MAPPS. If structured in the right way, this project could "nest" very well with the CTMP Pilot Plant and the DOE projects.

Funding requests for the project would probably be directed more at companies who supply process control or process management information systems (IBM, CE, Bailey, Oil Systems) rather than toward pulp and paper companies.