Installing an on-line information system in a manufacturing environment

by THOMAS J. ARCHBOLD

International Harvester Company
Hinsdale, Illinois

The Construction Equipment Division of International Harvester Company in 1971 developed a broad program to dramatically improve the material scheduling and shop floor control functions at the Melrose Park plant. The basic objectives were to improve efficiency and to be more responsive to customer demands for our construction equipment. The system that existed then provided manufacturing with data that could be from several days to several weeks old. An up-to-the-minute current status of material availability within the plant was not available. Discrepancies and error conditions of all types were extremely difficult to resolve because of this time delay. Changes to our manufacturing schedules to meet sales requirements were further complicated by the lack of current information.

The program that was designed to resolve these and many other manufacturing problems is called MICS, Manufacturing Information and Control Systems.

The primary objective of MICS is to generate realistic and economic manufacturing schedules for the machining, fabrication and assembly departments. In order to accomplish this objective, accurate and timely data must be available on the status of each part and assembly as they move through the 120,000 manufacturing operations to final assembly. This requirement dictated a system that would collect, analyze and record quickly changes in the status of material as it moves through the plant. The overall stock status of all parts and assemblies would have to be accessible to manufacturing personnel on request. The system must minimize the clerical work performed by plant supervisory personnel and maximize the manufacturing information available to them as required.

The major portions of this comprehensive system are in operation at the Melrose Park, Illinois, plant of the Construction Equipment Division. There are more than 100 data collection devices, typewriters and other terminals online or interacting with a remote computer 20 hours a day, six days a week. The remote computer is located at International Harvester's Corporate Computer Center, Hinsdale, Illinois, approximately 10 miles away.

A brief overview of the manufacturing facilities and the products manufactured will provide an insight into the complexity of this manufacturing requirement. The facility is located on a 125 acre site in Melrose Park, Illinois. There are 2.4 million square feet of manufacturing floor space. The plant has 70 interdependent departments, 2,200 production machine tools, approximately 4,000 employees, 40,000 purchased and manufactured parts and 120,000 manufacturing operations. A complete line of heavy construction crawler tractors and diesel engines are manufactured and distributed worldwide. Each end product has a wide variety of customizing internal and external attachments. The value and complexity of the product coupled with the wide range of significant attachments available on each product, add additional dimensions to the overall material management and manufacturing requirements. Manufacturing must be flexible and responsive to changes in production schedules as may be predicated on approval of major highway or other construction projects. Our ability to deliver the specific customized product required on a specific date, in many cases determines whether or not IHC obtains the order. Our recent order with the Soviet Union for our TD25C Crawler Tractor required special Arctic insulating and lubricating equipment so that these tractors would work at temperatures from a minus 60° to over 100°.

Before MICS, the computerized material management system that had been systematically developed since the late 1950's had been relatively effective and in many aspects a vanguard in many of the material control disciplines. However, the total system was oriented to either weekly or monthly shop and end product schedules.

Why develop a new system? In 1968, divisional management expressed a strong desire to improve the accuracy of manufacturing data and also the responsiveness of manufacturing to react to relatively short notice market needs. Extensive investigation by a five-man functional task group recommended a pilot MICS program be installed in a large complex machining department at Melrose Park. This "laboratory" was designed to evaluate many aspects of shop floor control and overall material management concepts. The pilot system which monitors 120 work stations has been successfully in operation for over two years. This system provides instant communication between the worker, foreman and a central control room. It mechanically collects production counts for the material control and incentive payroll...
systems. Machine downtime, setups, teardowns and other allowance conditions are accurately monitored by the computer. The integration of this pilot machine monitoring program into the overall MICS program will be discussed later.

The positive results gained in the machine monitoring pilot program and the continuing requirement for more accurate data throughout the plant resulted in the development of a plantwide total material management program.

What are the objectives of MICS? The primary objective of MICS is to develop economical manufacturing schedules for the 70 interdependent machining, fabricating and assembling departments. Effective scheduling in a dynamic environment required more timely information on the location and availability of all parts, assemblies and raw material. The investment in MICS was made to do the following:

1. Parts tracking is accomplished by accurately monitoring the availability of the 40,000 manufacturing and purchased parts in the production stores and manufacturing departments. Total parts availability is determined by exploding daily the produced crawler tractors and engines and reducing the availability of these assemblies for further manufacturing. The low level assemblies are exploded into their simple parts as each worker reports his production through data collection units.

2. Job order loading on individual machine tools or machining centers will be scheduled on the basis of setup costs and compared to carrying costs. Job order loading will provide the vehicle where EMQ can be effectively introduced onto the manufacturing floor. Job order loading of machine centers will also improve the predictable parts availability to meet production schedules.

3. The availability of assemblies and/or the simple parts will be predetermined at the time the order is received for that assembly. MICS will determine shortages by each customer's specific build ticket. Expediting and parts chasing will be reduced considerably.

4. Mechanised requisition of parts and raw material from production stores or the machining departments is now possible. The specific start of each machine operation is now predictable.

5. Based on the works approved end product forecast, attachments are currently being mechanically forecasted. This program is a major system in itself and will not be discussed in this paper. It is an integral part of the total MICS system.

6. The capacity planning phase of MICS will convert the end product forecast into machine tool and manpower loads for each department by weeks for a 13-month period.

7. The order entry system will generate a customer order and build ticket in machine readable form. The order, with its attachments, will be compared to the forecasted schedule for finished machines and attachments, and the most economical production slot in relationship with the customer's order date will be established. Reslotting of customer orders will be mechanically accomplished as schedules are changed.

How was this feasibility developed, presented and finally approved by top management? The above objectives were specifically delineated by the task group to executive management. A preliminary feasibility detailing the overall concept of MICS with estimated costs and savings was presented to executive management. The acceptance of MICS as a viable project was conditioned on specific resources being spent in areas that may be either overlooked or understated in feasibility proposals. These conditions were:

1. That a consulting training firm be called upon to develop and implement a training program.

2. That 20 stock status specialists be hired to analyze and correct production discrepancy conditions immediately as they occurred.

3. That a MICS Project Manager be assigned full time and report directly to the Divisional Vice President of Manufacturing.

In depth, strategic planning on all phases of this enormous project began with executive approval in November of 1971. Current manufacturing techniques played an important part in developing the implementation program. Because material moves through Melrose Park plant on a continuous flow basis, each department functions somewhat independently. There is a complex interaction on material movement, material requisitioning and material scheduling. This environment necessitated that each aspect or phase of MICS be implemented over the entire plant in as short a period of time as possible. Functions that could be separated were split into three phases. This basic approach allowed us to monitor the reliability and the results of each phase as well as receive the benefits of each phase, and because of the interrelationship of the various phases, any changes that were required during the parallel or implementation time period could be more economically reprogrammed.

What are the MICS phases? MICS Phase I provides the data base and data communications capability to enable management to maintain complete control over all purchased and manufactured parts, from the basic castings and forgings through lower level assemblies to the end products. Phase II extends MICS capabilities to enable the system to slot and reslot customer orders, to establish uniform assembly line sequences, and to predetermine the availability of parts for scheduled assemblies. Phase III further refines the system to calculate economic manufacturing lots at all levels, schedule production, sequence jobs, requisition the necessary parts and components, and recommend piece part production start and stop dates.

The MICS project spans a two-year period. Each phase was designed to overlap certain activities in order that maximum utilization of manufacturing and systems personnel
was attained. Although the overall concept was approved, a major planning effort remained. All levels of manufacturing personnel had to be motivated to change—to accept this new technique of manufacturing control. We developed, with the training consultant, Wilding Incorporated, Division of Bell and Howell, a 30-minute video film with key manufacturing management as the actors. The reasons for MICS, what MICS would do, and the functions of various computer equipment were addressed in this film. The film was directed to the foremen or first line manufacturing management. After viewing the film, there were buzz sessions with small groups of foremen conducted by industrial psychologists. Some of the recommendations from these sessions were incorporated into MICS. Training and systems manuals were prepared. Techniques were developed to train the thousands of plant personnel who would be using the system.

Now that the forward momentum had been established, detailed activities and implementation schedules would have to be developed to support each phase. Such questions as—What type of inquiries?—What are the error condition parameters?—What specific audit trails are required?—What aspects of the total system require backup or redundancy? This definition would then be converted to programming estimates, training requirements, and equipment installation dates and all other related tasks. Critical resources such as systems expertise could then move from one phase to another when they completed their portion of an earlier phase.

Each major area, such as systems development, programming, training and equipment installation, were divided into sub-tasks which were manually piped. Progress in all areas was reviewed weekly, and management was apprised of the progress through an exception report.

Throughout all phases of MICS, special computer analyses were designed and programmed to evaluate various aspects of the manufacturing data base. Simulations were used to determine online response and offline processing times. The "one-time" effort in analyzing data and alternate processing techniques is more prevalent in all our systems design today. This kind of analysis is almost essential in the development of online systems because of their hardware/software complexity and generally high cost. Special programs were developed to assist the user in his conversion from the old to the new system. For example, data from the new and the old were displayed on the same report for ease of comparison.

Because Melrose Park plant operates under continuous material flow concept and each work area is depending on others for materials movement, requisition, scheduling, etc., the implementation of MICS was difficult.

In order to maintain the integrity of the manufacturing data, implementation of each phase would have to be accomplished in the shortest period of time. Any installation delays would create an excessive hardship on the Stock Status Investigators in resolving any discrepancies between the MICS information and the current system at that time.

The primary objective of Phase I is to collect and maintain availability information on all purchased and manufactured simple parts and assemblies. This data includes all castings, forgings, purchased finished simple parts and assemblies, and manufactured assemblies.

During Phase I, data collection procedures were introduced. During this department-by-department installation, the pre-punched job assignment card system would be running in parallel. Duplicate employee earnings and production analysis statements were prepared and analyzed to insure accuracy of the new system. In order to maintain good employee morale, this duplicate reporting time period had to be as short as possible. Prior to the actual department parallel, an extensive training effort was made to assist the foremen and expediters in that department. A flexible front end program was used to move a department from the old system to a combination of the new and the old processing and finally to the new program. This flexibility was maintained so that a department could be put back on the old system if unforeseen difficulties arose.

Each machine tool schedule is keyed to the component parts required to fulfill its schedule. Component availability quantities and locations on any assembly or part is available on inquiry on 32 MICS typewriters located throughout the plant. In order to maintain reliable data, all simple parts and assemblies must be carefully tracked through their various phases of processing. This further reinforces the requirement to install the data collection and the typewriter/punch units as quickly as possible.

As a simple part or assembly is completed and then reported by the employee through the data collection station, the next department is determined from the routing file data base and an authority to receive card with the quantity made is punched out in this department. When the material is received, it is verified against the quantity on the card and the card is inserted into the data collection device to complete that portion of its routing through the shop. For example, the reporting cycle for a rough water pump impeller begins when it is received in the castings yard. The system shows the impeller as being available for any part that requires such a casting. A requisition to the casting yard for the impeller and notification of its receipt in the requisitioning department changes the impeller's location on the central data base. However, after the initial production operation is performed by the first production department, the raw casting will be no longer available in the system for other part numbers that might use this stock. It will be available only for subsequent operation of this particular impeller part number.

When the final production operation is completed, the impeller will be shown as available to the next higher level of a particular water pump assembly. When the impeller is assembled into the water pump assembly, it loses its identity and availability as an impeller part number. The system will continue to track the impeller or water pump from department to department, showing the availability of the total water pump. All other parts and materials used in this finished product are tracked in a similar fashion. The level-by-level component tracking provides answers at any time to inquiries on the availability and location of raw
A foreman, expediter or plant manager can use the 32 typewriter inquiry terminals to ask such questions as:

What is the availability of the finished components for a given part number?
What is the finished inventory of a given part number?
What is the in-process inventory?
What is the date and quantity of the last made figures?
What is the production schedule for a given part number?
What is the opening inventory or accumulated scrap of a given part number and operation?
When and how many adjustments have been made to the given part number and operation?

These and a variety of other questions concerning various fixed information about a part number such as its routing and process time are available on request 20 hours a day, six days a week.

When MICS indicates that stock is available, it reflects all actual usages. Simple parts that are already used in higher assemblies are shown as unavailable. Raw stock availability is reduced as the raw castings are requisitioned from the storage yard. Availability of parts is maintained by a series of unloading stages. Simple parts disappear as they are assembled into a higher level sub-assembly by exploding the Bill of Material the moment the employee reports the made quantity in the data collection unit. This unloading technique is also used when parts or assemblies are moved.

Parts and components that are used on the assembly line are unloaded by exploding the finished engines and tractors daily.

The processing points that require unloading and reducing the availability of material are:

1. In the warehouse when purchased or rough castings are moved.
2. In a machining or fabricated department after the first operation is completed.
3. In a department when finished parts have been received from another department.
4. On the assembly line when the end product is complete.
5. In the shipping department when service parts, collaterals or help-outs are shipped.
6. In various plant locations when scrap, substitution or loss is reported.

The primary objective of MICS Phase II is to reduce parts shortages on the assembly line. MICS will also drastically reduce the expediting activity immediately before a tractor is threaded on the assembly line.

In the current semi-mechanical system, build tickets are examined the day before line thread by assembly line expediter. Because each tractor requires over 1,000 separate simple parts and assemblies on the line to complete its assembly, only the major units can be effectively analyzed by the expediter. Shortages on simple parts are sometimes difficult to determine. If shortages are discovered on major components, the production department must either reschedule their build schedule or make an attempt to expedite within a few days the parts that are required.

Phase II of MICS compares the slotted order to the manufacturing authority build schedule. This will insure that all the materials have been ordered. When the slotted orders are within two to three weeks of the line thread date, the slotted order will then look ahead ten to fifteen working days to determine if finished components are available to build the planned machines. The projected parts shortages will be identified by their assembly line location. The shortages then can be expedited or the planned build schedule can be logically rearranged. This now allows considerably more lead time than existed prior to MICS.

A requirement to reslot a particular order can be easily analyzed. Then if this unit can be reslotted, the effect it will have on the other units, either in the pipeline or on the assembly line can be determined. Status of each specific order will be available to the Order and Distribution department which will provide better information for our Sales department and, of course, the customer.

The order slotting phase of MICS provides a considerable improvement in assembling the final machine. The logic of comparing the slotted build schedule against the availability of the simple parts and components would be almost valueless if the data provided in the first phase of MICS was unreliable.

MICS Phase III has three major sub-tasks—scheduling, order releasing and shop floor control. This phase adds new dimensions to our current system. Many of the techniques and business philosophies that have been built into our current batch material management system are being used in the new scheduling program. However, a radical departure from the old system is to base our orders on vendors and our manufacturing facilities on the available quantities shown on the stock status inventory generated in Phase I. The absolute necessity of reliable data is obvious.

The primary objectives of Phase III are:

to develop economic manufacturing quantities on all jobs released to the Melrose Park plant,
to reduce and even more important, to more appropriately allocate work-in-process inventories.
to reduce the amount of decision making by the first line supervision and replace these decisions with system generated schedules based on the broader scope of the total data, and
to improve the performance evaluation capability of the manufacturing departments.

In developing the concepts that will be used in this phase, extensive simulations and analyses of the data were made. The EMQ is developed at the high level assembly and works down to the simple parts. Therefore, because the lower level assembly is dependent on each subsequent assembly level, there are definite programming difficulties created in the calculation of EMQ's to fit at the various
assembly levels. In many industries the cost of setup for assembly is low. However, in our case, this is not true. For example, major track weldments, rear frames and welded assemblies have significant setup costs. These setups combined with the low cost setups significantly complicate the programming logic when there is a schedule change.

In order to reduce the expediting required on a schedule change, a de-lotting routine was developed to minimize the effect of this change on our suppliers. Manufacturing can code a particular part as being critical. Tolerances will be established on this particular part number which coupled with the previous orders to that supplier will provide the necessary data for the system to adjust the order to the quantity to meet current production. This may be a non-EMQ quantity.

Phase III of MICS will develop infinite loading on all manufacturing facilities. This infinite machine load will reflect the total machine tool requirements but will not reschedule or manipulate any overloaded conditions in the plant. This finite loading technique is being studied and will be developed in the future.

Extensive design and programming has been built into the system in an attempt to account for changes made by de-lotting economic lots. This effort, however, will make the formal system more complete and, therefore, should eliminate the need for an informal or hot list system to circumvent the unreasonable demands for material.

A major requirement necessary for any online system is to have reliable database files resident on a disc for access. Various techniques are available today for organizing data files on discs for rapid retrieval. Our experience started with the IBM Bill of Material Processor, then we tested extensively an IBM Users Bill of Material Processor, and finally decided to use the IBM Chained File Management System (CFMS).

The conversion of our data processing files to disc was complicated by the extensive integration of all our batch systems. Because we had developed major material management systems in the late '50s, file maintenance and report requirements were ingrained into these applications, and the extraction of portions or certain functions such as the file maintenance updating was, to say the least, extremely difficult. In many cases, these major applications had to be reprogrammed, or certain interfaces or bridges had to be constructed to support both the new and the old system. As time then would permit to redesign the application, these bridges then would be dissolved. The current manufacturing data base contains the following files: Product Structure, Part Master, The Bill of Material, Labor or Operation Routings, Work Center or Machine Tool File, a Location File, Employee File, Machine Asset File.

As a direct result of the MICS online data files and inquiry terminals, numerous other information files and sub-systems are being added presently or are being planned for the immediate future. For example, these include Assembly Error Analysis, Purchase Order Follow-Up System, Machine Order Processing System, Manufacturing Process Sheet System, and an expanded Man Data Base System.

Our confidence to go on-line through a remote processor was also based on the success we had with the IBM 370/155 under a multiprogramming environment. There are currently four high-speed RJE terminals operating in a HASP environment for data input, programmer testing and engineering testing. This computer is also used for the Corporate Message Switching System which has over one hundred terminals throughout the United States. A heavy load of divisional and plant batch applications are also processed. The I.B.M. 370/155 is also processing a similar on-line system for our Hough Plant 20 hours per day, six days a week.

Although the data collection control computer at Melrose Park, the IBM 2715, would be on-line 20 hours per day with the host computer at C.C.C., some buffering capability was essential in order to collect data during the off-line processing and during any unscheduled downtime. The IBM 2790 system, with its internal disk, would be able to buffer any telephone line or remote computer difficulty that would occur. The decision to go on-line to a remote computer was the determining factor on how the machine monitoring pilot department would be integrated into MICS.

The machine status and piece count data are collected by the IBM Systems 7. The IBM 1031 data collection units were replaced by the IBM 2791 units. All this data is consolidated in the host processor and, of course, is available for inquiry. The selection of the Systems 7 to replace the IBM 1800 was based on economics and its capability to expand the machine monitoring aspect of MICS throughout Melrose Park.

The overall system must be tailored to accomplish as many manufacturing objectives as possible. Then the hardware specifications can be written based on the performance parameter established in the original concept. If for reasons of cost or capability the equipment is not acceptable, the system must be restudied. This process will continue until an acceptable compromise between the objectives, costs and savings is achieved. The initial system design should never be centered around computer equipment.

Reliability and service support from the computer manufacturer were important considerations. The terminal units had to be able to interface easily with the host computer at C.C.C. Available computer software at the remote processor and the plant control computer were also major considerations.

The data collection units had to have some "intelligent" capability. This means, that the worker is led through his transaction by a series of lighted panels with verbal descriptions. If he enters an error, the terminal displays the error and "locks up" until he re-enters that step of the transaction. This step-by-step correction capability of the 2790 system considerably reduced the training and installation time. This overall capability of the data collection system was essential if the tight installation target dates were to be met.

Although the economies favored the IBM 2790 and 1050 systems, the advantages of having the same vendor's equipment at the plant and Computer Center are obvious. The complexities of installing an on-line manufacturing system would have been intensified if there were multiple vendors'
hardware to install and evaluate during the installation period. Questions like, "Whose equipment or software caused the failure?" "Was the failure in the telephone line, modem or computer control unit?" would result in unnecessary delays. The vendor, IBM, assumed full equipment and software responsibilities as long as the entire MICS application from terminal to host computer was IBM equipment. This overall responsibility was a major consideration in our decision on equipment selection.

In the original design of MICS, every reasonable effort was made to solidify as many facets as possible in order to insure maximum reliability and rapid installation of the system. More sophisticated hardware and/or software technology that may have been desirable but not necessarily essential were deferred to more dependable and proven techniques. For example, although the 2790 system computer was not as flexible as the Systems 7, the Systems 7 software and hardware interface to the 2790 data collection units was not as well developed as it was for the 2790 control computer. Before the 2790 system was selected, programs were compiled and tested for the 2790 system computer. This early confidence in the 2790 system was later substantiated as this phase of the MICS program was installed and in production with absolutely no difficulties.

The initial feasibility called for IBM 1050 and 2740 typewriters rather than cathode ray tubes (CRT's) for several reasons. Although a CRT would considerably enhance the system to the user, the 1050 systems were considerably less expensive. However, the primary reason was the anticipated difficulties with the software to support the CRT's at that time.

A major decision without which the MICS system would not have been installed in such a short period of time was to program the entire on-line system in Cobol. Although many on-line systems are programmed in an assembler computer language to reduce core utilization and for generally more efficient processing, the development of the on-line programs in Cobol offered some distinctive advantages. Programming is considerably easier in Cobol than in Assembler. Cobol programmers are more readily available in the market and considerably easier to train. Our programming staff had been writing exclusively in Cobol since the mid-1960's. This in-house capability coupled with our projection of as many as thirty programmers required over certain time periods, clearly dictated that MICS be written in Cobol. Also, the plausibility of retraining our personnel in an assembler language for this project was questionable. The other advantages of less core utilization and faster throughput were generally neutralized by the relative low cost of computer memory on the IBM 370 computers and the low computer cycle utilization projected for our on-line programs.

The coordination for the installation of the communication lines and modems required at Melrose Park and C.C.C. was developed in detail with Illinois Bell Telephone. IBT provided special support and assistance in the final design of the communication network.

During all phases of MICS and particularly during the installation of the typewriters and data collection units during Phase I, in-depth planning and close coordination between Manufacturing, C.C.C. and Systems was paramount. Problem areas, regardless as to whose responsibility, had to be quickly resolved. Once MICS was in production in one department, any programming changes or equipment modifications had to be tested “off line” which generally meant Saturday or Sunday. This limited repair time reinforces the overall requirement to be as complete as possible in the detail system design. Because the Corporate Center operates 24 hours a day, seven days a week, any time required to physically install new equipment and make the necessary electrical changes had to be carefully scheduled, alternate plans had to be developed in the event the computer would not be functional on schedule.

A new employee badge system was also instituted. As a department went on data collection, each employee had to be given a new badge with his picture and pre-punched clock number. This, too, was a major coordinating effort. Special photographic equipment and badge materials had to be purchased.

The physical installation of the equipment and telephone lines and modems required extensive planning and coordination. The physical layout of the data collection lines in the plant had to be designed for backup if one unit in a department failed and also for easy installation and testing. The possible addition or movement of a terminal had to be anticipated.

The location of some of the typewriters/punch systems created physical problems because these units would not fit into many of the foremen's offices. They were either placed outside the office in a protected area or a special enclosure had to be fabricated to protect these units.

Now that the system has been in production for eighteen months, what are our plans to improve or strengthen MICS? Conceptually, the original design of the system has not changed. However, we are addressing hardware improvements designed to strengthen the up-time reliability and improved performance for the user. The 2715 control computer will be replaced by twin Systems 7's. Systems 7 will provide additional backup support, and also the capability of processing the machine monitoring phase of MICS. The division of the data collection loops between the two Systems 7's will provide additional backup within each department if one of the loops and/or Systems 7's should malfunction. The high speed printer and inquiry device in the MICS Control Room will be replaced by an IBM 3270 with a side printer. This will provide faster response to inquiries and give the option of printing to the individual making the inquiry. The 1050 inquiry typewriters will be buffered into the Systems 7. In the event the lines or computer malfunctions, the Systems 7 will determine this malfunction and message each terminal that the computer or telephone lines are not functioning and that their inquiries will be logged by the internal disk on the Systems 7 for transmission later. Also, several major systems will be changed to provide direct updating of the data base files used by MICS through IBM 3270 CRT's.

Obviously, there are many tasks that must be continuously
monitored to insure the successful implementation of a manufacturing on-line system like MICS. Whether using a mechanical PERT or manual control system, some control mechanism must be employed. Not necessarily in order of importance, the following is a list of some of the more important aspects that must be addressed:

1. The system concepts must be developed by manufacturing personnel and supported totally by executive management.
2. A project manager must be assigned and should report directly to the highest level of manufacturing management in the division or works.
3. The database should be analyzed in depth to determine its reliability before the project is approved.
4. A training program must include all levels of manufacturing personnel.
5. Computer equipment should be selected after the system is designed and not vice versa.
6. Equipment installation must be coordinated between the telephone company, computer vendor and the plant engineers.

MANUFACTURING MUST BE TOTALLY COMMITTED TO THE PROJECT AND MUST GET INVOLVED.