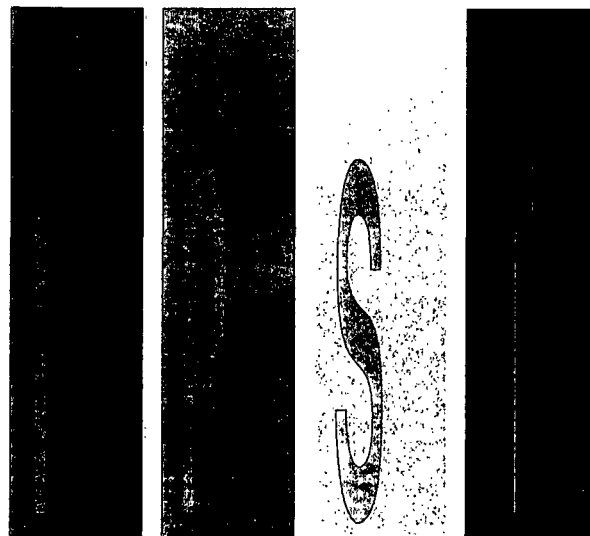# *Institute of Paper Science and Technology*

SLIDE MATERIAL

To The

PROCESS SIMULATION AND CONTROL

PROJECT ADVISORY COMMITTEE

December 20, 1990
Georgia Power Technology Application Center
Atlanta, GA

Atlanta, Georgia

7

PROCESS SIMULATION AND CONTROL
PROJECT ADVISORY COMMITTEE

IPST LIAISON: JIM RUSHTON

Mr. Jack M. Kleinfeld (*Chairman*)
Senior Staff Engineer
Champion International
West Nyack Road
West Nyack, NY 10994-0608
(914) 578 7292
(914) 578-7175 FAX

Mr. Willard M. Reed, Jr.
Process Analysis Supervisor
MacMillan Bloedel, Ltd.
Post Office Box 336
Pine Hill, AL 36769
(205) 963-4391
(205) 963-4850 FAX

Dr. G.R. (Ron) Brown
Director of Laurel Research Laboratory
Westvaco Corporation
11101 Johns Hopkins Road
Laurel, MD 20723

Mr. Glen C. Smith
Technical Manager
Mead Corporation
Central Research Labs
Chillicothe, OH 45601
(614) 772-3513
(614) 772-3595

Mr. Karel K. Cerny
Senior Control Systems Engineer
Georgia-Pacific Corporation
133 Peachtree Street, NE
Atlanta, GA 30303
(404) 521-4603
(404) 521-5093 FAX

Mr. Tom Tsai
Senior Manager Process Control
Tenneco, Inc.
(Parent Company of PCA)
Post Office Box 2511
Houston, TX 77252

Dr. Thomas C. Kisla
Senior Product Technology Engineer
Stone Container Corporation
2150 Parklake Drive
Atlanta, GA 30345
(404) 671-6714
(404) 671-6730

Mr. Keith D. Otto
Director of Control Systems
Technology
James River Corporation
1915 Marathon Avenue
Post Office Box 889
Neenah, WI 54957
(414) 729-8134
(414) 729-8160

AGENDA

PROCESS SIMULATION AND CONTROL
PROJECT ADVISORY COMMITTEE

December 20, 1990
Georgia Power Technology Application Center
Atlanta, GA

THURSDAY--December 20

8:00	Opening Remarks/Introductions	Rushton/Kleinfeld
8:15	Goals and Objectives of PAC	Yeske
8:45	Chairman's Remarks	Kleinfeld
9:00	A Brief History of MAPPS	Rushton
9:15	Project Reports	
	MAPPS System Analysis - Project 3471	Jones
	MLMAP Millwide MAPPS - Project 3688	Rushton
10:00	BREAK	
10:15	Proposed Future Directions	Rushton
10:45	Discussion	Kleinfeld PAC Members
12:30	LUNCH	
1:30	DEPARTURES	

DUES FUNDED RESEARCH PROGRAM

PROCESS SIMULATION AND CONTROL

PROJECT	TITLE	FY 90-91 BUDGET (K$)
MAPPS	Systems Analysis	150
MLMAP	Millwide MAPPS	50

PROCESS SIMULATION AND CONTROL

PROJECT ADVISORY COMMITTEE MEETING

GEORGIA POWER TECHNOLOGY APPLICATIONS CENTER

ATLANTA, GEORGIA

DECEMBER 20, 1990

AN OVERVIEW OF MAPPS

MODULAR ANALYSIS OF PULP AND PAPER SYSTEMS

FISCAL OVERVIEW

- ENERGY AND SYSTEMS ANALYSIS PAC ESTABLISHED IN JULY, 1980

- DUES-FUNDED EXPENDITURE HISTORY

FY 80-81	$231K
FY 81-82	268
FY 82-83	293
FY 83-84	258
FY 84-85	223
FY 85-86	206
FY 86-87	179
FY 87-88	209
FY 88-89	206
FY 89-90	199
DUES-FUNDED TOTAL	$2,272K
FY 90-91 BUDGET	$200K

FISCAL OVERVIEW

OTHER SOURCES OF REVENUE

* MAPPS ACQUISITION AND USERS FEES

  - 18 COMPANIES HAVE ACQUIRED MAPPS

    - 11 MEMBER COMPANIES @ $9,000
    - 7 NON-MEMBER COMPANIES @ $25,000

  - 6 (MEMBER COMPANIES) HAVE A CURRENT MAINTENANCE AGREEMENT @ $7,000

* CONTRACT RESEARCH

* EXTERNALLY FUNDED RESEARCH

  - DOE ($80K IN FY 90-91, $425K OVER 3 YEARS)

A CHRONOLOGICAL HISTORY OF MAPPS

JULY, 1980 - FORMATION OF ENERGY AND SYSTEMS ANALYSIS PAC

DEC., 1980 - PROJECT TO MODEL INTEGRATED KRAFT MILL USING IPC
MODIFIED **GEMCS** PROGRAM
PERSONNEL - KARTSOUNES, AHRENS, McCONNELL, HALCOMB

MAY., 1981 - EVALUATION OF **IPC/GEMCS, McGILL/GEMCS,** AND **PPRIC**
PROGRAMS FOR MODELING INTEGRATED KRAFT PULP AND
PAPER MILLS

BEGIN DEVELOPMENT OF IPC PROGRAM USING GEMCS
EXECUTIVE PROGRAM FROM UNIVERSITY OF WESTERN ONTARIO
(MAINTAINED BY SACDA)

PERSONNEL - KARTSOUNES, AHRENS, McCONNELL, HALCOMB,
NEWCOMBE

OCT., 1981 - FIRST REPORT ON DEVELOPMENT OF AN IPC SIMULATOR
THE PROGRAM WAS NAMED MAPPS SOMETIME BETWEEN OCT.,
1981 AND MAY, 1982.

IPC BEGAN USING **DYSCO**, A DYNAMIC SIMULATION PROGRAM
DEVELOPED BY LUIS LOPEZ AT U. OF MICHIGAN. IPC
BEGAN TO WRITE A USER'S MANUAL FOR THE IPC-REVISED
DYSCO PROGRAM

PERSONNEL - KARTSOUNES, OXBY, HALCOMB, McCONNELL,
NEMWCOMBE, SAFFRAN (STUDENT)

MARCH, 1982 - REPORT ON CONTINUING DEVELOPMENT OF MAPPS

FIRST MAPPS USER'S MANUAL WRITTEN FOR McCONNELL'S
CLASS

PERSONNEL - KARTSOUNES, OXBY, HALCOMB, McDONOUGH,
McCONNELL, NEWCOMBE, SAFFRAN (STUDENT)

OCT., 1982 - REPORT ON CONTINUING DEVELOPMENT OF MAPPS

FIRST USER'S MANUAL ISSUED

PERSONNEL - KARTSOUNES, OXBY, NEWCOMBE

MARCH, 1983 - TWO COMPANIES BEGIN WORKING WITH IPC ON SIMULATION
OF KRAFT PULPING

       INITIAL RELEASE OF MAPPS SCHEDULED FOR END OF 1983
DELIVERABLES TO INCLUDE CODE, USER'S MANUAL, MODULE
DOCUMENTATION, AND SIMULATOR DOCUMENTATION

       BUDGET OF $ 400,000 FOR FISCAL YEAR 82/83
ESTABLISHED FOR ENERGY AND SYSTEMS ANALYSIS
PROJECT

       PERSONNEL - KARTSOUNES, OXBY, PARKER, SAFFRAN
                (STUDENT), AND BIASCA (STUDENT)

OCT., 1983 - BUDGET OF $ 400,000 FOR FISCAL YEAR 83/84

       SAFFRAN WRITES MAPPS INTERFACE TO U. OF MISSOURI
OPTIMIZATION PROGRAM; CAN BE USED FOR OPTIMIZATION
AND DATA RECONCILIATION

       ANNOUNCEMENT OF BEGINNING DEVELOPMENT OF A "USER
FRIENDLY INTERFACE" - THE CURRENT INTERNAL EDITOR

       PERSONNEL - KARTSOUNES, PARKER

MARCH, 1984 - RELEASE OF MAPPS TARGETED FOR APRIL, 1984
DELIVERABLES TO BE CODE, USER'S GUIDE, MODULE
GUIDE, PROGRAMMER'S GUIDE, AND 2-3 DAY TRAINING
COURSE; CODE SUPPLIED ON MAGNETIC TAPE FROM
BURROUGHS

       FIRST MAPPS BROCHURE PREPARED

       PERSONNEL - PARKER AND SAFFRAN, BUCSH, RUDEMILLER
                (ALL STUDENTS)

OCT., 1984 - BUDGET OF $ 200,000 ESTABLISHED
BUDGET OF $ 200,000 FOR MAPPS SUPPORT?

       MAPPS DOCUMENTATION COMPLETED

       TWO COPIES OF MAPPS LICENSED AND DELIVERED
(THERE WERE ALSO THREE "BETA TEST" SITES)

       FIRST TRAINING SEMINAR OCT. 17-19

       MICRO VERSION OF MAPPS DEVELOPED

       PERSONNEL - PARKER, DOSHI, TWO PH.D STUDENT (PART
                TIME)

MARCH, 1985 - TEN MAPPS LICENSES - 7 P & P COMPANIES
                                    1 SUPPLIER COMPANY
                                    2 UNIVERSITIES

        μMAPPS RELEASED IN DEC., 1985; 6 COPIES IN USE
        (ONE SALE STRICTLY ON μMAPPS)

        FIRST USER'S GROUP MEETING 3/26/85

        CONSIDERATION OF "THIRD PARTY" FOR MAPPS SUPPORT

        PERSONNEL - PARKER, DOSHI, ??

OCT., 1985 - VERSION 2.0 RELEASED SEPT., 1985

        ADDITIONAL LICENSES - 3 UNIVERSITIES
                              1 COMPANY

        MAPPS BULLETIN BOARD ESTABLISHED

        RON MANN, JAMES RIVER CHAIRS USER'S GROUP

        PERSONNEL - PARKER, DOSHI, ???

MARCH, 1986 - ADDITIONAL LICENSES - I UNIVERSITY
                                    3 COMPANIES

        MECHANICAL PULPING MODULES ADDED

        DISCUSSION OF QUALITY MODELING

        PERSONNEL - PARKER, DOSHI, JONES, ???

OCT., 1986 - PAT MODELING ANNOUNCED; FIRST LIST OF PAT'S FOR
             MECHANICAL PULPING

        BUDGET REDUCED TO $ 150,000 FOR SYSTEMS ANALYSIS
        MAPPS SUPPORT ALSO $ 150,000

        OPTIMIZATION WITH MAPPS PRESENTED; TOUTED FOR DATA
        RECONCILIATION AND PROCESS DESIGN

        WORK ON RELEASE OF MAPPS 3.0 BEGINS

        PERSONNEL - PARKER, JONES, SCHREITER

MARCH, 1987 – WORK CONTINUING ON MAPPS 3.0; RELEASED IN LATE MARCH, 1987

PAC WORKS ON LONG RANGE PLAN FOR IPC SIMULATION ACTIVITY

PERSONNEL – PARKER, JONES, SCHREITER, BERCEAU

OCT., 1987 – HELSINKI U., W. MICHIGAN, AND MIAMI ANNOUNCED AS USERS

PROJECT TO REWRITE MAPPS AND ADD A USER FRIENDLY INTERFACE BEGINS

BETA TEST VERSION OF μMIP ANNOUNCED

PAT'S FOR PAPERMAKING DISCUSSED AT PAC

PERSONNEL – PARKER, JONES, SCHREITER, BERCEAU (PART TIME)

MARCH, 1988 – OULU U. OF FINLAND ANNOUNCED AS USER

μMIP RELEASED JAN., 1988; 4 COPIES SOLD

PERSONNEL – JONES, SCHREITER, BERCEAU (PART TIME)

OCT., 1988 – TUFTS U. ADDED AS USER;

ADDED 10 INDIVIDUAL AND 2 SITE LICENSES FOR μMIP

MAPPS 3.1 UPDATE SENT OUT FEB., 1988

MULTI-USER COMPUTER FOR GROUP BEING STUDIED

PAT'S WORK CONTINUES

PERSONNEL – JONES, SCHREITER, BERCEAU (PART TIME)

MARCH, 1989 – MAPPS NEW USERS, 1 P & P COMPANY, 4 UNIVERSITIES

COMPILED MICRO COMPUTER PRICING OPTIONS FOR MAPPS ESTABLISHED

PROPOSAL, "OPTIMIZING FIBER PROCESSING IN THE PULP AND PAPER INDUSTRY," SUBMITTED TO DOE

UNIX VERSION OF MAPPS ANNOUNCED

FIRST "ALPHA" TEST VERSION OF MAPPS WITH PAT'S MADE AVAILABLE TO USERS

DYNAMIC SIMULATION AND EXPERT SYSTEMS DISCUSSED

PERSONNEL – RUSHTON, JONES, SCHREITER, SKIFSTAD

OCT., 1989 – FIRST ON-LINE MAPPS APPLICATION DEVELOPED FOR CTMP CENTER; MAPPS INTERFACE WITH IBM'S RPMS

JOINT DEVELOPMENT PROPOSALS WITH SACDA AND U. OF IDAHO DISCUSSED

FIRST MAPPS STUDENT PAPER CONTEST ANNOUNCED

DOE/IEA PROPOSAL TO DEVELOP ON-LINE DYNAMIC SIMULATOR FOR TMP PRESENTED

PERSONNEL – RUSHTON, JONES, MIMMS, SKIFSTAD

MARCH, 1990 – BUDGETS ESTABLISHED FOR: MAPPS SUPPORT – $ 50,000, SYSTEMS ANALYSIS – $ 150,000, MILLWIDE MAPPS – $ 50,000

ONE MAPPS P & P COMPANY LICENSE AND 1 μMIP SITE LICENSE

MAPPS DEMONSTRATED AT TAPPI 90

RELEASE OF MAPPS 4.0 TARGETED FOR 4th QUARTER, 1990

GRAPHICAL INTERFACE FOR MAPPS DEMONSTRATED TO USER'S GROUP MEETING; LIVELY INTEREST BUT NO $ SUPPORT

JOINT DEVELOPMENT AGREEMENT WITH SACDA ANNOUNCED

PAPER BY PETER HART, WINNER OF MAPPS STUDENT PAPER CONTEST PUBLISHED IN TAPPI JOURNAL

VALIDATION OF PAT'S FOR MEDIUM BEGINS

PAT PROGRAMMING DEVELOPMENTS FOR LINERBOARD AND
FINE PAPER BEGINS

3 PROCESS ANALYSIS (CONSULTING) APPLICATIONS
UNDERWAY

DISCUSSIONS OF MAPPS/GEMS INTEGRATION CONTINUE

POSSIBLE VENTURES WITH IBM, DEC, OIL SYSTEMS,
OTHERS BEING PURSUED

OS/2 VERSION OF MAPPS AVAILABLE

PERSONNEL - RUSHTON, JONES, MIMMS, SKIFSTAD

CURRENTLY LISTED COMMERCIAL MAPPS USERS

1. SCOTT PAPER COMPANY - 1987 *

2. OWENS-ILLINOIS - ?

3. BROWN & ROOT - 1986

4. WESTVACO CORPORATION - ? *

5. CHAMPION INTERNATIONAL - 1984 (BETA TEST) *

6. JAMES RIVER CORPORATION - 1984 (BETA TEST) *

7. INTERNATIONAL PAPER - 1985 *

8. PROCTOR & GAMBLE CELLULOSE - ?

9. KIMBERLY-CLARK - 1987

10. STONE CONTAINER - 1987 *

11. FISHER CONTROLS - ?

12. P. H. GLATFELTER - ?

13. WILLAMETTE INDUSTRIES - 1986

14. CHESAPEAKE CORPORATION - 1986

15. AIR PRODUCTS - 1987

16. MacMILLAN BLOEDEL - 1988 *

17. GEORGIA-PACIFIC -1989 *

18. CONTAINER CORPORATION OF AMERICA (NOW JEFFERSON SMURFIT)

* CURRENT MAINTENANCE AGREEMENT

CURRENTLY LISTED ACADEMIC USERS

1. SUNY - SYRACUSE

2. AUBURN UNIVERSITY

3. UNIVERSITY OF MAINE

4. UNIVERSITY OF SOUTH FLORIDA

5. GEORGIA INSTITUTE OF TECHNOLOGY

6. U. OF WISCONSIN - STEVENS POINT

7. CLEMSON UNIVERSITY

8. WESTERN MICHIGAN UNIVERSITY

9. MIAMI UNIVERSITY

10. INSTITUTO DE MADERA (MEXICO)

11. HELSINKI UNIVERSITY OF TECHNOLOGY

12. OULU UNIVERSITY (FINLAND)

13. TUFTS UNIVERSITY

14. UNIVERSITE dU QUEBEC a TROIS-RIVIERES

15. TUSKEGEE UNIVERSITY

16. U. OF WISCONSIN - GREEN BAY

17. UNIVERSITY OF MINNESOTA

18. MONASH UNIVERSITY (AUSTRALIA)

19. NORTH CAROLINA STATE UNIVERSITY

20. UNIVERSIDADE De COIMBRA (PORTUGAL)

MAPPS - WHERE WE ARE AND WHERE WE'RE GOING

* THE NEW RELEASE - MAPPS 4.0

* PROCESS ANALYSIS APPLICATIONS

* JOINT DEVELOPMENT AGREEMENTS

* DOE FUNDED PROJECTS

THE NEW RELEASE - MAPPS 4.0

* **THE USER INTERFACE**

* **THE MAPPS CODE**
  FULL IMPLEMENTATION OF PAT'S

* **MAPPS DOCUMENTATION**

MAPPS 4.0 - THE USER INTERFACE

* **μMIP - MAPPS INTERFACE PROGRAM**

    CURRENTLY A STAND-ALONE PROGRAM (OUTSIDE MAPPS)

    MENU DRIVEN - LOTUS-LIKE APPEARANCE

* **MAPPS LINE EDITOR (INSIDE MAPPS)**

    THE BIG QUESTION MARK

    LIMITED HELP UTILITIES

    THE USER'S MANUAL

* **THE SOLUTION**

    INTEGRATE μMIP WITH MAPPS

    RESULT - THE USER HAS A CHOICE
    μMIP OR LINE EDITOR

MAPPS 4.0 - THE USER INTERFACE

* **THE PROBLEM - HARDWARE**

  DOS RAM LIMITATIONS

  PATS AND μMIP MAKE MAPPS TOO BIG FOR DOS

* **THE SOLUTION**

  LAHEY OPERATING SYSTEM AND COMPILER

  TRANSPARENT TO USER - LOOKS LIKE DOS

* **THE PROBLEM**

  ADDED SOFTWARE & HARDWARE

  LAHEY SYSTEM RUNS ON 386 MICRO COMPUTER ONLY

  LAHEY COSTS APPROXIMATELY $ 1000

  MICRO MUST HAVE EXTENDED MEMORY

* **THE SOLUTION (PARTIAL)**

  WE SUPPLY LAHEY WITH THE 4.0 RELEASE

  DISCOUNT FOR MULTIPLE COPIES

MAPPS 4.0 - THE USER INTERFACE

* **MORE ELEGANT SOLUTIONS**
    GRAPHICAL INTERFACE WITH ICONS

    WINDOWS INTERFACE

MAPPS 4.0 - THE CODE

* **SOURCE CODE - SUPPLIED ON FLOPPY DISKS**

* **EXECUTABLE CODE OPTIONS (MICRO COMPUTERS)**
  STANDARD - THE LAHEY/DOS VERSION

  OPTIONS: DOS OVERLAY W/O μMIP (NO ADDED COST)

  OS/2 VERSION ($ 500 EXTRA)

  UNIX VERSION ($ 500 EXTRA)

MAPPS 4.0 - THE DOCUMENTATION

* **EXISTING DOCUMENTATION**
  USER'S GUIDE
  MODULE DOCUMENTATION MANUAL
  PROGRAMMER'S GUIDE

* **REVISED DOCUMENTATION**
  USER'S GUIDE - COMPLETELY REWRITTEN
  MODULE TECHNICAL GUIDE - NEW
  MODULE DOCUMENTATION MANUAL - REVISED
  PROGRAMMER'S GUIDE - REVISED

MAPPS 4.0 - TIMETABLE

* **DEMONSTRATION OF LAHEY/DOS VERSION**

    MID-DECEMBER

* **DOCUMENTATION**

    MODULE DOCUMENTATION GUIDE - COMPLETE

    MODULE TECHNICAL GUIDE - ROUGH DRAFT FOR EDIT

    PROGRAMMER'S GUIDE - ROUGH DRAFT FOR EDIT

    USER'S GUIDE - 75% COMPLETE

* **TARGET DATE FOR ISSUE OF BETA TEST VERSION**

    JANUARY 31, 1991

PROCESS ANALYSIS APPLICATIONS

* **FOCUS OF PS & C GROUP FOR INCOME GENERATION**

* **NEW BROCHURE DEVELOPED**

* **CURRENT/COMPLETED PROCESS ANALYSIS APPLICATIONS**

    VALIDATION STUDY OF PAT'S FOR MEDIUM (FUNDED BY IPST)

    PAPER MACHINE BRIGHTNESS LOSS STUDY

    ALKALINE PAPER MAKING STUDY

    PROCESS CONTROL SCOPING STUDY

* **POTENTIAL PROJECTS**

    PAPER MACHINE RING CRUSH OPTIMIZATION

    CONTINUATION OF BRIGHTNESS LOSS STUDY

    BLEACHING OPTIMIZATION STUDY

    MILLWIDE DATA RECONCILIATION

JOINT DEVELOPMENT AGREEMENTS

* **CURRENT - SACDA/MAPPS INTEGRATION**

  IPST GRANTS SACDA MAPPS LICENSE

  SACDA INTEGRATES MAPPS MODULES (PAT'S)

  SACDA PAYS ROYALTY TO IPST

* **IPST CONTINUES TO MARKET MAPPS**

PROPOSED EXTENSION OF SACDA/IPST AGREEMENT

* MAPPS FROZEN AT STATE OF 4.0 RELEASE

* SACDA RESPONSIBLE FOR MAPPS SUPPORT

* IPST SHARES MAPPS LICENSING/MAINTENANCE FEES
  WITH SACDA

* SACDA/MAPPS INTEGRATED PRODUCTS BECOME
  FOCUS FOR CONTINUING IPST SIMULATION
  EFFORTS

* SACDA RESPONSIBLE FOR ALL MARKETING,
  MAINTENANCE, TRAINING, AND USER SUPPORT

* SACDA PAYS ROYALTY FEES TO IPST AS BEFORE

PROPOSED EXTENSION OF SACDA/IPST AGREEMENT
APPLICATIONS DEVELOPMENT

* IPST SUPPORTS SACDA INTEGRATION, MARKETING, ETC. BUT MAJOR EFFORT ON RESEARCH & DEVELOPMENT/APPLICATIONS

* SACDA/IPST SEEK JOINT APPLICATIONS AND SHARE PROFITS

* IPST SERVES AS P & P EXPERT CONSULTANT ON SUCH PROJECTS

* SACDA SERVES AS HARDWARE/SOFTWARE DEVELOPER AND SYSTEMS INTEGRATOR

* SACDA GRANTS EDUCATIONAL LICENSES TO IPST FOR ALL SACDA PRODUCTS

WHY CONSIDER A NEW SACDA/IPST AGREEMENT?

* **IPST CAN LEVERAGE LIMITED HUMAN RESOURCES**

* **CURRENT LEVEL OF STAFFING**
   GROUP LEADER - 1 (FACULTY)

   SENIOR RESEARCH ASSOCIATE - 1 (FACULTY)

   ASSISTANT ENGINEER - 1 (STAFF)

   TECHNICIAN II/MICRO COMPUTER SUPPORT - 1 (STAFF)

* **AGREEMENT WILL ENHANCE INCOME TO PS & C GROUP**
   PROFESSIONAL MARKETING STAFF

   ROYALTY FEES FROM NEW PROGRAMS

   GREATLY INCREASED POTENTIAL FOR APPLICATIONS

WHY CONSIDER A NEW SACDA/IPST AGREEMENT?

* **PROCESS ANALYSIS APPLICATIONS BRING IN $**

* **% OF TIME AVAILABLE FOR APPLICATIONS NOW**
  GROUP LEADER - 10 %

  SENIOR RESEARCH ASSOCIATE - 10 %

  ASSISTANT ENGINEER - 25 %

* **% OF TIME FOR APPLICATIONS AFTER NEW AGREEMENT**
  GROUP LEADER - 25 %

  SENIOR RESEARCH ENGINEER - 25 %

  ASSISTANT ENGINEER - 75 %

* **MORE PROJECTS -- MORE INCOME -- MORE STAFFING**

* **R & D/APPLICATIONS EFFORT MORE IN TUNE WITH IPST GOAL OF TECHNOLOGY TRANSFER**

OTHER JOINT DEVELOPMENT VENTURES

* **UNIVERSITY OF IDAHO/PACIFIC SIMULATION**

  INTEGRATION OF MAPPS/GEMS TO CREATE A BETTER SIMULATOR

  USER-FRIENDLY INTERFACE FOR MAPPS (PACIFIC SIMULATION)

* **DIGITAL EQUIPMENT COMPANY/OIL SYSTEMS/SACDA**

  RING CRUSH OPTIMIZATION PROJECT

    PI (PLANT INFORMATION) SYSTEM FROM OSI

    MASSBAL 3.0 FROM SACDA

    DEC HARDWARE AND OPERATNG SYSTEMS

* **INTERNATIONAL BUSINESS MACHINES**

  MILL APPLICATION FOR MAPPS/RPMS INTEGRATION

* **SPECTRAL DYNAMICS DIVISION, SCIENTIFIC ATLANTA**

  GRAPHICAL INTERFACE FOR MAPPS

  VIBRATION MONITORING ANALYSIS TO IMPROVE QUALITY

DOE FUNDED PROJECTS

* **FIBER OPTIMIZATION PROJECT**

    NOT YET FUNDED

* **DOE/IEA PROJECT**

    ON-LINE TMP SIMULATOR

    STEADY STATE AND DYNAMIC MODELS

    SACDA IS SUB-CONTRACTOR TO IPST

    2-3 YEAR PROJECT

    GOALS: ON-LINE DATA RECONCILIATION

                 ENERGY OPTIMIZATION

                 PROCESS OPTIMIZATION

                 ANALYSIS OF ALTERNATIVES

    FEATURES MASSBAL 3.0/MAPPS 4.0 INTEGRATION

    SYSTEM INTEGRATION OF DCS/MIS/MODELING

    FUNDING LEVEL - $ 460,000

CONCEPTUAL PLANNING FOR THE PS & C GROUP

* LEVERAGE LIMITED RESOURCES WITH JOINT VENTURES
  OR OUTSIDE FUNDING

* THIRD PARTY (SACDA) FOR MARKETING,
  MAINTENANCE, USER SUPPORT, ETC.

* INCREASE ROYALTY AND LICENSING FEES

* CONCENTRATE ON DEVELOPMENT/APPLICATIONS

* EXPAND GROUP VIA APPLICATIONS RESEARCH

MAPPS DEVELOPMENT

MODEL VALIDATION

PURPOSE

DETERMINE HOW WELL MAPPS PAT MODEL CAN TRACK
EFFECTS OF SEVERAL IMPORTANT PROCESS VARIABLES

- **VARIABLES**

  OCC CONTENT
  MACHINE SPEED
  REFINER POWER AND CONSISTENCY
  SEMI-CHEM FREENESS
  CALENDER STACK

- **DATA**

  THREE DAY MILL TRIAL
  24 REELS
  114 MACHINE PAPER SAMPLES
      24 REELS, 3 ROLLS, 3 SETS/REEL
  120 HANDSHEETS 5 LOCATIONS

- **PROPERTIES**

  CSF
  ZERO SPAN
  TENSILE
  ELASTIC
  POROSITY
  COMPRESSIVE

- **PREDICTIONS**

  24 MAPPS CASE STUDIES

- **SAS DATA ANALYSIS**

PRELIMINARY RESULTS

- **GOOD OVERALL FIT**

- **NO CHANGES IN MODELS REQUIRED AT PRESENT**

- **MODEL PREDICTIONS WITHIN MEASUREMENT ERROR**

- **EFFECT OF CALENDER LOADING ON BONDING MAY REQUIRE MODIFICATION**

- **VARIABLE EFFECTS**

    - **OCC RATIO NEGLIGIBLE**

    - **SPEED HAD MINIMAL EFFECT**

    - **CD VARIABILITY SIGNIFICANT WITH SOME PROPERTIES**

    - **CALENDER LOADING SIGNIFICANT FOR SOME PROPERTIES**

- **REPORT IN PREPARATION**

SYSTEMS DEVELOPMENT

■ **FILLERS**

• **FILLER ATTRIBUTES**

  DIAMETER
  ABSORPTION COEFFICIENT
  SCATTERING COEFFICIENT
  SHAPE FACTOR

• **MIXTURE ABSORPTION AND SCATTERING**

• **PROPERTIES**

  BRIGHTNESS AND OPACITY
  RETENTION AFFECTED BY DIAMETER
  BOND STRENGTH AFFECTED BY LOADING AND SHAPE FACTOR

■ **DYES**

• **DYE MIXING MODEL**

  THREE DYES - RED, BLUE AND BLACK

  ABSORPTION COEFFICIENT AT 457 AND 572 NM

• **OPTICAL PROPERTY MODULE**

  BRIGHTNESS AT 457 AND 572 NM
  OPACITY AT 572 NM

STUDENT PROJECTS

- **COLOR OF DYED SHEETS - MAYANK CHATURVEDI - WMU**

    FULL SPECTRAL REFLECTANCE PREDICTION 400-700 NM
    MULTIPLE DYES - DYE DATA BASE

- **BLADE COATING - DAVE STANDERFER - WMU**

    COAT WEIGHT
    COATER VARIABLES

- **DIOXIDE SUBSTITUTION MODEL VALIDATION - PETER HART**

    COMPARE RESULTS OF CSUBD MODEL WITH LAB DATA
    DETERMINE VALIDITY OF COMPETING REACTION MECHANISM

- **CTMP AND MILLWIDE SIMULATION - BARBARA GIEBNER- IPST**

    IMPROVE INTERFACE BETWEEN MAPPS AND RPMS
    UPGRADE RMPS TAGS AND GRAPHICS
    COMPARE MODEL PREDICTIONS WITH DATA

SYSTEMS ANALYSIS
PROJECT 3471

December 20, 1990
Georgia Power Technology Applications Center
Atlanta, Georgia

DUES-FUNDED PROJECT SUMMARY FORM
FY 90-91

Project Title: Systems Analysis   Project Code: MAPPS
Division: E&PM   Project Number: 3471
Staff: Gary Jones   Proposed FY 90-91
Budget: $150,000
Total to Date:

Project Objective: Continue development of MAPPS to incorporate Performance
Attribute (PAT) Modeling
Program Areas: Improved product quality; reduced operating costs;
improved process and supervisory control; process optimization.

Rationale: Mass and energy balance models of pulp and paper mills
developed using process simulation programs such as MAPPS provide valuable
information for engineering design, process modification, and cost reduction.
With such models, it is possible to determine the impact of any process change
on the total mill environment. A significant advance in process simulation,
unique to MAPPS, is a system, Performance Attribute (PAT) Modeling, to predict
important pulp and paper properties for any process stream. Using PAT
Modeling it is now possible to perform process optimization based on both
quality and production factors.

PAT's describe fundamental properties of fibers and the developing fiber
network of the sheet and are modified by PAT models that emulate the real
process. PAT's are then used by a series of property models to compute pulp
and paper properties (hand sheets and machine-made sheets). These new models
were developed from theoretical and experimental information but have not been
completely validated as a system over wide ranges of practical papermaking
conditions. To date, the Pat Modeling system has performed reasonably well in
predicting handsheet and pulp properties for a TMP mill and both handsheet and
machine-made sheet properties for a newsprint mill.

FY 90-91 Goals: Systematically validate the PAT Models for four important
paper grades: corrugating medium, newsprint, linerboard and free sheets, as
follows:

1) Complete validation of MAPPS PAT Model of a corrugating medium mill

A) Determine how well PAT models predict sensitivity of important process
variables to end-use performance through a controlled sensitivity study.

B) Determine how well PAT models track short and long term normal process
variability through a time sampling analysis.

MODEL VALIDATION

A trial was conducted from April 3-5 at MacMillan-Bloedel's Pine Hill, Alabama mill to complete objective 1A above. The trial was designed to determine the sensitivity of the models to the following process variables: OCC (old container cartons) content, machine speed, calender stack loading, primary refiner power and consistency and press conditions. The test data are now being analyzed to establish model validity.

Pulp and reel samples were obtained as each reel was turned up during each day shift. Composited pulp samples obtained at eight locations from the high density tanks to the broke chest were formed into 26 lb and 40 lb handsheets. On selected reels both roll and set samples were obtained to quantify CD as well as between-reel variability. All reel samples were tested for a wide variety of paper properties including basis weight, caliper, density, burst, MD and CD tensile strength, stretch at break, moisture, directional modulus (MD and CD), MD and CD STFI compressive strength, CD Ring Crush and Concora. Handsheets were tested for a subset of these properties.

Before the test began, a preliminary MAPPS flowsheet model was developed to simulate the No. 2 paper machine from the high density tanks to the reel. The model incorporated most of the major process equipment including refining, screening and cleaning, storage vessels, white water system, paper machine, press section, dryer section and calender stack. The tuned preliminary model predicted sheet properties in reasonable agreement with typical values. A final flowsheet model was developed from process information provided by MacMillan. A series of twenty-four test cases was developed to simulate each of the test points.

Both handsheets and machine paper properties were determined at IPST. Additional data on selected properties from the Macmillan Accuray system was also provided for comparison with the IPST data. All property data, processing conditions and MAPPS predictions were organized into a series of data bases which were subsequently analyzed using the SAS system.

A detailed report on the results of the test are now being prepared. Some preliminary conclusions are summarized below.

Overall Model Fit

The overall fit of the model to the data for both handsheet and machine paper was very good. Variability in the handsheet data was more difficult to account for than with the model than the variability in the machine paper properties. One measure of the goodness-of-fit of the models was to determine the statistics for a simple regression model shown below,

Measured Property = Coefficient * Predicted Property

The single coefficient value and statistical parameters were determined for each property in the data base. In every case, the R-squared value of the model was 0.99 to 0.998 indicating a high level of agreement. In general the coefficient corrections were in the neighborhood of "unity" although in the case of CD Ring Crush and MD STFI the coefficient values were 1.449 and 1.173 respectively indicating a systematic difference between the models and these data.

The same model applied to the handsheet data indicated a somewhat lower level but still very high level of fit. For example the R-squared value for Concora was 0.964 with a coefficient of 0.766 for the handsheet data. Other variables were fit better than Concora.

In nearly all cases, the predicted values fell within the measurement error. It should be noted, however, that relatively high R-Squared values could be obtained by simply fitting the mean of the data. For example a model of the form

Measured Property = A * Reel No. + B * Set No. + C * Roll No.

gave R-Squared values of 0.92 for practically all properties. Effect of OCC Content

OCC ratio increased from 18% initially to a maximum of 38 % on reel 10 and then declined to 25 % at the end of the test on reel 24. In addition to the overall swing in OCC, some cycling also occurred.

The effect on most properties of OCC was relatively minor due to the similarity between the semi-chem hardwood furnish and the mixture of hardwoods and softwoods in the OCC stock as measured by the performance attributes. Thus, the PAT values predicted a-prior that the OCC variation would not have much of an effect on the end-use performance such as compressive strength and tensile properties.

Effect of Calender Loading

Calender loading increased the density and decreased the caliper of the machine paper. The elastic properties such as MD and CD modulus increased in proportion to the increase in density as predicted by the PAT models. When the calender stack was pulled, density and sheet stiffness both decreased and caliper increased. The models also predicted that the compressive properties such as Concora, STFI and Ring Crush, would not change significantly with calender loading provided the decrease in modulus was offset by an increase in caliper. This was confirmed by the experimental data. The actual values of the calender load both before and after the load was pulled were not known. The results indicated that the calender conditions (i.e. temperature or load) required several reels to reestablish themselves at previous levels after the stack was reapplied.

Calender loading was not observed to have much effect on tensile properties such as MD and CD breaking length or burst factor. However, the models did predict a similar reduction in tensile properties with reduced calender loading. The calender model predicts that the calender stack increases the degree of bonding in the sheet in proportion to the increase in density. Thus, when the stack is pulled, the bonding level is reduced and tensile strength is predicted to decrease.

There are several possible explanations for these differences. One possibility it that modulus is only be a function of density rather than bond density as assumed in the model. It is possible that calender conditions were such that increased fiber contacts did not lead to increased bonding. Then the property models will predict that tensile properties will not change with calender loading. However, the elastic properties which depend on density will change with loading.

CD Variability

CD variability was significant for several important variables such as basis weight, caliper, density and to a smaller extent to tensile strength and modulus. Consistent CD patterns also developed for compressive properties but it is not certain how statistically significant these patterns are.

Machine Speed

Machine speed decreased by 30 % during the last eight reels of the test. The effects of machine speed were masked by freeness variations and changes in other variables.

Freeness Effects

Freeness levels of the semi-chemical furnish cycled during the test but the cycles were damped out at the headbox so there should not have been significant effects of CSF on properties. Changes in OCC ratio and broke flows also contributed to freeness cycling.

SYSTEM DEVELOPMENT

Fillers

New attributes have been added to simulate the effects of fillers in free sheets. The new attributes are particle diameter, specific absorption coefficient, specific scattering coefficient and particle shape. Currently, these attributes are associated with a single generic suspended solid, SUSSOL1, in the MAPPS paper stream. The scattering and absorption coefficients attributes allow mixing of any number of suspended solids with fibers in the papermaking process. Optical properties such as brightness of handsheets or machine paper are then based on the Kubelka Monk equations. Particle diameter affects the first pass retention of the mixture of suspended solids on the Fourdrinier. Particle shape influences the sensitivity of the sheet strength to filler loading. The system will be expanded to handle specific types of fillers such as TiO2 and carbonates for more complete free-sheet modelling. This limited filler modelling capability will be available in the new release.

Dyes

New modules have been added to simulate the addition of black, blue and red dyes. Dye addition changes the specific light absorption coefficient of the fibers. This in turn affects the brightness and opacity of the sheet. Dyes are added through a new dye mixing module which requires only information on the undiluted dye flow for each type of dye. Dye addition has no effect on mass or energy of the stream. A separate property block, OPTPRP, is used to compute brightness at 457 and 572 nm and the opacity at 572 nm of both handsheets and machine paper. These modules are the basis for the development of the full color modelling feature described below. This feature will be available in the next release of MAPPS.

RELATED STUDENT PROJECTS:

Color Matching

Mayank Chaturvedi, MS candidate at Western Michigan University, is developing a MAPPS model to simulate color matching. The model will handle the absorption of a wide variety of dyes and predict tri-stimulus values and full spectral reflectance curves for dyed papers. A series of runs will be performed on the WMU pilot paper machine in conjunction with a MAPPS simulation model to validate the color-matching model system for selected dyes.

Blade Coating

David Standerfer, MS candidate Western Michigan University, is developing a MAPPS model to predict coat weight as a function of blade loading, stiffness, thickness and angle, fluid viscosity, backing roll softness, paper roughness, applicator roll gap and web speed.

Dioxide Substitution

Peter Hart, PhD Candidate at Georgia Tech, is comparing the results of MAPPS dioxide substitution module, CSUBD, with laboratory data to determine if the chlorination and chlorine dioxide reaction can be modelled as competitive parallel reactions as assumed in CSUBD.

We hope to publish all of this work in major journals such as TAPPI or AIChE Journal within the next year.

CTMP - Millwide and Information Systems

Barbara Giebner, MS candidate IPST, is evaluating and upgrading our CTMP model, RPMS graphical interface and RPMS tag system on the CTMP pilot facility.

MILLWIDE MAPPS
PROJECT 3688

December 20, 1990
Georgia Power Technology Applications Center
Atlanta, Georgia

PROJECT SUMMARY FORM

DATE: December 20, 1990

PROJECT NO. 3688: Millwide MAPPS

PROJECT LEADER: JAMES D. RUSHTON

IPST GOAL:

The goal of this project is to demonstrate the feasibility of integrating
MAPPS with a process management/information and distributed control system,
i.e. a typical pulp and paper industry millwide network.

OBJECTIVE:

The objective of the project is to develop MAPPS applications for millwide
systems. For such applications, MAPPS will be configured to read "realtime"
process data from a millwide network, run a simulation, and write calculated
material and energy balance data and predicted product quality data back to
the millwide network. The realtime process data can be obtained via a
management information system such as the International Business Machines
Corporation Realtime Plant Management System (RPMS), the Oil Systems
Incorporated Plant Information (PI) System, etc. , or, alternately, it can be
obtained directly from the mill's distributed control system (DCS).
Similarly, calculated or predicted data can be sent back either to the
management information system data base or the DCS data base.   It can then be
made accessible to the Operator via existing graphical displays or via
uniquely configured displays.

CURRENT FISCAL BUDGET: $ 50,000

INTRODUCTION

Traditionally, pulp and paper industry applications of process simulation have been limited, primarily because of hardware/ software constraints, to the domain of the process and research engineer. Simulation programs normally run on mainframe, mini-, or micro computers which are not accessible to the mill's operators and line managers. Additionally, the complex, often confusing user interfaces included in a simulation program often preclude the use of simulation in real time, mill environments.

A readily accessible, easy-to-use version of MAPPS specifically tuned for a particular mill process environment, could be used to assist operators and line managers in the day-to-day tuning of process variables. Using the Performance Attribute Modeling capability of MAPPS, an operator or manager could conceivably achieve superior product quality while reducing or optimizing product manufacturing costs.

PROJECT PLAN

To demonstrate the commercial viability of a simulation application designed specifically for day-to-day mill operations, a joint venture project was initiated to interface MAPPS with IBM's RPMS (Realtime Plant Management System) and ABB Incorporated's Taylor MOD 300 distributed control system to optimize the operation of a CTMP Pilot Plant. The resulting integrated system was installed on a CTMP Pilot Plant at the Georgia Power Technology Applications Center located on Northside Drive in Atlanta. The plant is being operated by the CTMP Center, a research and development organization sponsored by Georgia Tech, IPST, Georgia Power, ABB Incorporated, IBM, Bowater Inc. and other pulp and paper related companies.

Specifically, the goal of the CTMP project was to develop the software required to:

a.   receive process data from the RPMS/MOD 300 systems and convert it to a format suitable for use in a MAPPS data input file,

b.   run a MAPPS simulation using the collected process data

c.   retrieve computed process data from the resulting simulation output file in a format compatible with the RPMS/MOD 300 data,

d.   "download" the computed data to the RPMS data base and, hence, to the MOD 300 to make it accessible to the CTMP Operator or to the research team.

ACCOMPLISHMENTS TO DATE

The demonstration project at the CTMP Center has been successfully completed. When CTMP pilot plant operations begin in earnest, the model will be tuned and used to assist the CTMP personnel with process analysis. The model may also be used to for other purposes, such as demonstrations and, ultimately, for the development of control strategies.

In a related development, Dr. Gary Jones visited the Australian Pulp and Paper Institute and several paper mill locations this year. While there he advised and assisted a graduate student in the development of a MAPPS on-line TMP model. This application was done through a Bailey Net 90 distributed control system and the model is currently running as a part of the millwide system.

FUTURE DEVELOPMENTS

Discussions have been initiated with several mills to determine how to structure specific proposals for millwide simulation projects. Two potential projects are (1) the optimization of ring crush at a linerboard mill, and (2) bleach plant optimization for a bleached market pulp facility. Such projects would likely be "joint ventures" between IPST and SACDA, computer systems suppliers, management information systems suppliers, and the candidate paper companies. Specific proposals for one or more such projects will be developed during the remainder of this fiscal year (90/91).

PUBLICATIONS AND PRESENTATIONS

Publications:

1. Jones, G. L., "Integration of Process Simulation with Millwide Information and Control," Tappi Journal 73(11): 113 - 118 (1990).

Presentations:

1. Jones, G. L., "Integration of Process Simulation with Millwide Information and Control," presented at the 1990 TAPPI Engineering Conference, September 24-27, 1990, Seattle, Washington.

2. Rushton, J. D., "Benefits of Process Simulation in an Integrated Millwide System," presented at the IBM Process Industries 1990 Process Plant Management Conference, July 9-11, 1990, Nashville, Tennessee and at Southeastern TAPPI, November 8-9, 1990, Decatur, Georgia.

RELATED PROJECTS

A project, "Development and Demonstration of the Use of a Modular Dynamic Thermo-Mechanical Pulpmill Simulation Model to Develop Energy Reduction Strategies," has been funded by the Department of Energy. This two-to-three year project will be implemented under the auspices of the International Energy Agency and is a joint venture between IPST and SACDA. Steady state and dynamic TMP models of a yet-to-be-selected mill will be developed using an integrated form of MASSBAL 3.0 and MAPPS 4.0. The steady state model will first be used to analyze the mill process data and set up a "reconciled" data input file for the dynamic model. The dynamic model can then be run to "look ahead" and determine the future process operating conditions and the quality of the pulp that will be produced.

As discussed above, the models will be set up to be relatively transparent to the operator and the calculated and predicted data will be displayed, via existing or new graphics, to assist the operator in process analysis and optimization.

STUDENT PROJECTS

Several student A190 projects have been initiated that relate to MAPPS millwide applications. These are:

1. Barbara Giebner (Jones) - Upgrade of the CTMP Model.

2. Gene Ochalek (Rushton/Jones) - Dynamic Features for MAPPS.

3. Norren Jonason (Rushton) - Development of a Dynamic TMP Model

4. Karen Gibson (Rushton/Ellis) - An Expert System Interface for a Dynamic TMP Model

5. Pirkko Petaja (Rushton/Ellis) - Optimization of Ring Crush for Linerboard