On-line Job Tracking and Design For Manufacturing Feedback in Product Development

Masters Project
University of Florida
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Executive Summary

The purpose of this project is to give the corporation a system that will have two capabilities that it does not currently have.

One purpose of this project is to create a consistent, visible system that can take advantage of certain in-house expertise and use this information to create a better, more producible product while at the seam time reducing standard cost. This system captures the toolmakers' feedback, and has the ability to retrieve this information at any time, but especially at design reviews to ensure that the feedback and advice was incorporated into the design. This early design for manufacturing feedback will result in parts designed which are easier to fabricate and thus less expensive to make which results in lower costs.

The second purpose of this project was to develop an on-line data-base of jobs submitted to the model shop with the ability to track the job's progress through the shop and to publish expected completion dates. During design and prototype phases, this visibility will allow designers and project mangers to plan design and test activity around part delivery and availability. Also, during pilot and initial build phases the production dates often have to slip due to long lead-times and due to orders being placed late. A remedy to this situation is to jump-start the pilot production by fabricating most of the late parts in the Product Development Model Shop. Once the production planners start to request parts from the development machine shop, they experience the same frustration that the engineers express regarding the lack of visibility of work activity and schedules. That is, once an order was placed into the model shop, it became a black hole with no visibility until the customer was notified when the part was completed. This system will allow the new product planners and buyers to coordinate the delivery of parts from the model shop with the delivery of parts from the production vendors to facilitate the pilot and initial build activity.

The needs, requirements and requests of the users were determined after conducting a series of interviews. Various members of the design community were interviewed. These members included machinists in the model shop and members of new product introduction and early supplier involvement from the supply management

Microsoft Access 97 was used as the database engine of the system.

The database was developed with constant feedback and interaction from the user groups and was an iterative activity of constant process improvement.

The capabilities of the system include:

1) A threaded system to enable individual machinists as well as the model shop supervisor to enter design for manufacturing feedback into the database. This feedback is tracked according designer, engineer and project so that reports can be generated to assess the affectivity of the design and the value of machinist's input.
2) A series of standard reports to retrieve this information in an easy to use and read format
3) A job tracking system that gives the ability to track specific job progress through the models shop.
4) A job tracking system that can report: shop capacity usage, start dates, due dates, open orders, closed orders and project job activity

Introduction

Toolmakers are traditionally associated with the final stages of design. Even if the toolmaker is part of a product development organization, the toolmaker is thought of as a service or support group whose role is to machine, build, mold, etc. the design of the engineer. There is, however, a direct correlation between the amount of experience that a designer or engineer has and the amount of advice (s)he seeks from the toolmaker. That is, the more experience, the more design and the more projects that an engineer has gone through, the more they come to realize the wealth of information that resides with the toolmaker or machinist individually and in the machine shop collectively. This occurs because the seasoned design engineer has learned, often too late, that these people in the shop know how things get done. One purpose of the database developed for this project is to systematize and procedurize the feedback mechanism from the model shop to the design community. With this capability it will be possible to incorporate and review this feedback into the design and cost of a product.

As in all expert based systems, the difficult part was to determine how to best capture the expertise residing in the expert and how to communicate that information to others in a timely and useful manner.

The traditional way of submitting work orders to the engineering model shop was to have a technician or engineer submit a work order request, attach an engineering drawing, walk these documents down to the shop, submit the job and wait for the part to be built. When the job is completed the model shop supervisor calls the requestor (customer) and informs them that the part is ready to be picked up. In the product development environment many parts are experimental and may never be used in the released product. Because these parts are new, some may not have enough detail to completely build the part and some drawings may in fact be just informal sketches, or even the ‘sketch on the back of a napkin'. The machinist often needs to ask questions regarding design intent or even may need to add missing or conflicting dimensions.

In a good dialog environment the machinist will make manufacturing recommendations to the customer and the customer will be open to the ideas and make the recommended changes. In a bad dialog environment the customer will adopt an arrogant attitude and not be open to any recommendations and stubbornly say 'just do it my way', ignoring the recommendations. It has been the author's observations through the years that often the merchant is the expert, (s)he knows the process, understands the issues, and has the solutions. In the development phases and prototype build activity the long term fabrication issues may not be readily visible and will only rear its ugly head at pilot or initial production when it is too late to make significant changes and production schedule is critical. Therefore it is important to perform design-for-manufacturing analysis early and often during the design cycle.

Along with all of the activity that occurs in a product development is the loading, scheduling and tracking of work activity through the shop. This is necessary in the design, prototype and pilot phases of a project. During design and prototype phases, this visibility will allow designers and project managers to plan design and test activity around part delivery and availability. During pilot and initial build phases the production dates often have to slip due to last minute design changes, long lead-times, and orders being placed late. A remedy to this situation is that we can jump-start the pilot production by fabricating most of the late parts in the Product Development Model Shop. Once the production planners start to request parts from the development machine shop, they experience the same frustration that the engineers express regarding work activity and schedules. That is, once an order was placed into the model shop, it becomes a black hole with no visibility until the customer is notified when the part was completed. This system will allow the new product planners and buyers to coordinate the delivery of parts from the model shop with the delivery of parts from the production vendors to facilitate the pilot and initial build activity.

The objective of this project is to develop an on-line database of jobs submitted to the model shop with the ability to:

1) Track the job's progress through the shop,
2) Capture the toolmakers' feedback,
3) Retrieve this information at any time, but especially at design reviews to ensure that the feedback and advice was incorporated into the design.
4) Create a system that allows users to view the shop capacity, start dates and due dates of submitted jobs.

Planning

The planning activity consisted of three major phases. The sequence of planning deviated from the normal reengineering activity because the deficiencies in the current process were pre-identified by the customers of the process and the product. Thus the activity of process selection was eliminated because the process was pre-selected, pre-identified by the pain of the customer, and the pain of the customer was clearly communicated to the owner of the process who was the manager of the of the engineering model shop (who is the author of this report).

The current process caused frustration because of the lack of visibility of job activity, job queue time, and job delivery dates.

The other area of frustration of management was the lack of control of standard cost information of new products.

These two issues combined to create a fertile opportunity for the development of a system that would give visibility to the work activity of the model shop as well as to incorporate design for manufacturing input into the product, thus reducing cost and lead time of parts when they go into production.

The first step of the planning phase was to identify why the customers were not satisfied with the current process. In the course of this investigation it was discovered that the customers were very pleased with the quality of the parts delivered from the model shop. The issue, however, was that the lack of predictable or consistent delivery of these parts made it difficult for the projects to schedule their development activity. Of course, when an engineer has an idea, (s)he wants the immediately so that the idea can be verified and if not, to determine what has to be changed in order to make the design work. Knowing that getting a part immediately is not practical, they would be satisfied if they could plan their other tasks around the delivery of parts. That is, they could be doing parallel design activity while parts are being fabricated, as long as they knew that the part would be available at a certain time.

The next step in the planning phase was to identify the current process and what might be improved. This was done by interviewing the same group of people who were identified as the customers and to discuss with them what they would like to see or how they might envision how a newer system would work.

The next step would be to select the tools that would be used to develop the system. This would include database tools for easy data input and easy report generation capabilities.

And the last step was to develop a training program so that the users of the systems so that the users could use it as it was intended.

This is actually an iterative process, because the users would be constantly asked for feedback in usability studies so that the developers could see what was working and what wasn't working and then make the appropriate changes.

Preparation

As with all business process improvement programs it was necessary to document the existing system. There is some debate whether this is a worthwhile activity since often the old system is eliminated and replaced by the old system. But the author wanted to determine if there was any data currently being collected or any part of the system that might be worth reusing. It was necessary to investigate how work flowed so one could create a system around the natural workflow to help make the transition easier or more acceptable by the current users. Documenting the old system also was helpful in identifying what data was currently being collected and to decide which of that data was useful or not so those wasteful tasks would not be duplicated in the new system.

The preparation phase of the project also included a series of interviews with different functions within the design community. Those functions consisted of program managers, project managers, design engineers, CAD designers, CAD administrator, CAD manager, engineering model shop supervisor, model shop machinists, new product planners, and Early Supplier Involvement (ESI) buyers.

Interview #1

This actually consisted of a series of interviews since it was an attempt to survey a broad base of customers and potential users of the system.

Various project customers and participants complained about the lack of visibility of jobs once they went into the model shop's build queue identified the need.

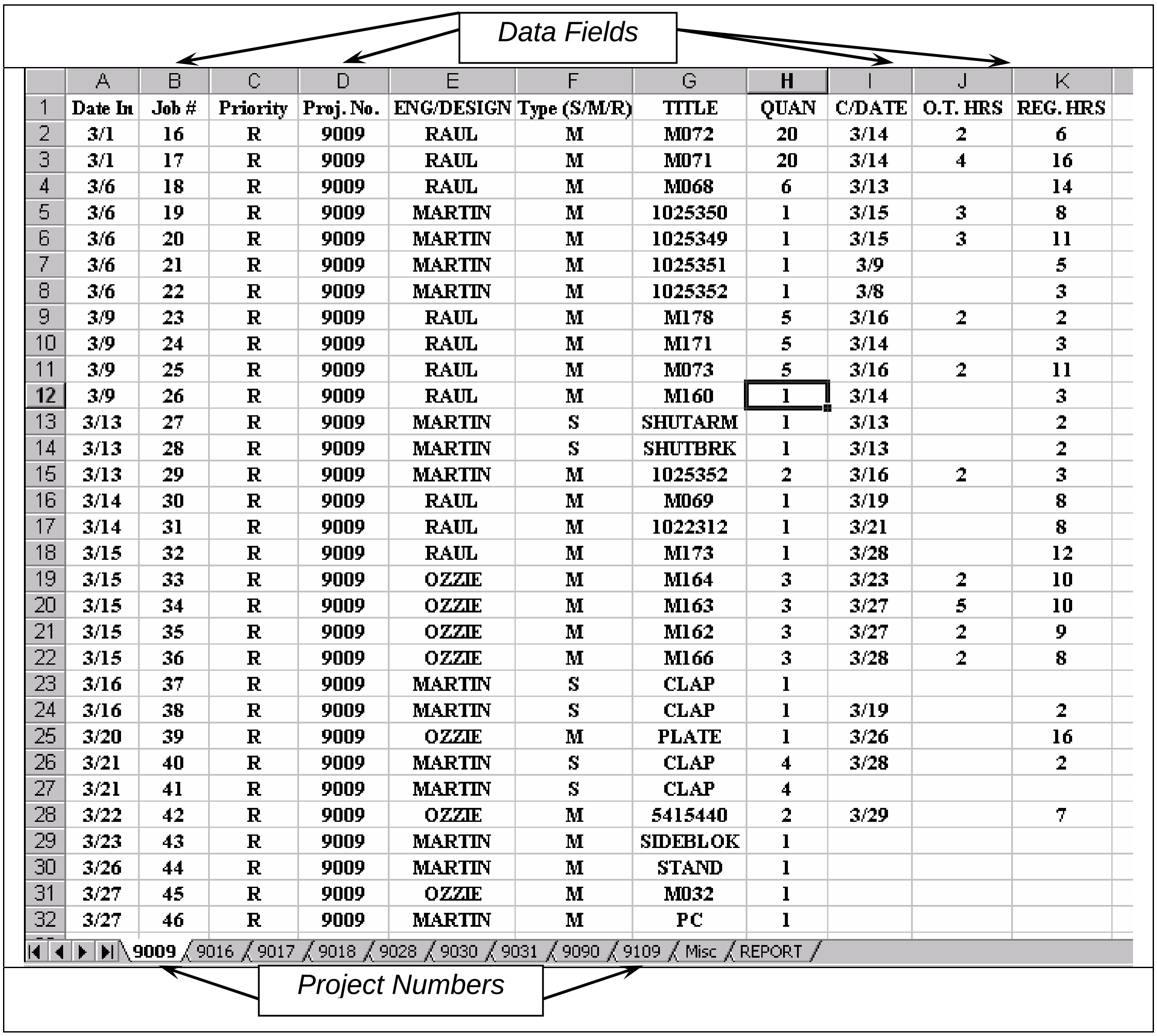
These participants were then interviewed to determine what their frustration was.

Some of the frustration that they expressed were a lack of a clear definition of job queue priorities, the lack of submitted job status, the lack of shop load information, and the lack of a visible job tracking system.

After expressing their frustrations, they were then queried as to what information they would like to have access to and how they would like to see it presented.

Interview #2

Another interview session was held with the model shop supervisor to investigate what kind of data that he currently tracks, how he captures that data and how the data is recorded and stored. A sample of the spreadsheet that he currently uses is shown in Figure 1.



	A	B	C	D	E	F	G	H	I	J	K
1	Date In	Job #	Priority	Proj. No.	ENG/DESIGN	Type (S/M/R)	TITLE	QUAN	C/DATE	O.T. HRS	REG. HRS
2	3/1	16	R	9009	RAUL	M	M072	20	3/14	2	6
3	3/1	17	R	9009	RAUL	M	M071	20	3/14	4	16
4	3/6	18	R	9009	RAUL	M	M068	6	3/13		14
5	3/6	19	R	9009	MARTIN	M	1025350	1	3/15	3	8
6	3/6	20	R	9009	MARTIN	M	1025349	1	3/15	3	11
7	3/6	21	R	9009	MARTIN	M	1025351	1	3/9		5
8	3/6	22	R	9009	MARTIN	M	1025352	1	3/8		3
9	3/9	23	R	9009	RAUL	M	M178	5	3/16	2	2
10	3/9	24	R	9009	RAUL	M	M171	5	3/14		3
11	3/9	25	R	9009	RAUL	M	M073	5	3/16	2	11
12	3/9	26	R	9009	RAUL	M	M160	1	3/14		3
13	3/13	27	R	9009	MARTIN	S	SHUTARM	1	3/13		2
14	3/13	28	R	9009	MARTIN	S	SHUTBRK	1	3/13		2
15	3/13	29	R	9009	MARTIN	M	1025352	2	3/16	2	3
16	3/14	30	R	9009	RAUL	M	M069	1	3/19		8
17	3/14	31	R	9009	RAUL	M	1022312	1	3/21		8
18	3/15	32	R	9009	RAUL	M	M173	1	3/28		12
19	3/15	33	R	9009	OZZIE	M	M164	3	3/23	2	10
20	3/15	34	R	9009	OZZIE	M	M163	3	3/27	5	10
21	3/15	35	R	9009	OZZIE	M	M162	3	3/27	2	9
22	3/15	36	R	9009	OZZIE	M	M166	3	3/28	2	8
23	3/16	37	R	9009	MARTIN	S	CLAP	1			
24	3/16	38	R	9009	MARTIN	S	CLAP	1	3/19		2
25	3/20	39	R	9009	OZZIE	M	PLATE	1	3/26		16
26	3/21	40	R	9009	MARTIN	S	CLAP	4	3/28		2
27	3/21	41	R	9009	MARTIN	S	CLAP	4			
28	3/22	42	R	9009	OZZIE	M	5415440	2	3/29		7
29	3/23	43	R	9009	MARTIN	M	SIDEBLOK	1			
30	3/26	44	R	9009	MARTIN	M	STAND	1			
31	3/27	45	R	9009	OZZIE	M	M032	1			
32	3/27	46	R	9009	MARTIN	M	PC	1			

Figure 1 - Current Model Shop Data Collection Spreadsheet

Interview #3

A third interview session was held with the CAD administrators to determine what kind of information was available in the CAD system and how this information might be used in the model shop system being developed.

This information would be used in the development of the fields in the new database and would be required information on the new, online Model Shop Work Request form. The information would include the CAD file names, revisions, server locations and other PDM information. There was also a lot of discussion of the new capabilities of the CAD system and the CAD PDM system that would be useful to be integrated into the system at some point in the future.

Interview #4

Interviews were held with the new product planners and the ESI buyers. Even though they are not part of the Product Development or Engineering organization, this group of people uses the model shop heavily during the pilot manufacturing stage of new product introduction. The standard practice is to use the conventional MRP system to procure parts. However, part requirements and specification changes occur too often with the needs too timely (as in, immediately) to use traditional production vendors. At this stage of the process they become dependent on internal resources such as the engineering model shop. Thus, they need some form of visibility of the activity in the model shop, which acts as an adjunct to the production MRP system.

Interview #5

The Model Shop machinists were interviewed to discuss their experience with interfacing with the engineers and designers. Their discussion focussed around two areas of concern. One issue was the overall lack of manufacturing process concerns that were designed into the part. Often, parts are designed solely to solve a performance problem with little thought towards cost or ease of manufacturing. This creates several problems for the model shop machinist that would not be experienced by an outside job shop vendor. One is that while the engineer does not have to pay in order to have the part fabricated, thus cost is not an issue, the other issue is the strain that it puts on the shop's capacity.

When a Request for Quote (RFQ) is sent to an outside vendor, the vendor can charge a price commensurate with the complexity and manufacturing difficulty of the part. The model shop does not have that luxury. Since they a service organization, they must make the part regardless of the design. With limited capacity, this creates additional burden to the shop and thus decreases its throughput and ability to serve other projects.

Often, when a machinist gets a drawing, they will make a phone call to the engineer and ask him/her to come to the shop to review and discuss some possible design improvements. Several scenarios can arise from this meeting. One is that the engineer will not listen to the machinist and imply say "do it my way". Another is that the machinist and designer will have a meaningful discussion about design improvements, but the discussion often ends something like "I don't have time to make the changes now, but lets mark-up the drawing and I will fix it for the next time". However, when the next revision of the part come back to the shop, the discussed issues are never implemented. Another scenario is similar to the previous except that the engineer actually listens to the machinists, makes the changes and the part is truly redesigned for manufacturability. This is the preferred way to do business.

These scenarios exhibit how powerless the machinists felt. They asked for a process by which their feedback could be documented so that later in the development process, their recommendations would have visibility beyond the individual engineer.

After these data and interview collection were done, and based upon the developers database knowledge and familiarity, it was determined that the Microsoft Access database program would be an appropriate tool to develop the system with.

Current System
Work Process Flow Chart

The existing system

Currently work is submitted using the Microsoft Word form in Figure 2 and the work flow chart is represented in Figure 3. The current tracking system is maintained in an Excel spreadsheet with a different worksheet for each project as previously shown in Figure 1.

SECTION 1 - PRIORITY | ROUTINE: | *URGENT:

If "Urgent" or state reason:

Comments:

* Approval Signature | Date:

SECTION 2 - *Work Request*

Primary Contact: | Phone: | Date Submitted:
Alternate Contact: | Phone:

Hematology ______________ ***Cytometry*** ______________ ***Other*** ______________

Project and Task Number: | Drawing No.: | Qty Req'd:

Drawing checked: Yes _______ No ________

SECTION 3 - Other Work Request

Scientific Instruments: | Manufacturing:

Primary Contact: | Date Submitted:
Alternate Contact:

Project Number: | Drawing No.: | Qty Req'd:

Manager Receiving Labor Transfer: | Dept.No.: | Drawing checked: Yes ___ No____

Section 4- Model Shop Information

Machinist Name	Date Completed	Estimated Hours to Complete Job	Labor Rate S.T./O.T.	Hours S.T.	Hours O.T.

Comments:

Figure 2 - Current Model Shop Work Request Form

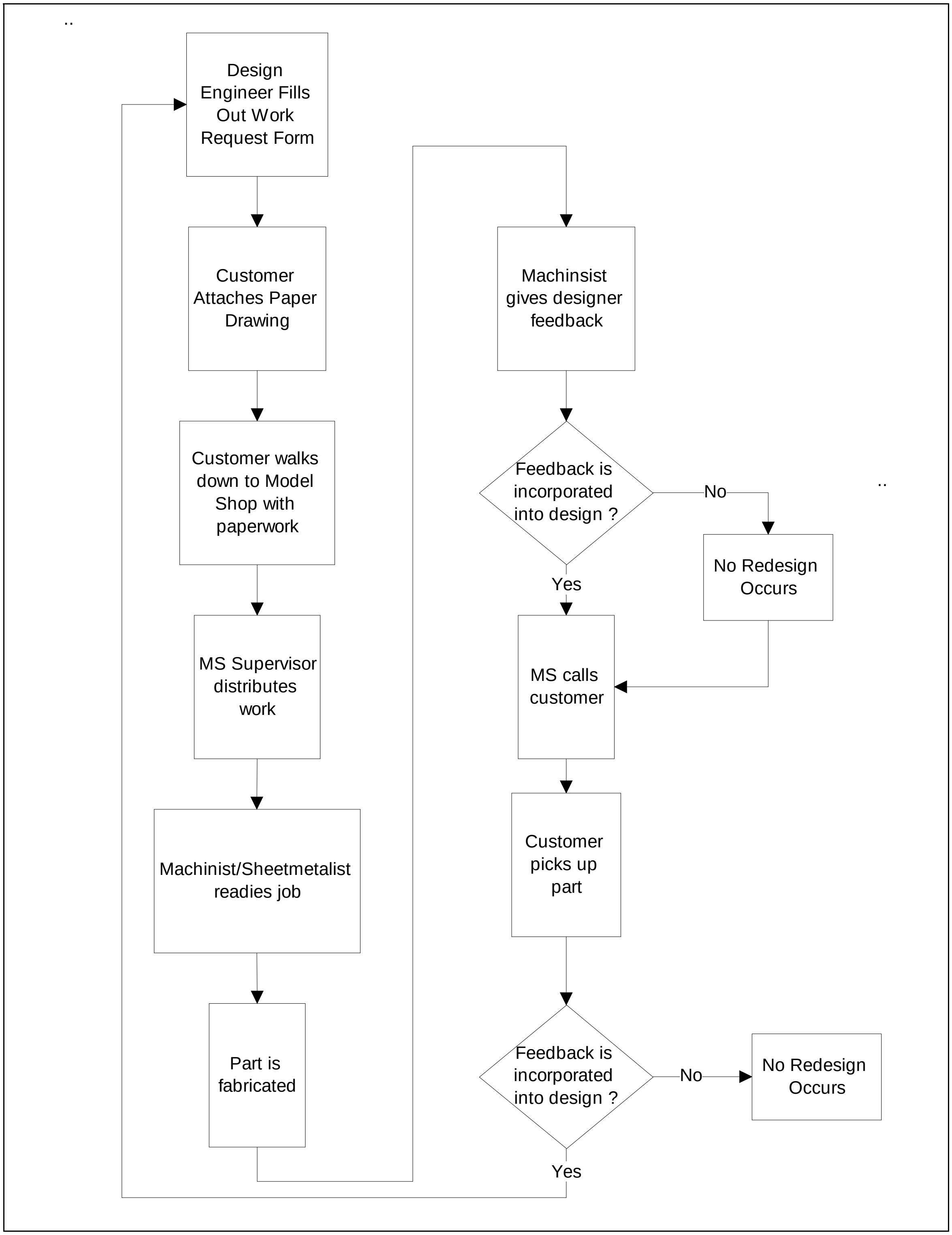


Figure 3 - Current Model Shop Work Flow Chart

The form is filled out, a part drawing is stapled to the form, the engineer walks the form to the Model Shop, puts the paper in the in-box and waits for a phone call from the Model Shop supervisor that his part is ready. There may be some discussion to clear up some information or discuss the design, but this is totally individual dependent and is not consistent.

Presently the data collected in the model shop is limited to the spreadsheet as represented in figures 1 and 4.

EMPLOYEE		H/WORKD
	W/ENDS 03/02	
J.SOSA		16
B.WILLIAMS		18
J.SZUMILA		20
P.SUDDERTH		20
R.AMADO		20
J.CASALANGUIDA		16
	W/ENDS 03/09	
J.SOSA		40
B.WILLIAMS		45
J.SZUMILA		50
P.SUDDERTH		55
R.AMADO		55
J.CASALANGUIDA		45
	W/ENDS 03/16	
J. SOSA		40
B. WIILIAMS		40
J. SZUMILA		55
P. SUDDERTH		55
R. AMADO		55
J.CASALANGUIDA		40
	W/ENDS 03/23	
J. SOSA		40
B. WIILIAMS		40
J. SZUMILA		55
P. SUDDERTH		55
R. AMADO		55
J.CASALANGUIDA		40
	W/ENDS 03/30	
J. SOSA		40
B. WIILIAMS		40
J. SZUMILA		54
P. SUDDERTH		55
R. AMADO		55
J.CASALANGUIDA		40
	TOTAL	1254

Figure 4 - Current Model Shop Data Report

This is a manual system that could have existed 50 years ago. Fill out a form, attach a drawing and bring it to the machine shop. It is simple, it gets parts made but it lacks the ability to provide meaningful information to the customer in an easy way.

Database Development

During the interviews and discussions with the design group and supervisors, it was determined that additional fields would be both needed and useful if the database were to be effective. If one of the requirements of the new system was to enable the model shop to directly retrieve the 3D CAD databases from the PDM system, then it would be necessary to specify where in the PDM system these files were located. The fields, which identified the location name and revision of the electronic files, are 3D part name, drawing name, assembly name, and assembly revision. One of the process requirements would be that the designer would have to use the PDM system and that the parts and drawings be checked into the system. If the PDM system was used properly, then the Model Shop could retrieve the information electronically. Other information that was requested to be included by the Model supervisor was the preferred material and the finish required. Even though these two pieces if information are documented on the drawing, it has been experienced in the past that this information is often not included on the drawing until much later in the design process. Thus, it would be good to include these on the form as a reminder that this information is needed.

If one of the goals were to report additional information then additional data would also have to be collected in the model shop. Table 1 shows the data fields that were being collected on the model shop spreadsheet. Table 2 shows all of the data fields that are being collected in the new system. The old system collected 13 data fields and the new system collects 35 data fields.

Date In	Title
Job #	Quantity
Priority	Completion date
Project number	Regular Hours
Engineer or Designer	Overtime Hours
Machinist	Project Number
Process Type (S/M/R) (sheetmetal, machining, rework)	

Table 1 - Data Fields Currently Collected

Unique job id number	Project number	project name
customer's name	Customer' phone	Designer's name
Designer's phone	Engineer's name	Engineer's phone
required date	date job submitted	date job promised
actual delivery date	quantity required	priority
part number	part name	part revision
regular hours	overtime hours	machinist's name
PDM path	PDM part number	PDM part revision
PDM drawing number	PDM assembly number	PDM part revision
PDM drawing revision	PDM assembly revision	preferred material
Machinist name	next assembly	fabrication process
Machinist feedback information		
Model Shop supervisor feedback		

Table 2 - Data Fields of New System

Now that the information needed was identified, the work on the development of the database could be started.

It was determined that there needed to be at least four different types of users who would input data into the database. One was the customer, the person who needed parts fabricated in the shop. Another was the machinist who would enter his/her feedback into the database. The third input would come from the model shop supervisor. He would enter all of the job control and administrative data such as assignee, due date, hours worked, delivered date, etc.

The fourth user group would be the members of the management team. These users would be occasional users who would want project status, or shop work load status so that they could plan schedules or review project status

With this varied array of users, it would be necessary to create a system that would clearly and easily lead the four different groups to the input or report screens that they would want to use. The screens were intentionally developed to be simple and clear of clutter. Options are simple button clicks and user prompts are simple pop-up screens. Fancy graphics and animations were intentionally left out. The system is meant to be a utilitarian tool meant to make it easy to input data and easy to retrieve status and other output.

Screen Descriptions and Functions

The first screen that users see when they enter the database is shown in figure 5.

Button 1 is used to enter the screen with options for creating a new work order request or retrieving project or job status reports from the model shop.

Button 2 is used by the model shop for both machinists' feedback and supervisor job input and feedback.

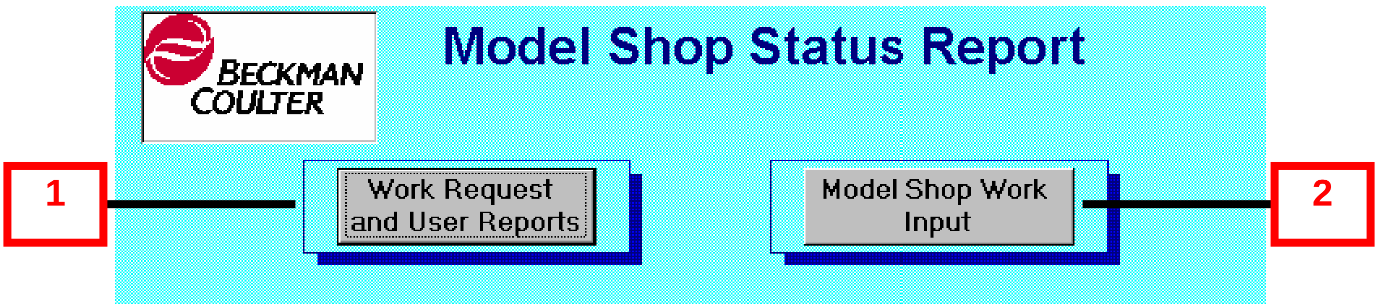


Figure 5 – Main Model Shop Screen

Figures 6 and 7 step through the sequence of clicks that will bring the user to the on-line model shop request form in figure 8. Notification that a new job has been submitted to the Model Shop is not yet automated. Even though the model shop supervisor periodically checks the database throughout the day for new submissions, it is recommended that the requester notify the model shop either with a phone call or email.

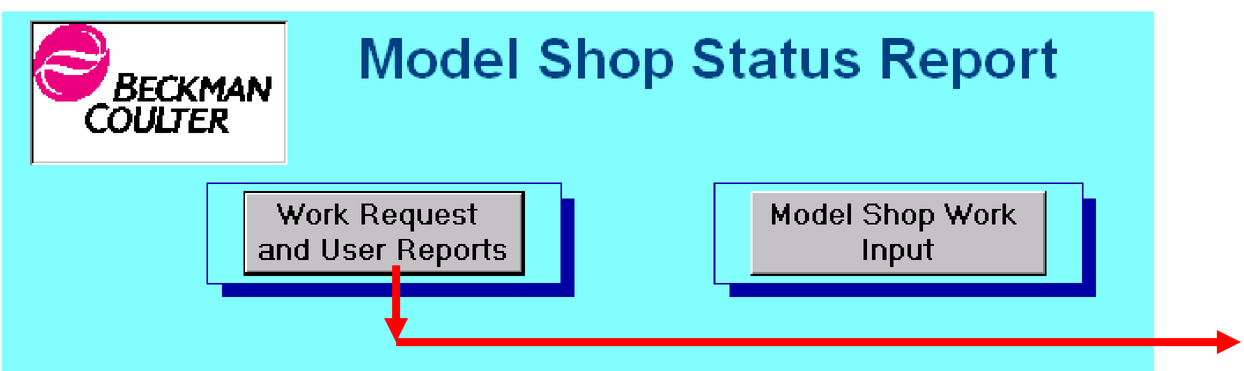


Figure 6 – Selection Button 1 from Main Model Shop Screen

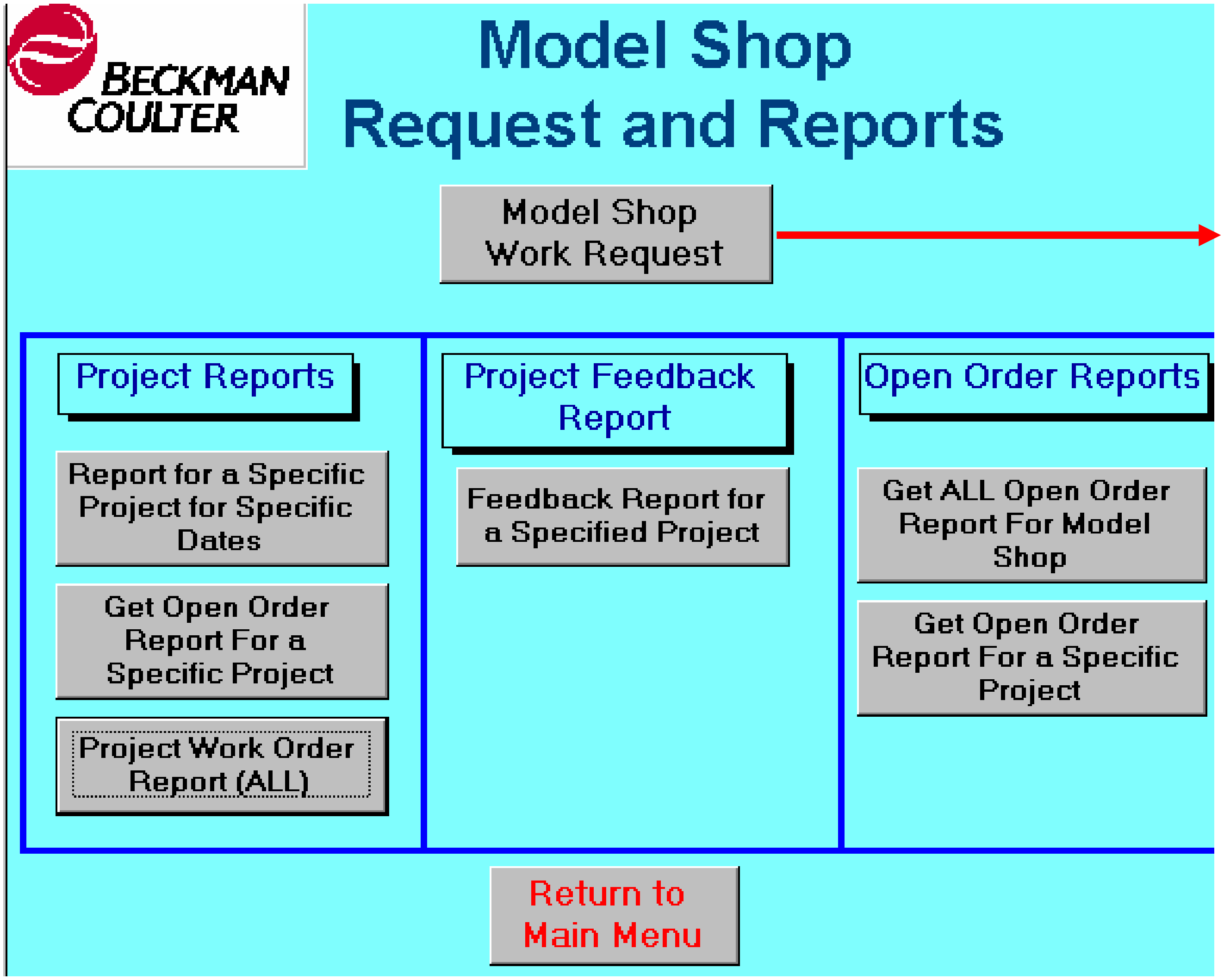


Figure 7 - Work Request Screen

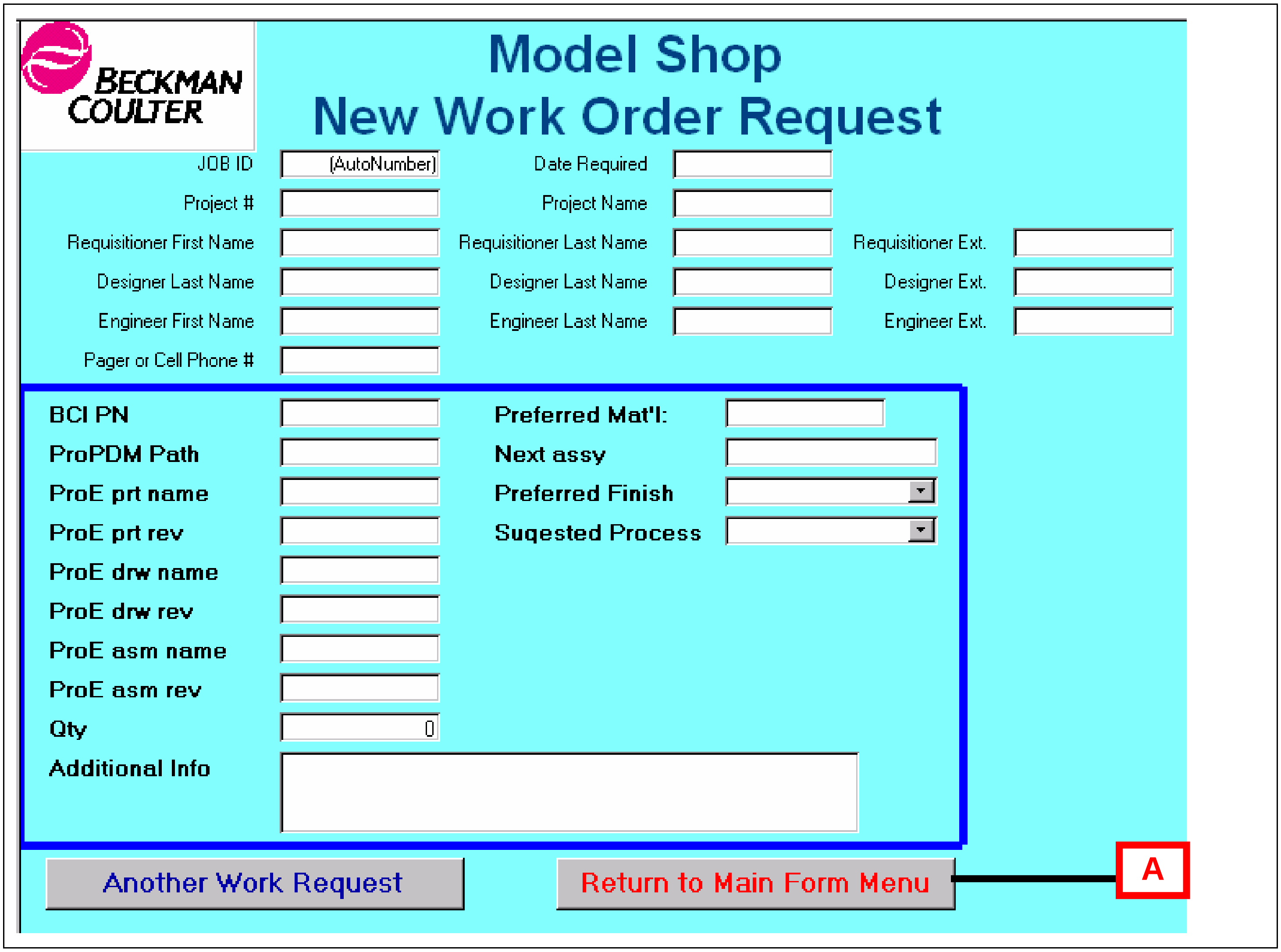


Figure 8– On-Line Work Request Form

Selecting the ***Return to Main Form Menu*** button (Button A) in figure 8 will bring the user to the Main User Switchboard as shown in figure 9.

Selecting ***Report for a Specific Project*** (Button 2) in figure 9 will prompt the user for inputs as displayed in figure 10 and then generate a report of all jobs worked on a specified project between the specified dates as displayed in figure 11.

Selecting ***Get Open Order Report for a Specific Project*** (Button 3) in figure 9will prompt the user for inputs as displayed in figure 12 and then generate a report that displays all of the jobs currently being worked on yet not yet completed as displayed in figure 13.

Selecting ***Project Work Order Report*** (Button 4) in figure 9 will prompt the user for inputs as displayed in figure 12 and then generate a report of all the jobs both open and closed for a specific project as displayed in figure 11.

Selecting ***Get All Open Order Report For Model Shop*** (Button 5) in figure 9 will generate a report of all the jobs currently being worked on in the queue as displayed in figure 13.

Selecting ***Get Open Order Report a Specific Project*** (Button 6) in figure 9 will generate a report of all the open work orders for a specified project as displayed in Figure 15

Selecting ***Feedback Report for a Specified Project*** (Button 7) in figure 9 will generate a report of the feedback generated for all of the jobs of a specified project number submitted to the model shop. A sample of this report is displayed in figure 23 and figure 24.

Main Request and Report Switchboard

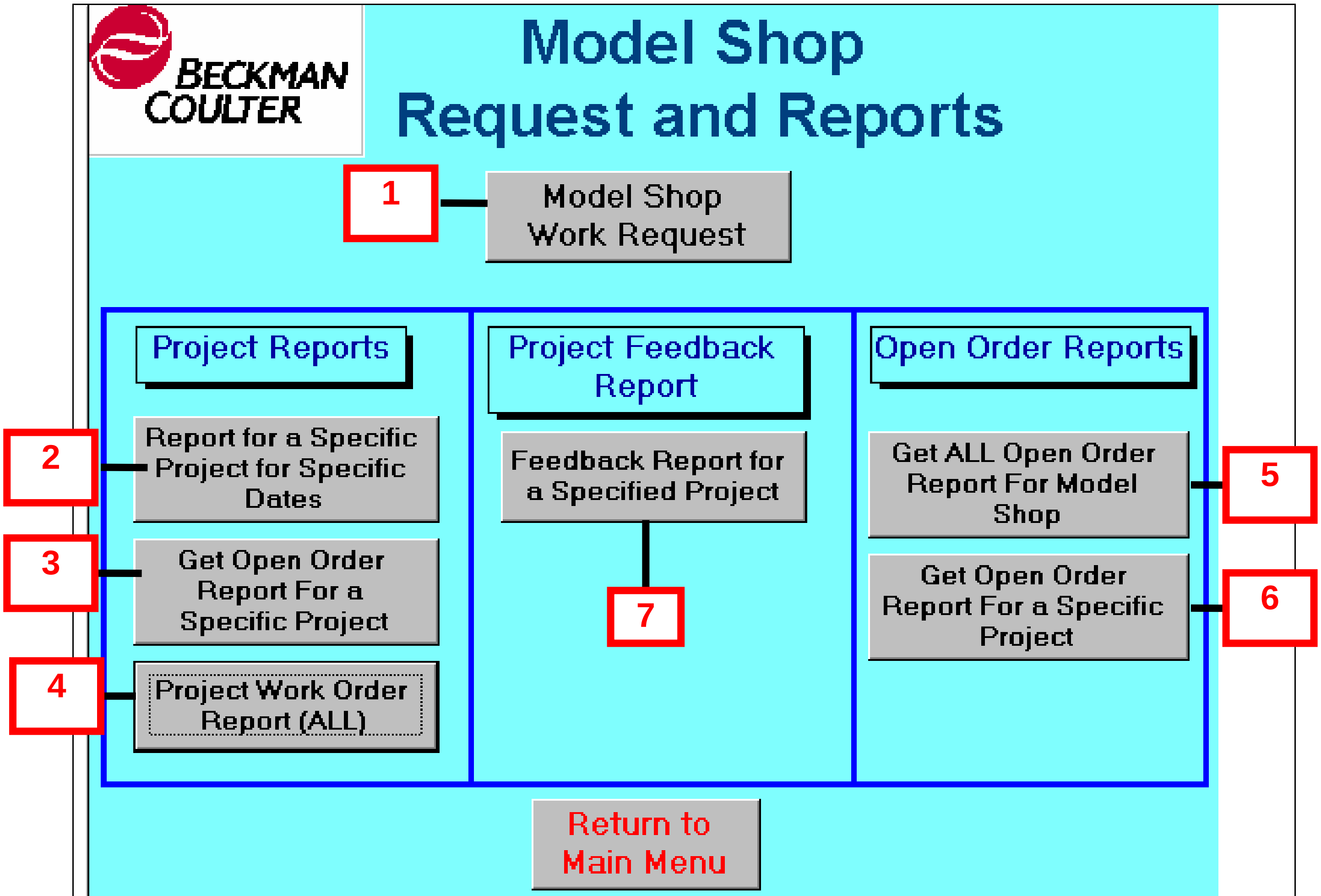


Figure 9 - Numbered Main report Screen

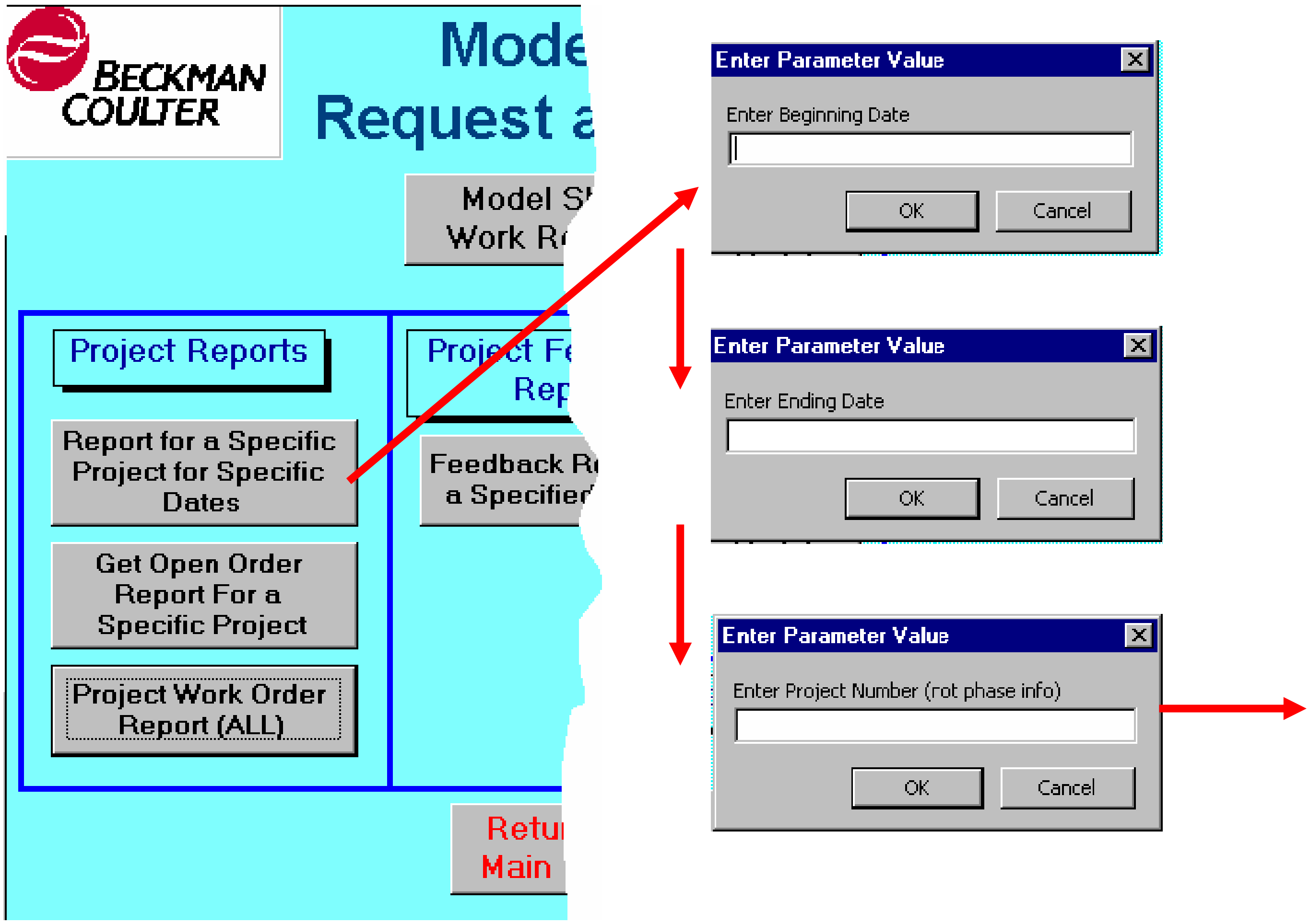


Figure 10 – Screen for Specific Project Number Report and Prompts

Report for all Orders for Projet 362 — 16-Apr-01

Proj No	Date In	Job	Priority	Engineer	Designer	Machinist	Process	Title	Qty	Reg hrs	OT hrs
362	1/16/00	6	Urgent	Callahan	Bernard	Williams, Bobby L	Sheetmetal		1	7	6
362	1/16/00	5	Urgent	Taylor	Winston	Williams, Bobby L	Sheetmetal		3	3	5
362	1/21/00	18	Urgent	Callahan	Cabrera	Hollister, Rick W	Wire EDM		5	22	7
362	1/28/00	29	Urgent	Tappen	Bernard	Bourdeau, Guy	Sheetmetal	M132	3	5	0
362	2/1/00	32	Routine	Fernandez	Garcia	Szumila, John A	Machinining	1025053	4	5	0
362	2/1/00	40	Routine	Weiner	Cabrera	Borenstein, David	Machinining	M137	7	4	1
362	2/10/00	43	Urgent	Taylor	Garcia	Sudderth, Philip A	Machinining	M147	9	5	11
362	3/6/00	46	Routine	Hernandez	Bernard	Williams, Bobby L	SLA	6806585	1	9	0
362	1/7/01	56	Urgent	Callahan	Smith	Szumila, John A	SLA	TUBE	2	5	0
362	1/19/01	15	Urgent	Weiner	Garcia	Hollister, Rick W	Machinining		5	22	20
362	1/27/01	28	Urgent	Hernandez	Winston	Fay, James	Sheetmetal	RESERVOIR	23	9	0
362	2/12/01	31	Routine	Martin	Lewis	Szumila, John A	Sheetmetal	1024268	6	43	13
362	2/24/01	59	Urgent	Callahan	Winston	Williams, Bobby L	SLA	P0023	11	53	21
362	3/23/01	69	Routine	Martin	Bernard	Hollister, Rick W	Sheetmetal	M133	23	5	0
362	3/23/01	49	Urgent	Martin	Garcia	Sudderth, Philip A	Sheetmetal	1024936	1	43	0
362	3/25/01	72	Urgent	Callahan	Winston	Szumila, John A	Machinining	6806910	3	6	11
362	3/28/01	39	Routine	Callahan	Kline	Williams, Bobby L	Machinining	1022067	4	22	
362	3/29/01	75	Routine	Tappen	Lewis	Hollister, Rick W	Machinining	1025119	4	16	0
362	3/30/01	79	Routine	Martin	Cabrera	Hollister, Rick W	Wire EDM	1024947	5	22	0
362	4/1/01	52	Urgent	Callahan	Cabrera	Szumila, John A	Wire EDM	6806957	2	22	0
362	4/1/01	83	Routine	Weiner	Bernard	Hollister, Rick W	Sheetmetal	P0131	3	5	0
362	4/3/01	86	Routine	Li	Winston	Szumila, John A	Sheetmetal	P0039	2	7	0

Figure 11 - Sample report for a specific project

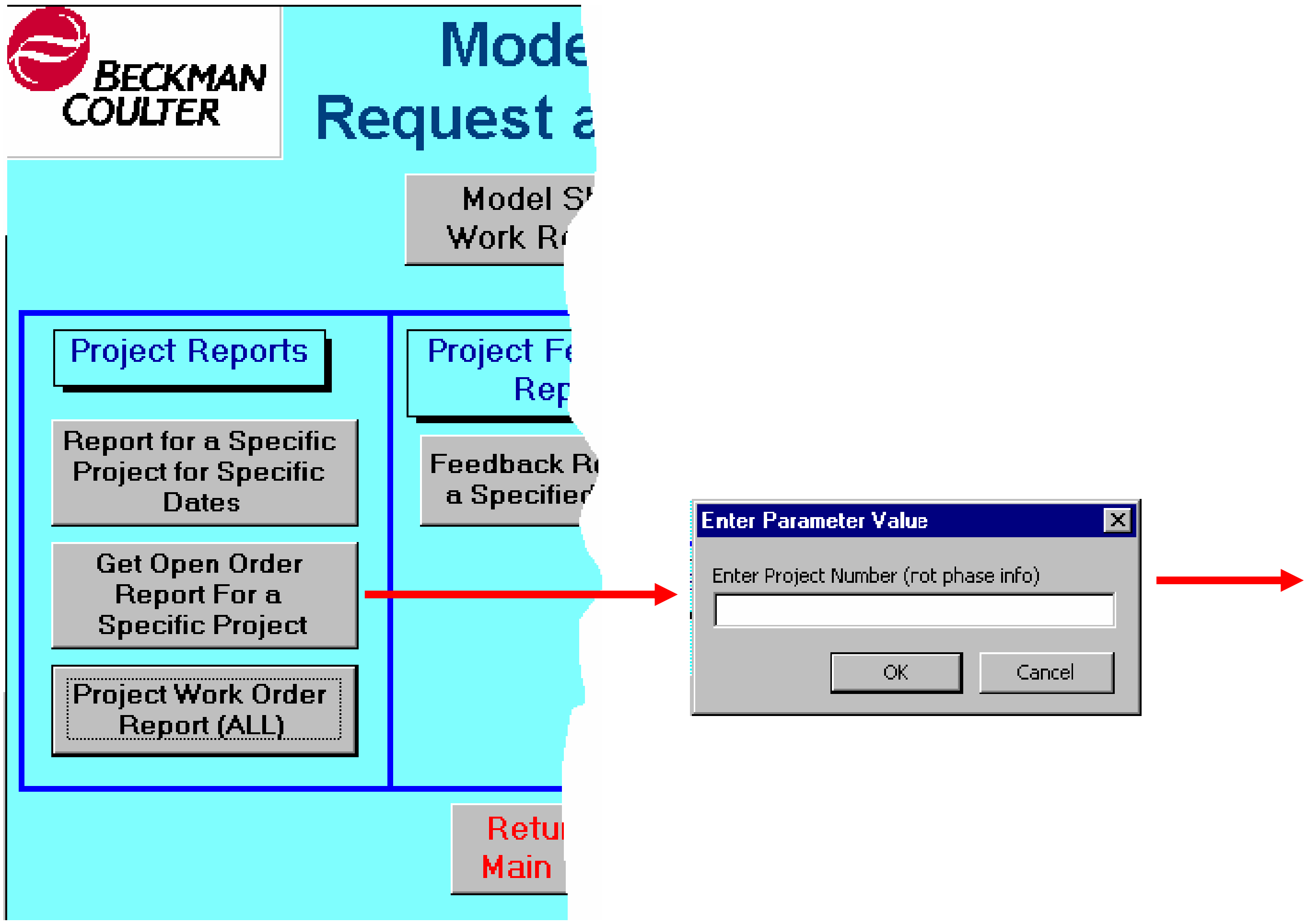


Figure 12 – Screen for all open orders for a Specific Project Number Report and Prompt

r

Model Shop - All Open Orders as of Sunday, April 15, 2001

Proj_no	Date In	Promised Date	Days until due (Negative = Overdue)	Job ID	Engineer	Machinist	Process	Qty	Reg Hrs	O/T Hrs
362	3/6/00	3/15/01	-31	46	Chris Hernandez	Williams, Bobby L	SLA	1	9	0
387	2/14/01	6/17/01	63	45	Craig Weiner	Hollister, Rick W	Wire EDM	15	43	0
362	3/23/01	4/1/01	-14	49	Robert Martin	Sudderth, Philip A	Sheetmetal	1	43	0
362	3/28/01	4/12/01	-3	39	Tony Callahan	Williams, Bobby L	Machinining	4	22	
362	3/29/01	3/29/01	-17	75	Frank Tappen	Hollister, Rick W	Machinining	4	16	0
362	3/30/01	4/10/01	-5	79	Robert Martin	Hollister, Rick W	Wire EDM	5	22	0
362	4/1/01	4/19/01	4	83	Craig Weiner	Hollister, Rick W	Sheetmetal	3	5	0
362	4/1/01	4/12/01	-3	52	Tony Callahan	Szumila, John A	Wire EDM	2	22	0
386	4/2/01	6/21/01	67	84	Chris Hernandez	Szumila, John A	Machinining	1	12	0
362	4/3/01	4/13/01	-2	86	William Li	Szumila, John A	Sheetmetal	2	7	0
280	4/4/01	7/1/00	-288	89	Richard Taylor	Szumila, John A	Sheetmetal	25	44	27

Figure 13 - Sample report for ALL open orders in the Model Shop

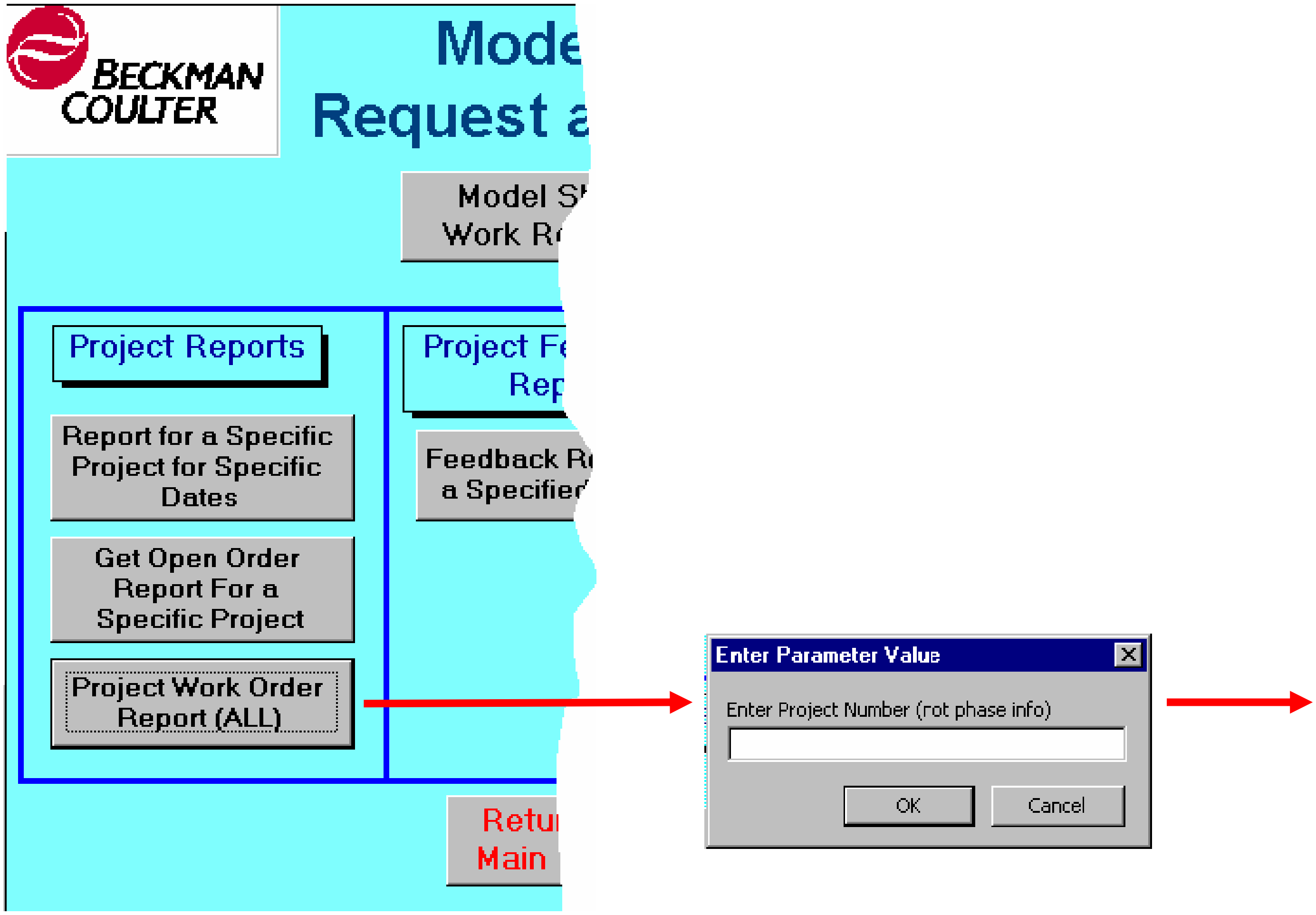


Figure 14 - Project Work Order Report with pr0mpt

Model Shop - All Open Orders For Project Number 362 15-Apr-01

Proj_no	Date In	Promised Date	Days until due (Negative = Overdue)	Job ID	Engineer	Machinist	Process	Qty	Reg Hrs	O/T Hrs
362	3/28/01	4/12/01	-3	39	Tony Callahan	Williams, Bobby L	Machinining	4	22	
362	3/6/00	3/15/01	-31	46	Chris Hernandez	Williams, Bobby L	SLA	1	9	0
362	3/23/01	4/1/01	-14	49	Robert Martin	Sudderth, Philip A	Sheetmetal	1	43	0
362	4/1/01	4/12/01	-3	52	Tony Callahan	Szumila, John A	Wire EDM	2	22	0
362	3/29/01	3/29/01	-17	75	Frank Tappen	Hollister, Rick W	Machinining	4	16	0
362	3/30/01	4/10/01	-5	79	Robert Martin	Hollister, Rick W	Wire EDM	5	22	0
362	4/1/01	4/19/01	4	83	Craig Weiner	Hollister, Rick W	Sheetmetal	3	5	0
362	4/3/01	4/13/01	-2	86	William Li	Szumila, John A	Sheetmetal	2	7	0

Figure 15 - Select for all open orders for a specific project

Model Shop Machinist and Supervisor Screens

Selecting ***Model Shop Work Input*** (button 2) in Figure 9 will lead the user to the Model Shop Input Screen as displayed in Figure 16.

Selecting ***Machinist/ Sheetmetalist Feedback*** (button 1) in Figure 17 will bring the user to the Model Shop input screens as displayed in Figure 17.

Selecting ***Supervisor Input*** (button 2) in Figure 17 will bring up the screen in figure 19

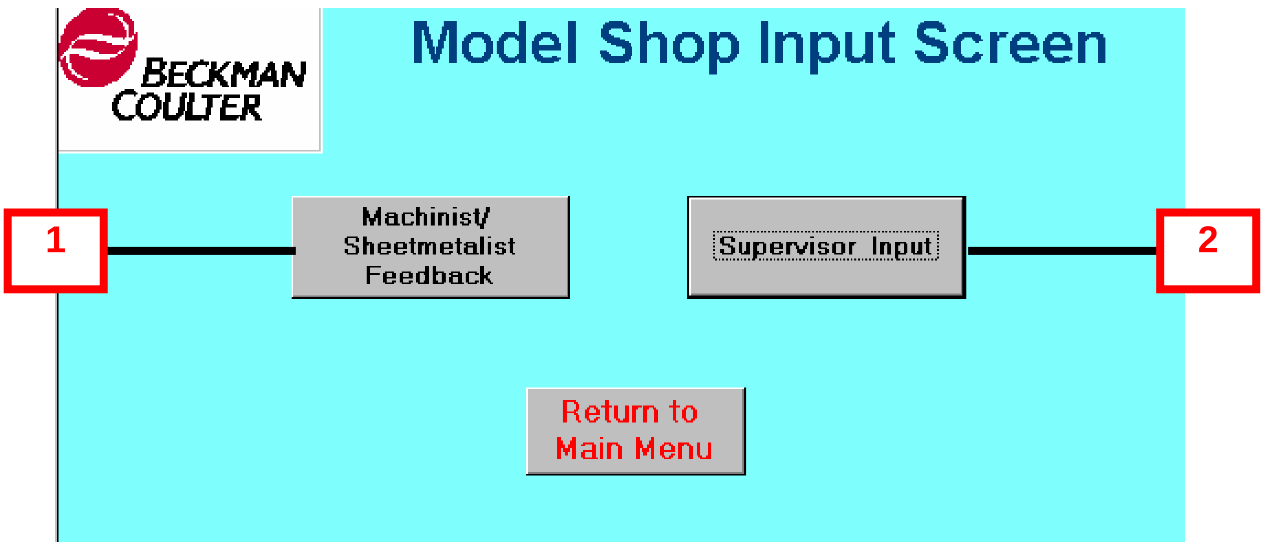


Figure 16 - Model Shop Initial Input Screen

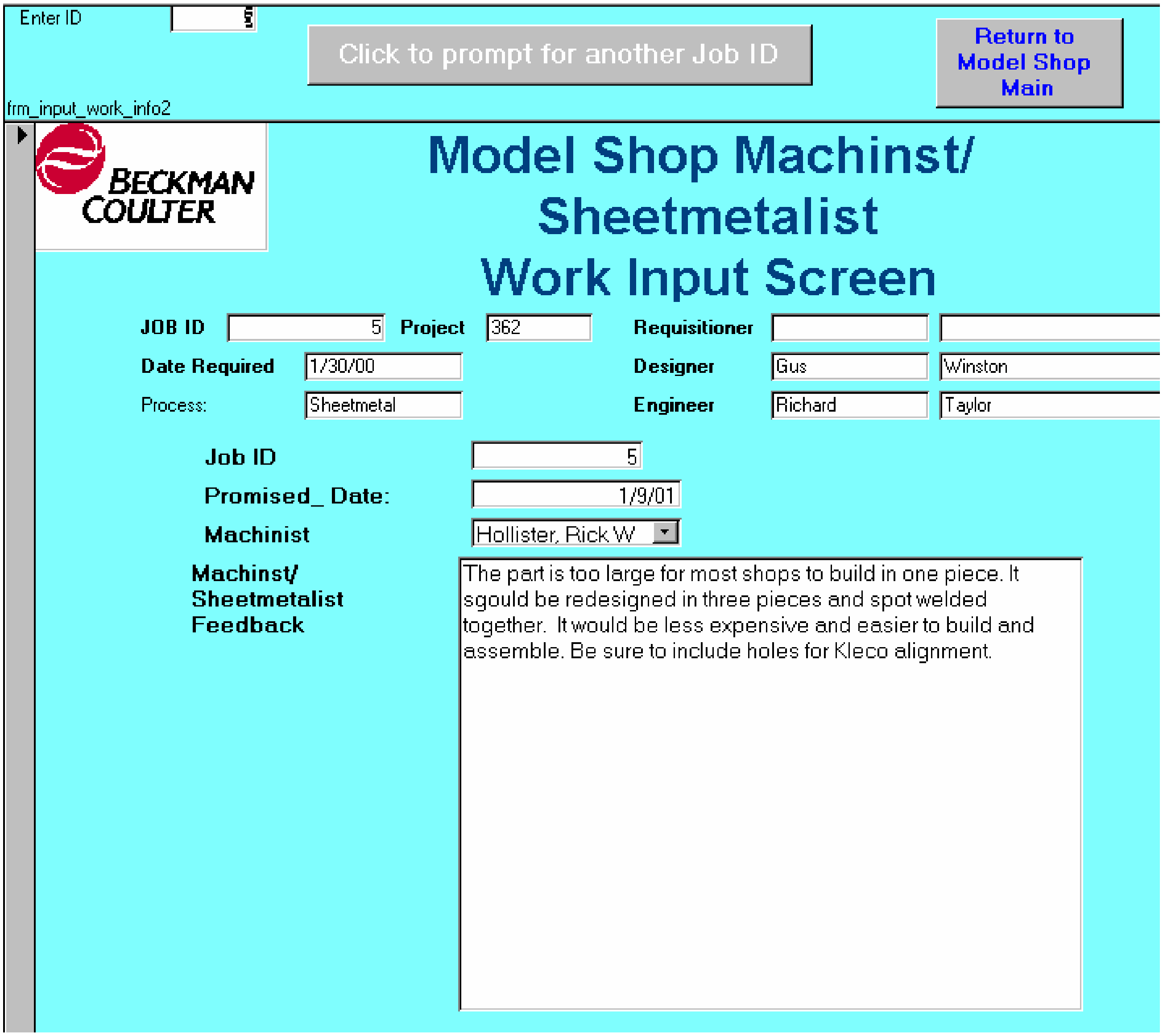


Figure 17 - Machinist Input Screen

Model Shop Supervisor Input Screens

Selecting ***Supervisor Input*** (button 2) in Figure 16 will bring the user to the Model Shop Supervisor Input Screen as displayed in Figure 18.

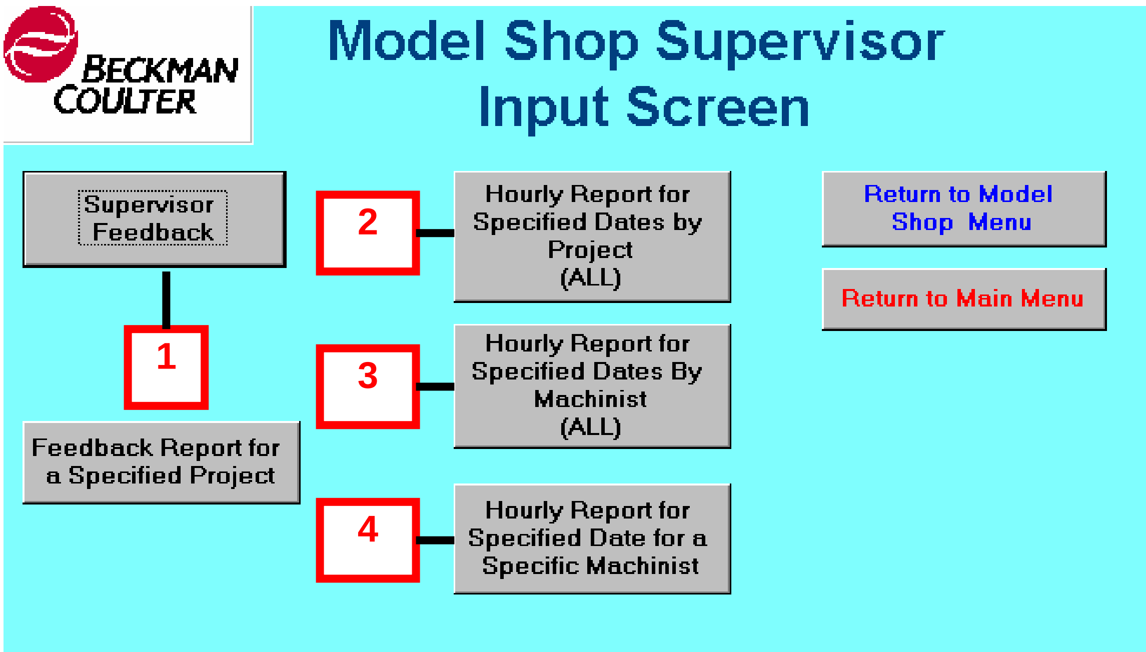


Figure 18 – Model Shop Supervisor Input Screen

Selecting ***Supervisor Feedback***, (identified in figure 18, as leader 1) will bring the user to the **Supervisor Feedback Input Screen** as displayed in figure 20. For convenience, the supervisor can select the ***Previous Machinist Feedback*** tab, (identified in figure 20, as leader 1) to review the feedback that the machinist entered previously.

Selecting ***Hourly Report for Specified Dates by Project (ALL)***, (identified in figure 18, as leader 2) will print a summary report which itemizes, details and totals all of the hours that that were worked for a specified project during a specified time period. An example of this report is shown in Figure 21.

Selecting ***Hourly Report for Specified Dates By Machinist (ALL)***, (identified in figure 18, as leader 3) is similar to the previous report except that it will print a summary report which itemizes and totals all of the hours that the machinists worked for a specified time period. An example of this report is shown in Figure 20.

Selecting ***Hourly Report for Specified Dates By for a Specified Machinist***, (identified in figure 18, as leader 4) will print a report for the total hours worked by a specified machinist. An example of the report is shown in Figure 21

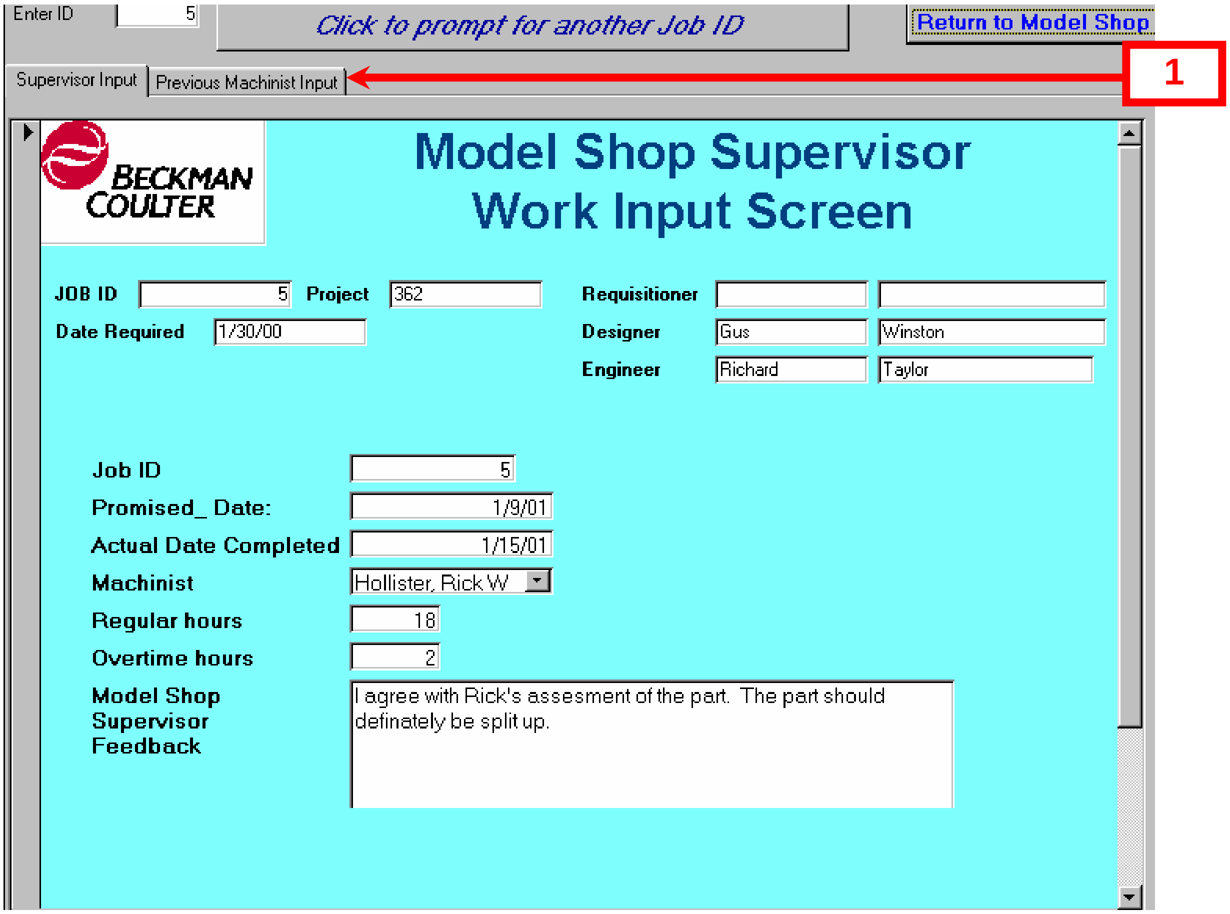


Figure 19 - Model Shop Supervisor Feedback Screen

Machinist Hourly Summary

Machinist	Date_in	Job_ID	Proj_no	Phase	Reg_hrs	O/T hrs	Process_type
Borenstein, David							
Borenstein, David	1/29/00	30	387		11	0	Sheetmetal
Borenstein, David	2/1/00	40	386		4	1	Machining
Summary for Borenstein, David (2 detail records)			Total Hours		15	1	Grand Total Hours 16
Bourdeau, Guy							
Bourdeau, Guy	1/3/00	1	276	50	3	1	Sheetmetal
Bourdeau, Guy	1/16/00	7	387	0	8	7	Sheetmetal
Bourdeau, Guy	1/28/00	29	386		5	0	Sheetmetal
Summary for Bourdeau, Guy (3 detail records)			Total Hours		16	8	Grand Total Hours 24
Fay, James							
Fay, James	1/27/00	28	362		9	0	Sheetmetal
Summary for Fay, James (1 detail record)			Total Hours		9	0	Grand Total Hours 9
Hollister, Rick W							
Hollister, Rick W	1/10/00	2	280	0	5	2	Machining
Hollister, Rick W	1/12/00	3	308	30	7	0	Wire EDM
Hollister, Rick W	1/18/00	10	12	0	12	4	Machining
Hollister, Rick W	1/19/00	15	362	0	22	20	Machining
Hollister, Rick W	1/21/00	18	362	0	22	7	Wire EDM
Hollister, Rick W	1/21/00	17	387	0	4	7	Machining
Hollister, Rick W	1/24/00	24	276		6	0	SLA
Hollister, Rick W	2/14/00	45	387		43	0	Wire EDM
Hollister, Rick W	3/15/00	48	387		11	7	Sheetmetal
Hollister, Rick W	3/31/00	51	387		5	0	Machining
Summary for Hollister, Rick W (10 detail records)			Total Hours		137	47	Grand Total Hours 184

Sunday, April 15, 2001 — Page 1 of 3

Figure 20 – Hourly Summary Report for all Machinists

Total Hours for Sudderth, P

Date_in	Job_ID	Proj_no:	Engineer	Designer	Process_type	Title	Qty	Reg_hrs	OT hrs
1/13/00	4	360	Juan Fernande	Sergio Cabrera	SLA		2	1	0
1/18/00	9	395	Frank Tappen	Roberto Garcia	Sheetmetal		10	5	5
1/23/00	21	389	Frank Tappen	Martin Muphy	SLA		5	3	0
1/23/00	22	395	William Li	Frank Lewis	SLA	M131	5	5	0
2/10/00	43	362	Richard Taylor	Roberto Garcia	Machinining	M147	9	5	11
3/23/00	49	362	Robert Martin	Roberto Garcia	Sheetmetal	1024936	1	43	0
3/25/00	50	386	Juan Fernande	Helen Smith	Machinining	1024953	1	5	0
1/5/01	55	360	Richard Taylor	Roberto Garcia	SLA	1018737	45	3	0
3/16/01	63	395	Richard Taylor	Frank Lewis	Sheetmetal	M148	5	2	0
3/21/01	67	308	Frank Tappen	Sergio Cabrera	Machinining	M130	32	9	0
3/25/01	71	387	Richard Taylor	Helen Smith	Machinining	M132	23	2	0
3/28/01	73	386	Frank Tappen	Maria Bernard	Machinining	1025151	8	88	23
3/30/01	77	386	Frank Tappen	Helen Smith	Machinining	1025109	9	23	0
3/31/01	81	387	Richard Taylor	Maria Bernard	SLA	P0005	1	2	0
4/3/01	85	387	Frank Tappen	Helen Smith	Machinining	SK-4198	1	23	2
4/7/01	93	999	Frank Tappen	Erik Kline	Sheetmetal	P0005	5	9	0
						Sum of Hours		228	41

Figure 21 – Total Hours Report for a Specified Machinist

Model Shop - All Open Orders as of Sunday, April 15, 2001

Proj_no	Date In	Promised Date	Days until due (Negative = Overdue)	Job ID	Engineer	Machinist	Process	Qty	Reg Hrs	O/T Hrs
362	3/6/00	3/15/01	-31	46	Chris Hernandez	Williams, Bobby L	SLA	1	9	0
387	2/14/01	6/17/01	63	45	Craig Weiner	Hollister, Rick W	Wire EDM	15	43	0
362	3/23/01	4/1/01	-14	49	Robert Martin	Sudderth, Philip A	Sheetmetal	1	43	0
362	3/28/01	4/12/01	-3	39	Tony Callahan	Williams, Bobby L	Machinining	4	22	
362	3/29/01	3/29/01	-17	75	Frank Tappen	Hollister, Rick W	Machinining	4	16	0
362	3/30/01	4/10/01	-5	79	Robert Martin	Hollister, Rick W	Wire EDM	5	22	0
362	4/1/01	4/19/01	4	83	Craig Weiner	Hollister, Rick W	Sheetmetal	3	5	0
362	4/1/01	4/12/01	-3	52	Tony Callahan	Szumila, John A	Wire EDM	2	22	0
386	4/2/01	6/21/01	67	84	Chris Hernandez	Szumila, John A	Machinining	1	12	0
362	4/3/01	4/13/01	-2	86	William Li	Szumila, John A	Sheetmetal	2	7	0
280	4/4/01	7/1/00	-288	89	Richard Taylor	Szumila, John A	Sheetmetal	25	44	27

Model Shop Feedback Report for Project 362

Job ID 5 **Date** 1/16/00 **Engineer** Taylor

Machinist Williams, Bobby **Designer** Winston **Requester**

Model Shop Feedback: The part is too large for most shops to build in one piece. It sgould be redesigned in three pieces and spot welded together. It would be less expensive and easier to build and assemble. Be sure to include holes for Kleco alignment.

Model Shop Supervisor Feedback: I agree with Rick's assesment of the part. The part should definately be split up.

Job ID 15 **Date** 1/19/00 **Engineer** Weiner

Machinist Hollister, Rick **Designer** Garcia **Requester**

Model Shop Feedback: Having reviewed the functionality of this part, there is no reason why the part cannot be machined out of plastic such as delrin or Norel. If quantites are large enough, tehn the part should be redesigned for injection molding.

Model Shop Supervisor Feedback: I am not sure if this is agood application for a plastic part. More testing will need to be done.

Job ID 18 **Date** 1/21/00 **Engineer** Callahan

Machinist Hollister, Rick **Designer** Cabrera **Requester**

Model Shop Feedback: The part was designed to be machined out of .062 aluminum . It's size and complexity make it a good candidate for stacking multi-up in wire edm when it goes into production. Oart should be quoted for edm and sheetmetal for cost comparisons.

Model Shop Supervisor Feedback: Stacking and burnign in Wire edm is an opportunity that we should take advantage of more often.

Figure 22 - First Page of Model Shop Feedback Report

Model Shop Feedback Report for Project 362

Job ID 43 **Date** 2/10/00 **Engineer** Taylor

Machinist Sudderth, Philip **Designer** Garcia **Requester**

Model Shop Feedback: All dimensional tolerances on the drawing are to three decimal places (.001). While several dimensions are critical, most are not. Open up the tolerances to make it easier to manufacture and reduce cost.

Model Shop Supervisor Feedback: This is a typical problem. We always over dimension and over tolerance.

Job ID 46 **Date** 3/6/00 **Engineer** Hernandez

Machinist Williams, Bobby **Designer** Bernard **Requester**

Model Shop Feedback: The SLA part is obviously being designed to be injection molded. There currently is no draft on the part. If part is to be tested for fit, the part shouldbe redesigned with draft on it to get a true representation of the size.

Model Shop Supervisor Feedback: The part is small enough to be injection molded in the model shop's injection molding machine. We can make a prototype mold to ecperiment with.

Figure 23 –Second Page of Model Shop Feedback Report

Implementation

During the development of the database customers were invited to review the input and output screens. Modifications and enhancements were made during the design phase to accommodate the feedback received at these reviews.

A pilot program was developed before the full introduction of the new program was released. A power point presentation and handout were created as a preliminary users guide.

The first step of the pilot program was to load the software onto a shared directory of a common drive on the corporate network. To ensure common mapping of the shared directory, the mapping of the drive was consistent with the usage from another engineering department Access date base developed and maintained by the components engineering department.

The initial training took place in the local division's computer training room where there are 14 computer workstations.

The first group trained consisted of the 14 members of the design community. This included the CAD designers, the design technicians and engineers, as well as ESI buyers and planners.   Because many of this group were part of the customer usability studies, this was a final shakedown of the ongoing activity that they had participated. Training consisted of more than just stepping the users through the input and report screens. Training the remainder of the group was also fairly straightforward and consisted of stepping the group through the input and report screens. The use of screens and reports was the easy part. The difficulty was in explaining what the new philosophy and strategy of was and why we wanted to and why it was necessary to change the way we were doing business. This included showing the advantages of on-line job submission and job tracking. When the user group was shown how the machinists' feedback would be input and maintained there was some resistance. This is a change in culture and will require some long-term behavioral changes. It is important to emphasize that this information will not be used as a tool to assess the competency of an individual designer, but will be used as a tool to try to produce the best part at the best price. Cultural change is a sensitive thing and will be treated accordingly as we move forward.

The next group trained was the machinists. This experience differed from the first because not everyone in this group was as computer literate or as comfortable with using the computer. As happens in the shop itself, those who are comfortable with automated tools such as CNC tool path generation supported those who were not as comfortable and helped them along. Again, the training consisted of stepping the group through the input and report screens and again the use of screens and reports was the easy part. Some of the machinists see their job simply as building the part to the print and going home at the end of the day. The behavioral change in this group will probably be slow and may in fact change only through attrition. This is so because several of the machinists are older, skilled craftsman and are not prepared to enter into the design and feedback arena. The change will occur through the success of the other users.

The third group trained was a group of project managers and other members of the management team. They were shown the reporting capability of the system and how these tools could be used to help manage the design activity.

As a key contributor to the maintenance and subsequent success of the program, the Model Shop supervisor participated in all of the training sessions. His input and support is critical to the continued and sustained use of the program. Since it will be his responsibility to input and maintain all of the scheduling data and encourage and enforce the proper usage of the machinist input activity, it is imperative not only that the rest of the users understand that he supports and will be using it as a tool to help manage his department, but also for him to realize that the design community is looking to him from leadership and information.

The users know that if the model shop does not buy into the program, then the program will fail.

Documentation Procedure Changes

Several Quality System Procedures (QSPs) needed to be changed in order to ensure that the system process is documented and to ensure that the data collected is reviewed during the design activity.

The QSP titled “Work request for the Model Shop” needed to be modified to allow for the use of the electronic work request from and for describing who will enter and maintain what data in the database and who will own the database itself.

The QSP titled “Design Review” needed to be modified to include the action of performing a review of the machinists and supervisors feed back as part of the design review process. The changes also described what actions needed to be taken to ensure that the recommendations are incorporated into the design or what rationale is needed to explain why the recommendations were not implemented.

The QSP titled “Designers responsibility” needed to be modified to describe whom the designers and engineers interface with the model shop.

The QSP titled “Supplier Management Ordering Parts for Prototype and Pilot Production” needed to include how parts are ordered from the model shop and how those parts are tracked either in the MRP system or in a separate database. There is some ongoing discussion about incorporating certain specific data from the model shop database into the MRP system so that the buyers can have visibility on all part orders placed either at internal model shop or at external production vendors.

Current Project Implementation Status

As of the conclusion of this project the system was not fully implemented. Time constraints and other priorities took precedent over the installation, training and full implementation.

When working on a project or program that is intended to integrate into the author's real-work environment, a caveat that must be acknowledged is that business priorities change and those changes are not always compatible with the work or scheduled that was planned to coincide with the needs of an external advanced degree program. As a result, the work load and work activity changed in the last 2 months of the education program, and that changed the management priority from developing and implementation a design feedback and work tracking system to feverishly working to get a New Product released. Since New Product Introduction is the author's primary responsibility, the specific role of coordinating all activities relating to the timely and successful release of a new product took precedent over the new system.

1. The specific tasks that did not get implemented were:
2. Developing full network access with multi-user capability
3. Providing security controls within the multi user environment
4. Converting the network capable program to a web-enabled program
5. Full training of all user groups and users to fully utilize the system
6. Debugging all known bugs in the system
7. Releasing revision B of the program that would include the above enhancements

Post Implementation Review

The original intent of the project was to develop a database and implement a system that would enable early manufacturabilty input into the product development process. However, during the development, two significant situations occurred that leant themselves to being incorporated into the project.

The first was that injection molded plastic parts were failing in the field. These $4.00 cracked parts in new instruments, still under warranty or under warranty contracts, were causing a $800 service call. Since the failed parts were being replaced with parts of the same design, the replaced parts would also fail. It was estimated that these parts were causing a $1.5 million loss for the company. As a result, corporate management was asking how did engineering allow such a 'bad' design into the instrument and what could be done to prevent that from happening again.

The second situation was the beginning of pilot and initial production of a new product was scheduled to occur. However, it was discovered that due to long lead-times and due to orders being placed late, the production date would have to slip. A remedy to this situation was that we could jump-start the pilot production by fabricating most of the late parts in the Product Development Model Shop. Once the production planners started to request parts from the development machine shop, they experienced the same frustration that the engineers expressed concern regarding work activity and schedules. That is, once an order was placed into the model shop, it became a black hole with no visibility until the customer was notified when the part was completed.

As a result of these two recent developments, the relevance and importance of the database development, implementation and change of business process became even more significant. As this paper is being written, the systems are being implemented and installed to incorporate the information into the design cycle.

Database SQL Code

SQL code for creating report querying for a specific project number, beginning date and ending date: - Figure 9 Button 2 – Sample report in Figure 11
SELECT model_shop_mstr1.Date_in, model_shop_mstr1.job_ID, model_shop_mstr1.Proj_no, model_shop_mstr1.Priority, [engineer_first_name] & " " & [engineer_last_name] AS Engineer, [designer_first_name] & " " & [designer_last_name] AS Designer, model_shop_mstr1.machinist, model_shop_mstr1.process_1, model_shop_mstr1.Title, model_shop_mstr1.Qty, model_shop_mstr1.[c/date], model_shop_mstr1.ot_hrs, model_shop_mstr1.reg_hrs, model_shop_mstr1.Part_no, model_shop_mstr1.Rev, model_shop_mstr1.Actual_date_out, model_shop_mstr1.Promised_date FROM model_shop_mstr1 WHERE (((model_shop_mstr1.Date_in) Between [Enter Beginning Date] And [Enter Ending Date]) AND ((model_shop_mstr1.Proj_no) Like "*" & [Enter Project Number (not phase info)] & "*"));

SQL code for creating report of all open orders querying for a specific project number, beginning date and ending date: - Figure 9 Button 3 – Sample report in Figure 15
SELECT model_shop_mstr1.job_ID, model_shop_mstr1.Date_in, model_shop_mstr1.Promised_date, model_shop_mstr1.Actual_date_out, [promised_date]-Date() AS days_till_due, (Date()-[actual_date_out]) AS days_since_out, model_shop_mstr1.job_ID, model_shop_mstr1.Proj_no, model_shop_mstr1.Priority, [Engineer_first_name] & " " & [Engineer_last_name] AS Engineer, [Designer_first_name] & " " & [designer_last_name] AS Designer, model_shop_mstr1.machinist, model_shop_mstr1.process_1 AS Process, model_shop_mstr1.Title, model_shop_mstr1.Qty, model_shop_mstr1.[c/date], model_shop_mstr1.ot_hrs, model_shop_mstr1.reg_hrs FROM model_shop_mstr1 WHERE (((model_shop_mstr1.Actual_date_out) Is Null) AND ((model_shop_mstr1.Proj_no) Like "*" & [Enter Project Number (not phase info)] & "*"));

SQL code for creating report of all orders querying for a specific project number: - Figure 9 Button 4 – Sample report in Figure 14

```
SELECT model_shop_mstr1.Date_in, model_shop_mstr1.job_ID,
model_shop_mstr1.Proj_no, model_shop_mstr1.Priority, [engineer_first_name] & " " &
[engineer_last_name] AS Engineer, [designer_first_name] & " " & [designer_last_name]
AS Designer, model_shop_mstr1.machinist, model_shop_mstr1.process_1,
model_shop_mstr1.Title, model_shop_mstr1.Qty, model_shop_mstr1.[c/date],
model_shop_mstr1.ot_hrs, model_shop_mstr1.reg_hrs, model_shop_mstr1.Part_no,
model_shop_mstr1.Rev, model_shop_mstr1.Actual_date_out,
model_shop_mstr1.Promised_date
FROM model_shop_mstr1
WHERE (((model_shop_mstr1.Date_in) Between [Enter Beginning Date] And [Enter
Ending Date]) AND ((model_shop_mstr1.Proj_no) Like "*" & [Enter Project Number (not
phase info)] & "*"));
```

SQL code for creating report of all open orders in the model shop: - Figure 9 Button 5– Sample report in Figure 11

```
SELECT model_shop_mstr1.Date_in, model_shop_mstr1.Promised_date,
model_shop_mstr1.Actual_date_out, [promised_date]-Date() AS days_till_due, (Date()-
[actual_date_out]) AS days_since_out, model_shop_mstr1.job_ID,
model_shop_mstr1.Proj_no, model_shop_mstr1.Priority, [Engineer_first_name] & " " &
[Engineer_last_name] AS Engineer, [Designer_first_name] & " " & [Designer_last_name]
AS Designer, model_shop_mstr1.machinist, model_shop_mstr1.process_1 AS Process,
model_shop_mstr1.Qty, model_shop_mstr1.ot_hrs, model_shop_mstr1.reg_hrs
FROM model_shop_mstr1
WHERE (((model_shop_mstr1.Actual_date_out) Is Null))
ORDER BY model_shop_mstr1.Date_in;
```

SQL code for creating report of all open orders for a specific project in the model shop: - Figure 9 Button 6– Sample report in Figure 15

```
SELECT model_shop_mstr1.Date_in, model_shop_mstr1.Promised_date,
model_shop_mstr1.Actual_date_out, [promised_date]-Date() AS days_till_due, (Date()-
[actual_date_out]) AS days_since_out, model_shop_mstr1.job_ID,
model_shop_mstr1.Proj_no, model_shop_mstr1.Priority, [Engineer_first_name] & " " &
[Engineer_last_name] AS Engineer, [Designer_first_name] & " " & [Designer_last_name]
AS Designer, model_shop_mstr1.machinist, model_shop_mstr1.process_1 AS Process,
model_shop_mstr1.Qty, model_shop_mstr1.ot_hrs, model_shop_mstr1.reg_hrs
FROM model_shop_mstr1
WHERE (((model_shop_mstr1.Actual_date_out) Is Null) AND
((model_shop_mstr1.Proj_no)=[Enter project Number]))
ORDER BY model_shop_mstr1.Date_in;
```

SQL code for creating report of all the feedback generated for a specific project in the model shop: - Figure 9 Button 7– Sample report Figures 22 and 23
SELECT model_shop_mstr1.Proj_no, model_shop_mstr1.job_ID, model_shop_mstr1.Date_in, model_shop_mstr1.Proj_name, work_mstr1.ms_feedback, work_mstr1.supv_feedback, model_shop_mstr1.req_last_name, model_shop_mstr1.designer_last_name, model_shop_mstr1.engineer_last_name, model_shop_mstr1.machinist FROM model_shop_mstr1 INNER JOIN work_mstr1 ON model_shop_mstr1.job_ID = work_mstr1.job_ID WHERE (((model_shop_mstr1.Proj_no) Like "*" & [Enter Project Number] & "*"));

SQL code for creating report for the model shop supervisor for all hours spent on all projects between specified dates – Figure 18 – Button 1
SELECT model_shop_mstr1.job_ID, model_shop_mstr1.Proj_no, model_shop_mstr1.Phase, model_shop_mstr1.machinist, model_shop_mstr1.reg_hrs, model_shop_mstr1.ot_hrs, model_shop_mstr1.Date_in, model_shop_mstr1.Promised_date, model_shop_mstr1.Actual_date_out, model_shop_mstr1.Qty, model_shop_mstr1.process_1 AS Process FROM model_shop_mstr1 WHERE (((model_shop_mstr1.Date_in) Between [Enter Beginning Date] And [Enter Ending Date])) ORDER BY model_shop_mstr1.Date_in;

SQL code for creating report for the model shop supervisor for all hours spent on all projects for all of the machinists between specified dates – Figure 18 – Button 2
SELECT model_shop_mstr1.job_ID, model_shop_mstr1.Proj_no, model_shop_mstr1.Phase, model_shop_mstr1.machinist, model_shop_mstr1.reg_hrs, model_shop_mstr1.ot_hrs, model_shop_mstr1.Date_in, model_shop_mstr1.Promised_date, model_shop_mstr1.Actual_date_out, model_shop_mstr1.Qty, model_shop_mstr1.process_1 AS Process FROM model_shop_mstr1 WHERE (((model_shop_mstr1.Date_in) Between [Enter Beginning Date] And [Enter Ending Date])) ORDER BY model_shop_mstr1.Date_in;

SQL code for creating report for the model shop supervisor for all hours spent on all projects for a specific machinist between specified dates – Figure 18 – Button 3
SELECT model_shop_mstr1.Date_in, model_shop_mstr1.Proj_no, model_shop_mstr1.job_ID, model_shop_mstr1.Priority, [engineer_first_name] & " " & [engineer_last_name] AS Engineer, [designer_first_name] & " " & [designer_last_name] AS Designer, model_shop_mstr1.machinist, model_shop_mstr1.process_1 AS Process, model_shop_mstr1.Title, model_shop_mstr1.Qty, model_shop_mstr1.[c/date], model_shop_mstr1.ot_hrs, model_shop_mstr1.reg_hrs FROM model_shop_mstr1 WHERE (((model_shop_mstr1.machinist) Like "*" & [Enter Machinist Name:] & "*"));

Course Contributions

The courses and specific material used in this project were:

MAN 5245 Organizational Behavior

- How individuals adapt to organizations
- Organization cultures
- Performance structure
- Leadership and power in organizations

ESI 6912 Business Process Management

- Change Management
- Process Selection
- Business process reengineering
- Preparation

MAN 6721 Business Policy

- Managers and managing
- Communication
- Strategy Implementation

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