Bridging the Gap Between Industrial Engineering and Special Education

Wayne State University

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INTRODUCTION

In a special education facility, there are many unique needs that must be recognized and traits that should be acknowledged in order to successfully integrate students into the job market. Some of these are:

- Student initiative
- Student empowerment
- Student independence
- Teamwork
- Frequent change of type of product manufactured
- Simple flow of people and materials
- Flexible systems due to frequent employee (*) turnover

Manufacturing facilities around the globe continue to embrace the philosophies of lean manufacturing. The principles of lean manufacturing coincide with all of the qualities that are desirable in a special education facility. Such universal applications as employee empowerment and initiative, quick set-up of activities, and flexible systems can be successfully used for the work environments of individuals with mental and physical disabilities.

The purpose of this document is to showcase the ideas and philosophies that can be shared in the intersection of the concepts behind Industrial Engineering and the work environment of individuals with mental and physical disabilities. This will be accomplished by pinpointing several priority areas chosen by the Engineering Team upon touring the facilities at Bovenschien and the Bryant Center. These priority areas are specific to individuals with physical and mental disabilities in both a learning and a working environment. These issues are:

- Educational objectives
- Student independence
- Student self-esteem
- Facilities planning
- Staff workload

EDUCATIONAL OBJECTIVES

In order to have the chance to successfully operate in a real work environment in the future, students must develop many core concepts. These concepts, such as teamwork, empowerment, and independent decision-making, should be incorporated into the design of the workstation as well as the process flow. Tasks should be structured and linked so that there is some type of dependency between work cells, allowing students to feel their importance in the manufacturing process and hopefully pressuring them to work even
harder. Also, tasks should be structured so that students must communicate when more parts are needed or when a supervisor is required to inspect the quality of a unit. Teamwork could also be promoted by setting production goals at the beginning of each shift and developing incentive plans (rewards for surpassing production goals).

**STUDENT INDEPENDENCE**

It is essential that students be able to work independently so that they can develop such skills as initiative, empowerment, and a feeling of self-confidence. There are many areas that must be addressed in order to increase the amount of student independence.

A means for students to communicate is essential to promote independence, whether it be verbal or non-verbal. While specific types of communication devices will vary by student, it is important that the positioning of these devices is set for the students’ movement patterns. Also, it is important for students to have access to devices that will allow them to initiate action sequences, such as a request for more parts to be assembled. Ergonomics (method of designing that stresses a functional relationship between the work environment and a person) play an important role in this aspect as well.

By reducing the amount of variability in the task structure (making the task structure standard), the amount of pressure on students will be decreased and work will become repetitious and less frustrating, traits that are very desirable when dealing with individuals with physical and mental disabilities. Creating a standard work process would ensure that the throughput (number of units through a work station) and cycle time (amount of time a part is processed at one workstation; this time determines the throughput rate of the entire work cell) would have consistent and predictable production rates and final output. It is important to develop a very simple task sequence due to the limited memory and cognitive abilities of many of the students. Other considerations for this area would be to reduce the set-up time of the workstation and to error-proof the workstation so that mistakes cannot be made without a warning signal being triggered. Error-proofing would also contribute to the quality of the products that are produced. A product that cannot be processed the wrong way cannot be shipped to the customer the wrong way.

In addition to independent working, it is essential that the students work for longer periods of time to ensure that they can easily adapt to the job market when the time comes. The student work time must be increased by ensuring that materials, tools, and inventory are ergonomically placed around each student, making it convenient to reach for materials. Positioning the students at the workstation is crucial in promoting independence and productivity. Tables and other equipment should be adjustable and fitted to their numerous differences rather than forcing students to adjust to whatever workstation is available.
STUDENT SELF-ESTEEM

In order to increase productivity and to promote self-esteem among the students, it is essential that workstations and task sequences are designed so that the probability of success is extremely high. Students who are working at a workstation which has small cycle times and elemental times (elapsed time for a single action) will see a greater amount of product passing through (a higher throughput rate per workstation), leading to a greater feeling of accomplishment. Also, by decreasing the variability of the task and error-proofing as much as possible, success could be guaranteed to each student.

Also, by developing work cells so that students are strategically placed along a production line or a table, students can socialize and observe each other while working. This could lead to encouragement of the bottleneck (the task *student* with the smallest cycle time which essentially determines the pace of the entire process) to work harder or faster by other students. Perhaps a degree of cross-training could even occur as a student may make suggestions on how to accomplish the job even faster.

FACILITIES PLANNING

A functional, efficient work environment is essential to maximize the amount of throughput through this facility. In order to achieve a facilities planning scheme that works, the process flow must be maximized so that obtaining materials, setting-up the workstation, processing the part (weighing, sorting, counting, assembling, or packaging), cleaning-up, material handling, and the flow of inventory are simple and effective. This could be accomplished by paying special consideration to the accessibility of students and teachers to workstations and through aisles. All storage areas should be organized and labeled using simple, easily identifiable symbols. Due to the unique nature of the students, safety should also be a major factor in facilities planning.

INSTRUCTOR CONSTRAINTS

A definite causal relationship between the independence of the student and the constraints of the instructors such that as student independence increases, instructor workload decreases. This will have many benefits to both the students and the instructors.

The time that an instructor spends with each student is severely limited. By increasing student independence, the value-added activities of the instructors (i.e. those tasks that are not wasted on inspecting, material handling, or storing a product; instead, processing *teaching* is performed on an object *the student*) would be increased, allowing more time for one-on-one interactions and planning, and improving the efficiency (a measure of how well something actually performs as compared to how well it could theoretically perform) of the production rate. Further, this would increase the volume of students that could use the work environment at any given time, thereby increasing the quality and
amount of time of the work experiences. A method to increase the value-added time for instructors would be to implement a student monitoring system. A student monitoring system would consist of a set of indicator lights that would indicate such things as if the student is idle or out of materials, allowing instructors to view from a distance whether or not the students are having problems. Such a system would have many additional beneficial ramifications, such as being able to halt problems early on and further increase the independence of the student.

Instructors in these work environments often have strenuous physical tasks. Several staff members may be required to place one student at a workstation. By deploying ergonomically designed workstations, instructors would be able to easily place students at workstations. This would decrease the amount of strain and fatigue on the backs, legs, and arms of the instructors, and allow for easier lifting and moving.

**CONCLUSION**

We have presented the intersection between the needs of special education schools and the principles of Industrial Engineering. Hopefully, these principles can help improve upon the unique set of objectives that exists in a special education facility and better prepare students for a successful integration into the job market.