

The Productivity of Overtime

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ABSTRACT

This paper examines the research that has been previously presented on the use and productivity of overtime in multiple industries, including manufacturing, service, and construction. Finally the paper uses statistical software to produce optimal solutions for overtime and headcount for a real-life manufacturing facility.

OVERVIEW OF OVERTIME USE

America continually has one of the most productive economies in the world (1). Currently American manufacturing production workers work an average of 41.1 hours each week (2). This average is slightly higher than the standard 40 hour week and is possible through the use of “overtime”. But do these extra hours of overtime benefit the productivity of the nation? More specifically, when a company chooses to work its employees a few extra hours each day or week, does it improve the profit of the company?

It is important to realize that overtime is used differently depending on the industry. This paper will examine overtime in the manufacturing, construction, and service industries.

There are a few benefits that companies capture by working overtime including producing safety stock, reduce head count, absenteeism, high demand, and seasonal/cyclical demand (3).

Often companies will produce more units than are being sold, either in anticipation of a demand surge or a change in production status. However, there are many times in the manufacturing industry that overtime is used to accommodate a change, such as a machine breaking down, a new machine being installed (and the resulting reduction in productivity), or even a new process being integrated. Usually overtime is used well past the period of time it was intended for and then it simply becomes the way business is done.

A company's profit is of great concern to its managers and presidents. One of the driving forces for a company's profit is the labor cost attributed to the number of workers that are employed, head count. Instead of hiring an additional employee, the company may opt to have each of its current employees work a few extra hours. New, additional workers are not only paid a wage, but also consume benefits from the company. As companies continue to offer better benefit packages to their workers, this makes overtime look increasingly more attractive compared to the hiring of new workers. Besides the increase in benefits costs of hiring a new employee, he or she is often less proficient, initially, than the current employees.

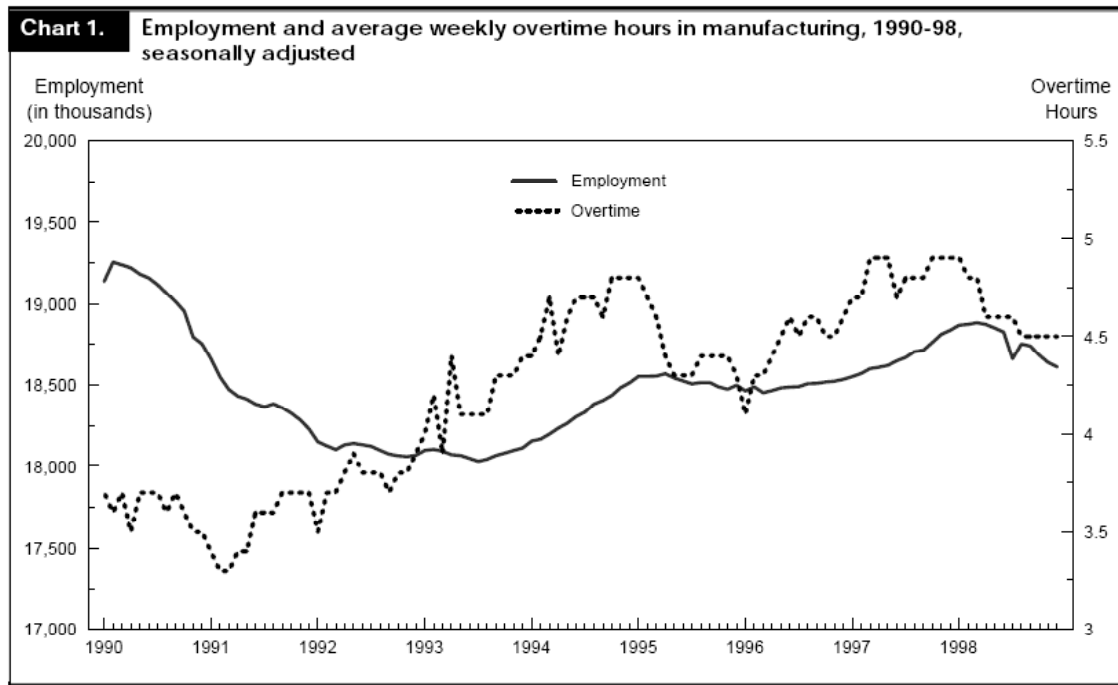
Absenteeism has always been a problem that businesses have trouble controlling. It can be extremely hard, especially in manufacturing, for a company to run smoothly when they don't know how many employees are going to show up each day. These companies usually do not have a surplus of fabricators, assemblers, or other blue-collar workers, so when one employee does not show it creates a gap that often needs to be filled. The quickest solution is to have a few workers located in the same area as the absentee worker, work overtime to replenish the lost hours.

Also high demand often requires the use of overtime since it usually occurs without much warning. By not having a safety stock, a company may encounter a period of high demand without any other option than to work overtime. High demand can develop from a marketing strategy, geopolitical changes or instability, crucial legislation passage, or even changes in the

environment. This high demand can differ in duration and intensity, from a short burst to a year-long blowout.

Finally, a company has to account for seasonal or cyclical demand. In some manufacturing companies it is possible to work ahead, similar to building a safety stock. This allows the company to build extra units in the low periods to account for the lack of capacity during the high periods, in essence the company levels the production demand. However, there are some companies, mostly in the service industry, that can only perform their operation when the demand is presented. A customer service representative cannot answer phone calls before they arrive at the call center, thus capacity has to be even more fluid for these companies. In essence, both the high demand and seasonal/cyclical demand cases are those in which the company is interested in adding capacity. This is one of the main benefits of using overtime, to increase the capacity of your unit without a large monetary investment in the form of capital. Typically to increase capacity a company has to invest in larger buildings, more machines, and more workers. However, through the use of overtime this additional capacity can often be realized. Figure 1 below shows the change from 1990 to 1998 in the amount of overtime hours worked on average along with the change in total employment for the manufacturing industry.

FIGURE 1. Change in Overtime Hours and Employment in Manufacturing (4).



LITERATURE REVIEW

Manufacturing Industry

There has only been a little research into the use of overtime in the manufacturing industry, mostly centered on the automotive segment of the industry. Research may be centered on the automotive segment because in 1995 Anita Lienert found that unskilled union autoworker labor cost the industry over \$2 billion in wages. Thus, significant savings can be realized through effectively utilizing overtime. With a small 5% reduction in overtime, \$100 million could be saved each year (5, p. 555).

In the automotive industry, overtime is needed for two main reasons. The first is when stations experience blocking and starving. In either case, work cannot continue. When a station is blocked, the following station has a full queue. When a station is starved, it has an empty queue in front of it. With a blocked station, the overtime has to be used in the station with the full queue. For the starved station, overtime is used in the preceding station to produce more work for the starved station. The second reason for overtime is quotas and variability in production. In some segments of manufacturing there are goals for stations, however in the automotive segment there are typically hard-line quotas present. This means that each station has to manufacture a specific number of units each day, sometimes each hour. Often it can be hard to reach these quotas due to variability present in production processes, like unforeseen delays, quality issues, and worker productivity. Instead of the production line running smoothly, it starts and stops multiple times dramatically increasing the non-value added time for the production cycle. Naturally, non-value added time is something we strive to reduce to a minimum. There are ways to reduce variability in our process and through the line, but this is beyond the scope of this paper (5).

Inman also realized and pointed out that his research was prompted by automotive assembly plants, but that it was possible to apply this same research to any industry and plant that had three key attributes. The first attribute was the ability to work a range of overtime hours in each and every area or department in the plant. This allows each area or department to be autonomous. We must realize that we cannot take this to an extreme and that is why Inman notes that

there must be a “significant buffer”. This allows incoming variability into each station to be minimized despite possibly significant outgoing variability. We also have a limitation on this first attribute when we introduce union shops. Often the union has very strong contractual language when regarding how much and what type of overtime is allowed. These contracts typically spell out whether each department can work different levels of overtime, or if the plant has to maintain a level amount of overtime. The second attribute is the ability to evaluate daily what level of overtime is necessary. As with the first attribute, a worker’s union can have a very strong opinion as to whether this is possible or not. In some union contracts management has to decide how much overtime to request a week in advance. As one can imagine, this is very restrictive in allowing production to flow smoothly. The ability to evaluate daily needs also requires foreman and supervisors that can devote the proper amount of time and attention to deciding how much overtime is right each day. It is reasonable to realize that these managers cannot establish overtime levels simply using hand arithmetic, but often the use of a personal computer is a bare necessity. This allows the managers to quickly and easily see the entire process – from what is upstream and downstream in the process, to what work is required of their area and how long it is supposed to take. The computers and software used must be able to deliver answers within minutes, not hours to increase the effectiveness of the decision. The final attribute is the ability for blocking and starving in the system. This is possible through the use of finite buffers. Finite buffers represent a capacity sensitivity that is missing in some Materials Resource Planning, MRP,

software. The finite buffers also increase the “realism” factor, since this is what physically takes place everyday throughout the world, though in some companies it may feel like there is infinite inventory (5, p. 556).

So with these three parameters necessary for application to other situations, it is clear to see that Inman’s research can actually be applied to multiple industries and segments. His research is not limited to the manufacturing industry; however it can be most directly applied to manufacturing. Using his parameters, a service industry can apply his findings because even the finite buffers can be fulfilled. For example, United Parcel Service (UPS) can only hold so many packages of a given volume on each truck and at each transfer station. This creates a maximum amount of given work that will ever need to be accomplished. In dry cleaning there is a finite buffer of how many pieces of clothing that can be on the conveyor at once (5, p. 556).

After setting forth the preceding three criteria, Inman discussed the four overtime policies that are possible. First, “Entire-Line” which results in all of the stations working identical overtime until all of the stations have met their quota. This policy is one that can often be seen in union shops to promote equality, so no specific department is viewed as having favoritism. Yet this promotes significant waste and even blocking and starving. Typically there are only a few stations that really need the help of significant overtime. If all of the stations work identical overtime, then the stations that always meet their quotas overproduce, causing blocking for the next station and potentially starving themselves. The

worst case scenario would mean the station working overtime the evening of the first day and then not having any work for the regular shift the next day (5).

The second policy, “Empty-End-of-Line” is more complicated. The goal is to meet the quota for the last station by working a sufficient amount of work in process, WIP. This could be likened to a Bill of Materials explosion. The manager finds out how many units are needed to meet the quota at the end and then works his or her way back up the process flow to each station determining how many units each specific station needs to finish, to provide the last station enough WIP to meet the quota. This easily requires more time to implement by management than the first policy. The stations that work the overtime could also experience starving the next day since they most likely processed some of the buffer that was between them and the preceding station. This creates a deficiency for the next day (5).

The third policy is “Station-Quotas”, which is really straightforward. Each station works as much overtime as is necessary to meet its quota. This policy is really easy for managers to use and has great flexibility for daily variability. Its main disadvantage is that one station may have to work significant overtime to meet its quota, while another station might achieve the quota during its regular time allotment (5).

The final policy is “Historic-Bottlenecks” which allows the bottleneck stations to work ahead for the next day by filling up the next station’s buffer to at least 75% of the demand. Usually the stations that continually produce the lowest

units are considered the bottlenecks. Naturally the stations that are in most need of the overtime are the ones that work the overtime (5).

Inman used the “SLAM II” language to construct a simulation of an automotive plant with twenty-one automated stations. The simulation ran ten times for each overtime policy to determine the mean overtime for both a medium quota and a high quota. The medium quota was the “mean regular-time production”, while the high quota was 10% higher than the regular-time mean production (5). Below Table 1 shows the results from the simulation.

Table 1. Average Overtime for each Policy

Policy	Mean Overtime	
	Medium Quota	High Quota
Entire-Line	1424	4601
Empty-End-of-Line	1457	5035
Station-Quotas	1411	4541
Historic-Bottlenecks	1369	4459

It is easy to see that using the Historic-Bottlenecks policy results in the fewest hours of overtime, regardless the size of the quota. This simulation result makes sense because during the long term the bottleneck station sets the production level for the entire line. So, if and when the bottleneck station can increase its output, the entire line produces more (5).

However, Inman did not stop with this simple simulation because it was felt that the Historic-Bottlenecks policy could be improved. He continued by first

creating a “dynamic bottleneck heuristic” by using linear programs that represented the stations and buffers in the simulation. The use of linear programming allows for quick calculations through the use of computers. With this new heuristic, the minimum overtime required is estimated, then the overtime amount is selected and finally blocking and starving the bottlenecks is eliminated through adjustment of the overtime policy. This new heuristic resulted in significant savings in overtime hours through three different operating environments – strict daily quota, strict weekly quota, and flexible daily quota (5). Below Table 2 compares each overtime policy under strict daily quotas.

Table 2. Overtime Policies Under Strict Daily Quotas

Policy	Mean Overtime	
	Medium Quota	High Quota
Entire-Line	1424	4601
Empty-End-of-Line	1457	5035
Station-Quotas	1411	4541
Historic-Bottlenecks	1369	4459
Dynamic Bottleneck Heuristic	1253	4337

Table 3. Overtime Policies Under Strict Weekly Quotas

Policy	Mean Overtime	
	Medium Quota	High Quota
Entire-Line	371	3165
Empty-End-of-Line	387	3278
Station-Quotas	376	3118

Historic-Bottlenecks	651	3141
Dynamic Bottleneck Heuristic	339	2983

Table 4. Overtime Policies Under Flexible Daily Quotas

Policy	Mean Overtime	
	Medium Quota	High Quota
Entire-Line	412	4401
Empty-End-of-Line	432	4833
Station-Quotas	444	4126
Historic-Bottlenecks	577	4159
Dynamic Bottleneck Heuristic	383	4118

With a strict weekly quota, a station has all week during its regular time to meet that week's quota and will not work overtime until the end of its regular week. This gives the station the opportunity to catch up during regular time if it falls behind. However, the flexible daily quota allows the station to fall behind a small amount. The only stipulation is that the station has to remain within one hour of the year-to-date quota (5).

Just as Inman used simulation for an automobile factory, Bernbeck Martin used simulation to address the issue of a constant "move rate" aircraft factory. It was her objective to minimize the amount of overtime for a feasible schedule. Through the use of a few simple assumptions, the simulation demonstrated that there was a large variation in the number of overtime hours and utilization between individual workers. It stood out that some of the workers were far under utilized, while others were over utilized and had to work a large amount of

overtime. This demonstrates why a constant “move rate” system is difficult to model in simulation and causes difficulty in properly scheduling labor to keep the product moving. Unfortunately, Inman’s Dynamic Bottleneck Heuristic policy would not seem directly feasible for application in the system that Bernbeck Martin modeled. Mostly this is because there is only a small amount of build-ahead that is possible in the aircraft assembly system. Also, since Bernbeck Martin’s simulation algorithm included the assumption that a workstation would use overtime to work on parts that were up to sixteen hours behind schedule, this should easily cover the look-ahead functionality of Inman’s Dynamic Bottleneck Heuristic (6).

Clearly, the Dynamic Bottleneck Heuristic policy works best in each of the environments tested by Inman, mostly due to its use of preventive overtime. This would allow a company to proactively work ahead each day. This policy would not be as simple as the others since it considers the fact that the bottleneck moves from time to time. However, as is shown by the simulation statistics, this policy can be ran in a reasonable amount of time like the other policies, but with even better performance. However, as we see with certain industries like aircraft assembly, this policy does not appear to be applicable or at least optimal.

Construction Industry

The construction industry has significantly different work throughout its segments from new home construction to the construction of asphalt highways. However, typically on each construction job there is a master schedule of events

with a corresponding timeline. Often there are events that have to wait until a specific event has been fully completed. While there are a few events that can happen simultaneously without regard for each other, both are similar to the dependent and independent processes we find in manufacturing, respectively. There are two main sources of information on overtime for the construction industry. First there was a literature review compiled by Randolph Thomas comparing the number of hours worked per week, hours per day, and days per week. The second source was led by Linda Goldenhar, which reviews the structure and implementation of overtime, along with how the overtime affects the individual.

Thomas was interested in trying to extract some useful conclusions from the limited amount of construction overtime literature that had been published. Unfortunately, he found that the data and studies were deficient in providing sensible results. As Thomas notes, the studies on overtime productivity in construction do not have a standard time productivity baseline to compare to the productivity of the overtime that was used. In science and research, it is crucial to compare the results of changing the independent variable to the baseline before changing the independent variable. Yet, this has not been achieved in the construction industry, let alone most studies in any industry that have been conducted (7).

Fortunately, Goldenhar was interested in how overtime affected construction workers' health and safety. An ethnographic study of construction worker focus groups was used to look at the human culture side of overtime.

These focus groups produced three themes stood out: “Work Organization Issues”, “Why Workers Chose to Work Overtime”, and “Effects of Working Overtime”. The two main factors in the Effects of Working Overtime were “Health & Safety” and “Productivity”. Even though these focus groups were subjective in nature, they can still provide some insight into overtime in the construction industry (8).

“Sleep, injury, fatigue, and stress” were identified as being the major health and safety issues. Many of the workers spoke about the lack of sleep that they endured while working overtime. Usually the deprivation did not affect them until after a few days into the overtime cycle and usually it was noticeable during commutes to and from work. Employees also noticed that there were more injuries as the amount of overtime increased. They felt that fatigue increased errors and decreased the ability of the workers’ immune system. Finally, workers discussed how working the overtime increased animosity between workers and it also resulted in more family problems at home. Employees also discussed worker productivity during overtime. Many of the workers believed that long days and long weeks resulted in reducing their productivity (8).

Service Industry

A critical piece about overtime in the service industry was written by Easton and Rossin in 1995, titled “Overtime Schedules for Full-time Service Workers.” They were interested primarily in determining whether the recent increase in wages for part-time workers made overtime more attractive to

employers. As with previous journal pieces in the other industries, Easton and Rossin noted that overtime was mostly used when uncertainty existed. This uncertainty could be in the form of unknown supply or demand, and also absenteeism. Initially they believed that companies used overtime to reduce their exposure to fixed costs associated with each employee, like health insurance or vacation time. However, after putting together a few labor cost equations and evaluating the then current data on the labor figures, they realized that there were more complicated inputs driving the labor output data (3, p. 285-287).

Easton and Rossin continued by experimenting with different overtime schedules for a fictitious service company to determine what amount of overtime would be most appropriate and how future wage increases would affect the use of overtime. They aimed to solve conservative to aggressive overtime policies which resulted in 16 overtime policies, 3 business-day lengths, 2 wage levels, and 36 different daily and hourly demand distributions. After solving all of this and heuristically arriving at some feasible results, they discovered some interesting results (3, p. 291-292).

The results showed that on average all of the overtime schedule policies outperformed a standard work week, in terms of cost, workforce size, and schedule efficiency. The results also demonstrated that companies with longer work days would benefit the most with overtime policies. Even though the overtime policies with longer shifts, longer days, and more allowed overtime proved to be the most economically beneficial, the authors did bring a note of caution. They felt that limiting overtime to “4 hours per shift and 6 hours per tour”

(3, p. 294) would help reduce the likelihood of side effects like fatigue, accidents, and absenteeism.

Literature Review Conclusion

Collectively, the literature demonstrates that there are many times where it is appropriate and even necessary to work overtime. This naturally results in more work being accomplished, often with fewer resources being consumed. However, the construction industry was the only one to look at the potential downside of overtime in terms of fatigue, accidents, and absenteeism. Even though the article brought to light what may happen when overtime is worked, there seems to be little research into the true outcomes of working overtime. This could be because it is often hard to quantify how individuals feel, as to compare their fatigue during normal hours and when working extra hours.

The technique that may have the most promise for quantifying fatigue is the testing of cognitive skills before and after an employee's shift starts. Then this could be compared to the cognitive skills after an overtime shift has been completed. This would not be a perfect test of how well an employee can think at each point in time, but it could provide useful insight into how much and to what extent overtime work affects the human body.

It does seem as though the use of simulation has started to spring up with research into the use of overtime. However, the applications are rather sparse. The use of simulation is not a must, as it is very time intensive, but it does allow us to model many unique situations. Naturally, it is important to ensure accurate

representation of what is actually taking place, but it affords us the easy option to manipulate the system, without disturbing it.

These literature articles are worthy of practical use, in their respective industries and with specific applications. It could be greatly beneficial to develop a simulation for one's plant just like Inman chose for his paper. Then, the current state and future state could be simulated using the chosen policies and the specifics of one's home plant. With Goldenhar's paper, it is important to see that having an employee committee or forum to discuss overtime policies may be important. This could foster more trust and goodwill between management and the employees. More importantly the employees would potentially feel more empowered and involved, hopefully leading to increased productivity. Finally, Easton and Rossin demonstrate that only a few hours of overtime may have to be worked each week to garner the vast majority of benefits that are possible. This should be greatly reassuring to both the overworked employees and the bottom-line conscious managers. The word of caution, however, is that with the optimization-minded papers, Inman and Easton & Rossin, these are optimal conditions with computer simulations. Unfortunately, employees do not always behave as instructed or as intended. This can quickly diminish the savings and benefits of changing policies.

INDUSTRY REVIEW

Fortunately, I was able to obtain raw data from a local aerospace company for the overtime worked and the resulting output from a number of

departments in their manufacturing facility for the past year and a half. The departments include an array of work that is done to produce parts, from manually intensive work to the more computer automated work. My interest in this data was to simply see if there existed a specific amount of overtime that should be worked on a weekly basis for each department.

Unfortunately there is no singular overtime policy across all of the departments, as each department foreman decides how overtime is worked and to what extent. For the departments with only first and second shifts, overtime is usually worked during the week, at the beginning of first shift and at the end of second shift. For these same “first & second” shift departments, there is often optional overtime on Saturday for eight hours and Sunday for five hours. The Saturday overtime pays 1.5 times the regular wage, while the Sunday overtime pays two times the regular wage. There are also departments that have a slightly different shift structure consisting of fifth and sixth shifts, which are ten hour shifts, Monday through Thursday. The fifth shift is similar to first shift, while sixth shift is similar to second shift. Since fifth and sixth are worked through Thursday, there are two special shifts seventh and eighth that work twelve hours, Friday through Sunday. Again seventh shift is the earlier shift and eighth shift is the later shift.

With the data I was provided, the overtime has been aggregated into a percentage of the total hours worked. So if a department works 1000 regular wage hours and works 100 overtime hours, then the department has 10% overtime for that week. The data set also included the number of employees that

worked during that week. Finally, the output for each week was “Standard Hours”, which are figured according to the part routing sheets. If the order is supposed to take 5 hours to complete in Department B, they will be credited with 5 standard hours when the order reaches the check point and is counted.

I used statistical software (Minitab) to determine what variables should be used in the regression model for each department. The following variables were considered for each department:

ot	=	Percent of overtime worked
ot ²	=	Percent of overtime worked squared
hc	=	Number of Employees that worked
hc ²	=	Number of Employees that worked squared
ot * hc	=	Interaction factor
ot ² * hc ²	=	Interaction factor squared

After determining which variables were most appropriate to use in modeling each department, I ran a regression analysis with those variables. I then used the regression model that Minitab computed to determine the optimal solution for “ot” and “hc” using Excel Solver. I constrained “ot” between zero and fifty, thus limiting each department to working a maximum of fifty percent overtime each week. Since each department has different headcounts, I decided to constrain “hc” to a minimum that was approximately ten percent employees

below their lowest headcount and a maximum of ten percent employees above their highest headcount.

Results

Unfortunately, there was only one department that had decent values for R-square and R-square adjusted. This indicates that the variables in the regression model explain only about forty percent of the variance in the output, standard hours, for Department A. The optimal solution was 162 employees with no overtime. Currently that department has 235 employees with an average overtime of twenty-four percent.

Even though there was only one reasonable regression model for a department, there are still five basic solutions that can exist for optimal solutions:

- 1) Maximum of overtime, minimum number of employees
- 2) No overtime, finite number of employees
- 3) Finite overtime, finite number of employees
- 4) Finite overtime, maximum number of employees
- 5) Finite overtime, minimum number of employees

If a department is optimal with a maximum amount of overtime and a minimum number of employees, it demonstrates that the department may be overstaffed and that a new employee is less productive, generally, than an experience employee. This result could also be due to limits on the number of

machines available, so its more productive to fill gaps in the schedule than to simply hire more individuals.

If the department is optimal with no overtime and a finite number of employees, it might mean that the department is currently overstaffed and the overtime that is worked is not very productive. This is a department where either the employees take advantage of the overtime and do not work as hard, or we may not have enough data at the lower end of the overtime scale to paint a clear picture of its productivity.

When a department has the optimal solution of both finite overtime and finite number of employees, it shows a break-even aspect of overtime and headcount. This is always nice to see in theoretical applications to demonstrate that it can be wasteful to hold either overtime or headcount to an extreme, but that they should be carefully balanced. Even though this data comes from real situations, it is highly doubtful that the department foreman is going to specify that only these finite levels of overtime and headcount be set forth. There is generally pressure to keep the headcount steady or on the increase, while controlling overtime usage.

In a department that has a finite solution for overtime and requires a maximum number of employees, it demonstrates a need for more individuals during the normal shift. This could mean that there are currently open machines or spots, which would allow more work to be accomplished. Also since there is only finite overtime, this could mean that this department has more manually intensive work where rest and recuperation may be required daily or even hourly.

Finally, when a department needs finite overtime and minimum number of employees, it raises the flag that again there may be too many workers in the area. One possibility is that there are simply not enough machines or work stations for everyone on the shift, or some of the employees are simply not very productive.

In many discussions with foremen through different departments, one ideal came forward – allowing only the top performers to work overtime. Unfortunately overtime in a union shop has to either be optional or be split evenly, which negates the ability to implement this overtime policy. However, it seems to make the most sense, as long as the department is a fairly balanced line and there aren't strict quotas. If only the best workers are allowed overtime, in theory they should produce the best productivity and even though it may be less than their standard rate productivity it is still greater than the productivity of the average worker.

Conclusion

In "Quick Response Manufacturing", Rajan Suri proposes the idea of a "Response Time Spiral" (9, p. 57). This idea was originated in the 1950's, however Suri expanded its application to the make-to-order and engineer-to-order companies. In an aircraft company, we can say that the assembly division is make-to-order since each airplane has a specific customer order that is driving its creation, while the manufacturing of parts is make-to-stock since the parts order are driven off of a sales forecast. Even though most aircraft companies

have a consistent backlog to help smooth their forecasts, customers' orders are typically aggregated to create the forecast for parts. Suri points out that as a company lengthens its quoted lead time, many things change. First, this leads to an increase of inventory throughout the system, since there is more uncertainty. Next, the longer lead time affords management the ability to insert more expedited orders, thus shuffling the scheduled orders down the list. This allows the company to get the expedited orders out, but then causes the regular orders to become late. This usually forces the company to expedite even more of the regular orders, since they are behind from earlier expediting. The net result of this is that the company is producing orders later than what they quoted their customers. The next step is for the company to push out the quoted lead time to give themselves a comfort zone that will allow the orders to be produced in time for the new quoted lead time. However, since the new planning horizon is even further out, this results in even less certainty, thus more variance into the system. This causes the cycle to repeat with an increase in inventory, more expedited orders, and finally another increase in the quoted lead time (9).

Suri explains that there are also five smaller policies that promote the Response Time Spiral. These include:

- Always making a minimum quantity
- Building ahead to save on setups
- Making components to forecast
- Building ahead to keep machines and people busy
- Making to customer's forecast

These all tend to be fairly common policies that one may see at their own company. Often these are seen to help the company, not hurt the company since resources are seen as being better utilized than simply laying idle. However, Suri points out that these policies are harmful since it uses a resource for work that is not called for, thus eliminating that resource from being used when there is actual customer demand (9).

Later, Suri notes that the traditional approach for reducing lead times is to have employees “work faster, harder, and longer hours” (9, p. 312), but that this is typically “unproductive and even counterproductive.” He feels that this approach is unproductive since it is not feasible for workers to increase their productivity to the level that is sought by QRM and that it is counterproductive since this approach leads to the formation of a company that is broken into functional departments, thus leading to the creation of the Response Time Spiral.

This is the point at which Suri enters our discussion of overtime productivity. Inman has shown us that overtime policies do have distinguishable differences, while Bernbeck Martin demonstrated that in a unique system, a feasible schedule may have wild swings in terms of worker utilization and overtime hours. Goldenhar pointed out that overtime is usually an extrinsic motivation for workers, though it can have serious physical consequences for those workers. Easton and Rossin concluded that only a few hours of overtime can be necessary to garner a majority of the benefits to be realized in a service company. However, Suri seems to undercut the basic assumption of the other

authors that overtime is acceptable, through his basic premise that it is “unproductive and even counterproductive” for the workers to work longer hours. It seems commonplace for overtime to be worked these days. It is far less commonplace for a manager to pose the question, “Why?” Typically, it is far easier to just accept the “fact” that overtime is necessary, while it is much more difficult to question that status quo. Suri is able to question the status quo and propose that the entire organizational system, the fabric of a company, be changed so that the company can focus on reducing their lead times, instead of focusing on cost reduction.

This does not leave us with a conclusive answer like a regression model would present, company xyz does a, b, and c to achieve its optimal overtime policy. Instead it makes us question something even deeper than the foundation of this discussion – whether the system in question is in need of change. This should produce a healthy source of future research and debate. However, for the current time it is important to realize that a feasible solution for every day work is needed, even if it is not optimal. Unfortunately, since none of the regression models could explain a large percentage of the variance in output, more research is needed to identify which specific variables do significantly affect the output. This would have to be conducted on a case-by-case basis, though there may be some similarities between departments and companies.

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