A Pragmatic Approach to Sustained Flexible Manufacturing

To:	Mrs. Karen French
From:	Jacob Valdez
Date:	November 7, 2017
Re:	Proposal to develop flexible manufacturing system

I put forth the proposal to develop a flexible manufacturing system. A flexible system is one that another can easily alter to reach a desired state of the system. A computer is a flexible system in that a programmer can define its state of action. Often, flexible systems are modular being composed of discrete, interchangeable components. Interlocking, studded, plastic toy blocks form a modular system when assembled into a representational house. These system characteristics beg consideration in our current manufacturing situation.

Problem

Fabricator Inc. currently employs two different manufacturing operations to produce its products: precision boring and external threading. Precision boring machines only differ slightly in construction from external threading machines, but Fabricator Inc. purchases two distinct machines to perform those operations. This is comparable to having a house of interlocking, studded plastic blocks that does not have a window and then buying a complete set of blocks that builds a house with a window just so that the existing house can have a window. It would be much more affordable to solely buy the window components. Far from costing the equivalent of a plastic house or even some real houses though, the machines we are buying run into the hundreds of thousands of dollars. (Kief and Roschiwal)

Now Fabricator Inc. is about to switch many of its manufacturing operations to lathing, honing, and electron discharge machining (E.D.M.). This will require purchasing a whole new set of manufacturing machines specifically designed for those operations. In fact, for every field of manufacturing our company expands into, we will need to make an additional investment of millions of dollars in machines, yet all the manufacturing machines we ever may buy vary only slightly in design. If we buy a machine for every specific manufacturing operation our company expands into, it will be like buying that set of plastic blocks to build the house with the window again and again.

Objectives

To solve this issue, a set of general components needs to be identified among all manufacturing machines we may ever use and consolidated into a general manufacturing machine. The general manufacturing machine must host interchangeable, manufacturing process specific components such as the boring head in precision boring machines or E.D.M. wire in our electron discharge machines. It also must cost less time and money to interchange the specific components on a general machine than buying manufacturing process specific machines.

Solution

A general manufacturing machine will support a variety of manufacturing operations by hosting translating components along a quadruple-rail axis. Modular cartesian coordinating systems, robotic arms, and other “positioners” individually perform a variety of general motions. However, combined in a single manufacturing machine, individual positioner capabilities coalesce performing unique operations seen otherwise only on manufacturing operation specific machines. Interchangeable manufacturing process specific components further highlight the flexibility of a modular manufacturing system.

For example, a precision boring machine requires a cartesian coordinating system to precisely position a rotating boring head. A normal drill attached to a cartesian coordinating system will only have a maximum resolution of 5μm, but a boring head attached to a cartesian coordinating system can readily exceed 0.2μm precision. However, precision is not always the most desired factor. Increased precision often comes at the cost of time demanding a trade-off. When selecting fixed machines, this trade-off involves deep analysis, yet with a flexible manufacturing system, a normal drill can simply be replaced by a precision boring head when desired. This simple solution enables versatile machine function at minimal cost.

Another example considering more exotic ranges of manufacturing operations examines generalization of carburization, lathing, and electron discharge machining. Carburization is a manufacturing process that increases the carbon content of surface-layer steel by immersing products in a carbon rich atmosphere at elevated temperature. Since their high carbon internal atmosphere contains toxic chemicals, carburization machines are sealed airtight. Lathing, a more traditional manufacturing process, applies a cutting blade onto an object rotating at high velocity. This approach calls for a very sturdy positioning system. Finally, electron discharge machining uses electricity to vaporize metal. Often, E.D.M. employs liquid submersion of its workpiece. Examining these three exotic manufacturing processes seems to indicate no similarities that could be shared by a general manufacturing machine, yet there are similarities. These processes all share a positioner that moves a tool around. Two of these manufacturing processes also call for a workpiece enclosure. Even in the diverse situations here, a general manufacturing machine proves effective.

Method

I propose to implement this general manufacturing machine by researching in detail any possible manufacturing machine our company may need. This will involve consulting with the sales department Then I will identify key components shared by all manufacturing processes. These key components will be made interchangeable with additional manufacturing process specific components. Finally, I will make a proof of concept milling machine from this general manufacturing machine.

Each general manufacturing machine will be made using our existing manufacturing machines. After designing the general manufacturing machine, I will have it reviewed for possible errors and safety standard compliance. Then, if approved, I will send it to our production team as an internal project.

Our manufacturing process operators are already familiar with a wide variety of manufacturing setups. Training for a new manufacturing process is typically done through a brief training session. Thus, our operators will quickly be able to learn and implement flexible manufacturing with a general manufacturing machine.

Resources

To develop this project, I will need

- 5 days allocated for me to develop this machine
- Sales department projected manufacturing operation expansion
- 3 hour-long meetings with the engineering team

- 45 minutes on the production floor

Schedule

This project is completable in a single workweek. Listed below are time allocations.

Task	Hours
Review manufacturing operations	2¾
Consult sales for potential manufacturing operations	¼
Identify basic trends in manufacturing processes	2
Confirm findings with engineering team	1
Outline flexible manufacturing system	2
Design general manufacturing machine	4
Design feedback from engineering team	1
Finalize general manufacturing machine design	3
Review design with engineering team for safety or functional errors	1
Build machine parts on production floor	½ ± ¼
Assemble proof-of-concept milling machine	4
Train production operators on machine operation.	12
Total Hours	42

Qualifications

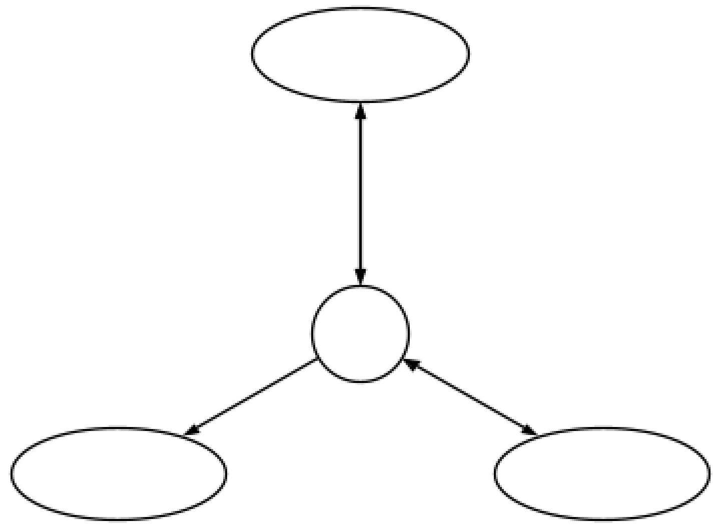
I am qualified to implement this flexible manufacturing system because I work for Fabricator Inc. as a production consultant. I find areas where Fabricator Inc. can save money in process and design. I spent 12 years in postsecondary education. I graduated number one in engineering school, second in chemistry school, and in the top-ten percent of my MBA program. Then I spent thirty years working for Apple and Microsoft at the same time overseeing their hardware production factory. After working for Fabricator Inc. for 24 years, I have established strong relationships with the various teams. I can communicate to them effectively and clearly to achieve our company's goals.

The engineering team all are top-ten A&M engineering school graduates. Most of them have worked for our company for over a decade. They have seen common mistakes made in product design and are well equipped to preventatively spot them in this general manufacturing machine.

The production team is also very qualified to produce this general manufacturing machine and implement it in a flexible manufacturing system. They typically spend five days on a single manufacturing environment setup and then switch to a different manufacturing process, so these employees are readily capable of learning to work with a new system.

Management

The completion of this project depends on three teams and me. Inter-team communication is generally at a peer-to-peer relationship except when communicating to the production team where they will produce the designs I specify.



Cost

The cost of this project will total less than a quarter of buying a single specialized manufacturing machine. Individual costs are tallied below. Hourly rates were calculated from our current corporate revenue and the salary of workers.

Task	Cost
Personal time spent	\$2,100 = 42hrs. × \$50/hr.
Time on meeting with sales team	\$120 = 10min. × \$90/hr. × 8 employees
Time on 3 meetings with engineering team	\$975 = 3 × 1hr. × \$65/hr. × 5 engineers
Production floor time	\$800 = 45min. where \$64,000 profit made last week over 60 hours
Machine cost	\$20,000 = 2 machines × \$10,000/machine
Training	\$1,280 = 1hr./employee-trained × 32 operators × ~\$40/hr.
Total Cost	\$25,275

Conclusion

I am ready to develop a general manufacturing machine that can be customized and implement it in a flexible manufacturing system. Our company's teams and I are more than qualified for this improvement that will boost productivity. This project, I am confident is an investment worth making.