Scheduling the Manufacturing Workforce

"THE JOB FROM HELL"

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For many large-scale manufacturing companies with constantly changing production requirements, scheduling the workforce has become a costly nightmare. Since labor is the most significant cost of production and management is under pressure to keep their workforce lean, automating the scheduling process stands out as an area where IT should focus. Unlike call centers or airline crewing, in manufacturing the absence of a leading IT solution has been a conspicuous problem.

Based on experience adapting IT to the scheduling requirements of several large manufacturing facilities, the structure of the problem becomes apparent and when new optimization technology is applied, a solution has emerged. A comprehensive and innovative software application now exists to meet this workforce scheduling challenge.

THE PROBLEM

Imagine you are scheduling an employee pool of 200 to 2,000 employees in a 24/7 facility - with a slender profit margin. Add variable job start and end times, rotating job and shift patterns, overtime assignments, seniority rights, different classes of employees, multiple departments and crews, all the absentee conditions you can imagine along with regular requests for time off. Assume employees each have from five to 40-or-more unique job qualifications, as well as preferences for certain jobs. In the words of the very people hired to schedule this workforce day-to-day, you now have “the job from hell.”

In these scenarios when facing last-minute changes in production plans or other swings in staffing requirements even a skilled scheduler is unable to optimize the allocation of the entire workforce. In an era when computers can handle almost everything, why does the company scheduler still rely on spread sheets, clipboards, 3X5 cards and lots of arm twisting? It’s not unusual to find that managers have a difficult time keeping good people in the largely thankless job of scheduler.

Often, manufacturers compartmentalize scheduling. Different supervisors handle it for different departments or crews, sometimes using very different interpretations of the rules and policies. Like sweeping things under the carpet, this seems to work, however there is no way to coordinate and review the scheduling needs of the entire facility. Inevitably, there are redundancies.

WHERE’S AUTOMATION WHEN YOU NEED IT?

Though manufacturing spends less on IT per employee than almost any other industry, they do include “world-class” IT systems for accounting, payroll, ERP, and HRIS in capitalization plans. Nonetheless, facilities are still asked to produce more product, at better quality, for yet lower unit cost. So the challenge is to wring more productivity out of the workforce and equipment that is in place.

Initiatives in workforce management such as ISO 9000, Kaizen, 5S, etc., do not address the scheduling problem found in dynamic and complex manufacturing operations. Since payroll remains the largest single cost-of-operation, IT must bring the entire scheduling process into step with the business needs of the company. Until now, this challenge has largely remained unmet.

How do you allocate the entire workforce in an optimal manner when resources must be constantly reallocated to meet changing demand? After studying the problem, it became apparent that an industrial engineering analysis could rationalize the process and then IT could

automate dynamic operations even where complex rules are the norm.

DYNAMIC OPERATIONS

Dynamic operations with complex requirements have some or all of the following characteristics:

- 200 to 2,000 or more employees, in 24-7 operations.
- High number of products.
- Time-sensitive products.
- Configurable production lines.
- Relatively short-term production runs with frequent product changes.
- Individual employees with multiple job qualifications called on to perform different jobs depending upon production requirements.
- Multiple classes of employees: full-time, part-time, temporary, casual, disadvantaged.
- Shift and job rotation patterns.
- Rolling job start and end times.
- Job preferences.
- Complex seniority rules and rights.
- Union representation.

COMPLEX RULES

What makes workforce scheduling so difficult in these dynamic manufactruing operations are the many rules, policies and priorities that interact and often conflict with one another. A shortage of a resource in one area can disrupt priorities among other employees and collide with rules in more than one area. Changing one job assignment often has a cascade affect on several other assignments. The problem is much more difficult then merely slotting the next available employee into an open job.

For a fix, management has looked to software that runs payroll, time-and-attendance, or production planning. Though related, these applications have no way to automate complex scheduling policies and rules. When one looks closely, they don't even collect and maintain the fine-grained data that is essential for managing workforce scheduling.

A better place to start is to document the existing scheduling process into a rational order using industrial engineering analysis. This new solution uses concepts and a vocabulary that are specific to scheduling and the resulting document enables manufacturing managers to verify - sometimes for the very first time - their own rules and policies. These concepts are then written into a library of task-specific programs that models the scheduling process.

SAME GAME DIFFERENT RULES

One of the main reasons this problem remains unsolved is the absence of any standards for workforce scheduling as a business process. This can be attributed to:

1. The complexity and diversity of the rules, practices, and constraints at different facility.
2. Lack of focus on the problem at the corporate IT level (how plants schedule their employees is seen as a plant-level problem).

In every facility, scheduling is given the same tasks: assigning employees to shifts and overtime, managing vacations and absences, etc. Yet, no two facilities run their scheduling operations alike. Any organized approach to standards from within a typical organization, much less within an industry, is altogether missing. There are no

guidelines showing how priorities should be aligned, how conflicts should be resolved, or even what an ideal solution would look like.

Today's big manufacturing plants are mired in a crazy world where the same game is played by different rules on different fields. In not a few plants, a popular indoor sport is gaming the scheduling office.

ONE SIZE DOES NOT FIT ALL

After analysis, the work-rules document specifies what the work rules engine must do to automate scheduling according to the rules and policies as they exist. In other words, the rules engine is tailored to the specific scheduling process that is found in each facility. This eliminates the need for a company-wide standard.

Database schema design is specific to jobs, employees and scheduling. Links are provided for scheduling-specific data to related systems such as production planning, payroll, time-and-attendance and HRIS. Thus all scheduling data is current and correct. As a result, this solution creates schedules that are not only accurate but also enables last-minute changes and recovery from emergency situations that occur in the facility.

Like ERP, can the solution automate the entire process from start to finish? This problem is addressed by a conventional design which includes separate modules that manage vacations, absences, and training while all the associated data is organized in a unified database schema.

WHAT IS OPTIMIZATION?

Finally, behind the rules engine, schema, and modules, a proprietary mathematical algorithm solves the entire schedule and allocates all job assignments in an optimal manner including the last employee.

What do we mean by optimal and how can it make a difference? Consider a small group of employees, each with a different set of skills.

	QUALIFICATION			
EMPLOYEE	**Butcher**	**Baker**	**Candlestick Maker**	**ABSENT**
John	**X**	**X**	**X**	No
Paul		**X**		No
George		**X**	**X**	**Yes**
Ringo	**X**			No

The challenge: Where George is Absent and John's regular job is the Butcher, assign the employees so that all job assignments are filled with a qualified employee and no job is unfilled.

SCHEDULE A NO OPTIMIZATION	
JOB	JOB ASSIGNMENT
Butcher	John
Baker	Paul
Candlestick Maker	**No one available!**

SCHEDULE B OPTIMIZED	
JOB	JOB ASSIGNMENT
Butcher	Ringo
Baker	Paul
Candlestick Maker	John

In Schedule A, we begin at the top of the list of jobs and merely assign employees to their regular job. When we get to the last job, there are no Candlestick Makers left.

Schedule B is “optimized” in that there are no unfilled jobs, and all employees are assigned to jobs for which they are qualified even though John didn’t get his regular job.

Obviously a mathematical algorithm is overkill for this illustration. It is easy enough, even in real life, to assign the senior employees to their default or bid jobs. Assigning the last 25% of jobs - juggling junior employees, those with not enough skills, against senior employees who don’t want the job or the shift - that’s when the pain-and-suffering occurs.

Even in these cases there are many possible combinations of job assignments that will meet production demand. Ideally, however, you’d like to resolve the tricky assignments while eliminating the negative impact on the largest possible number of employees. This is done with a proprietary mathematical algorithm. Along with the rules engine, the algorithm processes records and not only fills job assignments for the entire workforce, it also does it according to a perceived benefit for the majority of employees. As a result, the schedule is optimized. This is nearly impossible to achieve with manual methods.

Optimization can be adapted to satisfy different benefits such as:

1. Minimize the need for overtime.
2. Equalize the impact for drafted overtime.
3. Equalize access to preferred job assignments.

SAVINGS

Savings emerge from applying the scheduling rules and policies consistently and objectively. Fortunately, this can now happen since the scheduling process is organized within a software rules engine that automates it in a completely predictable manner. By assigning each employee to a task that is optimal, based on the overall business requirements of the facility, and doing this consistently for every employee, every shift, every day, the entire workforce is allocated more efficiently. Key savings derived from the improved allocation of the entire work force are seen with reduced overtime and the elimination of any un-needed overstaffing.

CONCLUSION

Dynamic staffing requirements and complex rules create conditions that are particularly daunting when scheduling a large workforce. Although computer automation is found in almost every process in manufacturing operations, spreadsheets are usually the most sophisticated tools applied to workforce scheduling. Applications for payroll, time-and-

attendance, and production planning, though related, are not designed to address complex workforce scheduling processes and data. The absence of any consensus for rationalizing the scheduling process, combined with the unique rules and policies found in different facilities, even within the same corporation, make it impossible to provide a standard solution.

Since scheduling determines the efficient allocation of labor, which is the largest or second largest cost of operation in most manufacturing operations, the availability of a new automated scheduling solution solves a conspicuous need and points to significant savings. Savings achieved by eliminating the un-needed overtime and any over-manning that accompanies the inefficient allocation of labor resources can be significant. Fortunately, an IT solution now exists for the “job from hell.”

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