THE CHALLENGE OF TAKING ADVANTAGE OF INTER-FIRM INFORMATION SHARING IN ENTERPRISE RESOURCE PLANNING SYSTEMS WHILE LIMITING ACCESS TO SENSITIVE CUSTOMER INFORMATION

Michael E. Busing, James Madison University, busingme@jmu.edu

ABSTRACT

Supply chain management and tight control over scheduling jobs within the supply chain, two trends in Enterprise Resource Planning (ERP), may be enhanced by the combined use of currently available ERP software packages and the World Wide Web (WWW). ERP software allows automated exchange of information within a company, and the exchange of information is easily broadened to external organizations. For instance, customer information can be made available to supplier(s) of parts and components for the purpose of increasing effective planning and control. Such exchanges of information between a customer and supplier may benefit supply chain management at the expense of critical information security. Suppliers benefit from access to a customer's dispatch list and material requirements plan (MRP) in order to determine priority of jobs in queue at various work centers within their own organizations. Other customer information, however, should remain secure and unavailable to supplier firms. In this paper, a priority-sequencing rule that explicitly considers downstream shop conditions is examined. The rule is hypothetically applied to situations in which downstream is outside official corporate boundaries, and proposals are suggested for (1) types of information that should be freely exchanged between customers and suppliers and (2) types of information that should remain secure. This paper also proposes practical measures to manage access to information.

Keywords: Supply chain, ERP, information security, dispatching

INTRODUCTION

Dispatching is generally defined as a procedure that uses logical and simple decision rules to determine the priority of jobs waiting at a work center queue. Review of the dispatching research for job shops indicates that this is a problem that has been studied for over four decades. Dispatching has been described as potentially difficult since for a given set of jobs, m, waiting in queue, there are m-factorial ways to sequence those jobs. The ultimate goal of dispatching is to develop a schedule for the queue of waiting jobs that results in good shop performance with respect to both efficiency (e.g., flow time statistics) and effectiveness (e.g., consistent due date performance).

Today, information can be easily exchanged between suppliers and customers through the World Wide Web. This new information exchange medium may have a great impact on dispatching, making it a more global venture and thereby improving shop performance. The use of the WWW for this purpose should be undertaken with caution. Only information that is directly applicable to the dispatching problem should be shared. Other information should be safeguarded – especially when it is proprietary.

The following sections will discuss shop floor dispatching in light of recent advancements in ERP systems and the development of a new shop floor dispatching rule. Following that, the topic of appropriate information sharing will be addressed.

RECENT DEVELOPMENTS IN DISPATCHING RESEARCH

Ovacik and Uzsoy (1994) point out that advancement in shop floor information systems (i.e., legacy versions of modern-day ERP packages) has outpaced dispatching rule research and development. Current shop floor control modules not only track the current location of a job and where it needs to go next, but also determine with significant accuracy when the job is expected to arrive at a particular work center, given current shop conditions. Current dispatching practice and research, however, does not take advantage of this readily available and potentially valuable information – particularly when the information is contained in a customer's database.

The Ovacik study develops a heuristic for shop floor dispatching that takes advantage of shop floor status (global) information. Jobs currently in queue at a machine center as well as those jobs that are expected to arrive at that machine within a pre-specified time window are considered candidates for next selection by the algorithm.

There is a definite need, with respect to job shop dispatching, to further develop and study rules that take advantage of global information readily available in modern ERP systems. The global information should be accessed to determine a realistic assessment of priority in the event that a particular job in queue at a work center is an input to a customer's manufacturing process (i.e., downstream in the supply chain). Cost savings resulting from increased efficiency and effectiveness may serve as incentive to customers to share the information.

DEVELOPMENT OF A SHOP FLOOR DISPATCHING RULE

Earlier the point was stated that shop floor dispatching generally relies on due date information for the control of work flows. In theory, this should provide for good customer service with respect to meeting job due dates. A problem with such an approach, however, may result from congestion at overburdened work centers. This congestion, if severe, can ultimately stifle job throughput and actually increase mean job flow time.

At the other end of the spectrum, shop floor dispatching can rely solely on downstream work center conditions when determining which job to run next. If two or more jobs are waiting in queue at a work station, for example, then the job that has the least amount of expected waiting time at its immediate successor operation, based on current downstream queues, is chosen for processing next. Intuitively, this approach should display a low mean job flow time (relative to a rule that relies exclusively on due date information) due to minimum likelihood of congestion and waiting at the downstream operation. There is a problem with this approach, however, in that it is without regard for due dates, so jobs may either be delivered from the system early or late – neither of which is desirable under a forbidden early shipment constraint.

A shop floor dispatching rule that is classified somewhere in between on the continuum should be sensitive to due dates and to downstream work center conditions (i.e., amount of work currently in queue at the downstream operation). A dispatching rule may utilize job/operation due date information in addition to information about actual shop floor conditions to be considered hybrid. It is likely that both types of information come from customer ERP system databases.

SHOP FLOOR DISPATCHING RULE

Developed for use in this study, the following dispatching rule allows a user to vary the degree to which a decision rule relies on either due date information or shop floor conditions (work in queue at a job's next operation). This is important from the standpoint that the decision maker can fine-tune the model to meet his or her own customer service / operating cost objectives.

To be successful, however, customer databases must be accessed by supplier firms whenever both of the following conditions are met: 1) a job is at the last operation work center in the supplier company and 2) a job is used as an input to the manufacturing process of the customer's operation (i.e., further value is added before it reaches the customer's immediate successor in the supply chain).

The model requires that a shop floor dispatching constant, α, be selected ($0 \leq \alpha \leq 1$). For each job waiting in queue at a particular work center, the following hybrid index is computed:

$$\text{Dispatching Index} = \alpha\,(TTD) + (1-\alpha)\,QT_C \qquad (1)$$

where

α = shop floor dispatching constant ($0 \leq \alpha \leq 1$),

TTD = current operation's due time in hours - current calendar time in hours, and

QT_C = present amount of work in hours waiting at the job's next operation.

The job with the smallest dispatching index is selected for processing next. A small index is of high priority since it can become small due to a small amount of time remaining until due or due to a small amount of work (i.e., congestion) at the next operation (regardless of whether or not the next operation is internal or that of a customer). In the event of a tie between two or more jobs, shortest operation next (SON) prevails as the decision rule due to its superior queue clearing properties and resulting guarantee of minimum mean flow time for a set of jobs at a particular queue. When a job is at its last operation, the value of QT_C is determined by accessing the customer's database. Specifically, the job is matched with the customer's production schedule to determine which work center or facility will perform further processing in the supplier organization. In the event that the job has no further value added at the customer's organization or is simply a stock-item (to be used later), the dispatching index is exclusively TDD.

This priority dispatching rule can be constructed such that it places more emphasis on operation due dates ($\alpha \rightarrow 1$), or so that it weights actual shop floor condition information more ($\alpha \rightarrow 0$). In addition, when $\alpha=0$, the dispatching rule relies exclusively on downstream shop floor conditions and when $\alpha=1$, the rule relies exclusively on operation due dates. Thus the model is extremely flexible.

INFORMATION SHARING

Key customer information that should be easily accessed by suppliers will be proposed in this section. Following that discussion, a proposal to safeguard other, perhaps proprietary, information will be made.

Freely Exchanged Information

For the model shown in equation 1 to be effectively employed by a supplier firm, specific job related information should be accessible by the supplier's ERP system from the customer's manufacturing database. Specifically, when a job is at the last operation at the supplying firm, the supplier should access the customer's database to determine:

1. whether or not the job requires further value (i.e., processing at the customer site) and if it is required to enter the production process immediately upon arrival at the customer location. If the answer is "yes" to both questions, continue gathering information below. If the answer is "no" to either question, schedule job according to TDD (time until due date);
2. the *job's due date* at the customer operation;
3. the *job's first operation area* (via the job's routing file);
4. the *amount of work (standard hours) in queue at the job's first operation area*.

Only the information noted above is needed for employment of the model proposed in equation 1. Furthermore, the above represents the only information that the customer should make available to its supplier.

Secured Information

A customer should ensure that the information listed below is not made available to a supplier's database if the customer is to protect itself from loss of proprietary information and from threat of forward integration on the part of supplying firms,

1. customer's customer contact information and other marketing data;
2. job pricing and costing information;
3. engineering drawings;
4. bill of materials files;
5. financial data (profit/loss statements, etc.);
6. payroll;
7. employee database and other human resources data;
8. work center or process proprietary information;
9. accounts receivable;
10. accounts payable;
11. inventory.

The above list is by no means exhaustive, but does represent a minimum level of protection. It is evident when the information listed in the two categories (i.e., "Freely Exchanged Information" and “Secured Information”) that the information required by the supplier to effectively implement the model is but a small part of all the information available.

PROTECTING PROPRIETARY INFORMATION

The topic of threats to proprietary information is addressed in many research studies. Since outsiders (i.e., entities other than suppliers of parts and components or those employed by the organization) represent only 20 percent of the total attack threat (Nichols, Ryan, and Ryan, 2000), this paper will focus on the larger, insider, threat (specifically, suppliers of parts and components). It is clearly advantageous for a customer to share selected information with suppliers if the result is better shop performance and resulting lower costs that are passed on to the customer in terms of lower prices. However, a customer should also ensure that the proprietary information identified above is not shared with suppliers such that information security is compromised.

Nichols, Ryan, and Ryan (2000) identify Access Controls as a means for limiting and managing access to data within an enterprise. Two types of access controls may be employed in order to share appropriate information with supplying firms while prohibiting access to other, proprietary, information. They are discussed below as they relate to protecting customers from supplying firm information misuse.

Role Based Access Control

Information within the organization is classified according to *subject matter* in role based access control (RBAC),. Those personnel, both inside and outside the organization, are given access to specific information based on the role they play in the organization when RBAC’s are employed. For example, with the shop floor dispatching rule detailed above, a supplier may be given access to shop floor information because of their role as a supplier. However, it should also be noted that the same supplier could conceivably access shop floor information that is not needed to perform the dispatching rule calculation based on their *role* as a supplier. This information could include work center or process proprietary information if role based access control is the only system in place to manage access to information.

Mandatory Access Control

Mandatory Access Controls (MAC’s) permit or prohibit viewing and transmission of data based on the information’s *sensitivity* within the organization. When RBAC is combined with MAC, a much higher level of security is realized since MAC generally takes priority over RBAC. For example, when the above scenario is again considered with the addition of MAC, a supplier has access to shop floor information because of his/her *role* in the organization as a supplier and because the firm has a RBAC in place. However, the same supplier may not view the work center or process proprietary information because it is highly sensitive in nature and because a MAC is in place.

CONCLUSION

In this paper, a practical scenario in enterprise resource planning where two firms can benefit from the sharing of information has been examined. Specifically, a supplier of parts and components can very likely achieve cost savings by obtaining up to the minute information about a buyer's shop floor conditions when job priority and dispatching decisions need to be made. If a portion of these cost savings can be passed on to the buyer firm, willingness of both parties to share information should exist. However, with the sharing of selected information comes the need to protect more proprietary information. This paper suggests that Role Based Access Control be combined with Mandatory Access Control to facilitate protection of proprietary information.

REFERENCES

1. Day, J.E. and Hottenstein, M.P. (1970). Review of Sequencing Research. *Naval Research Logistics Quarterly*, 17, 11-39.

2. Fry, D., Philipoom, P.R., and Blackstone, J.H. (1988). A Simulation Study of Processing Time Dispatching Rules. *Journal of Operations Management*, 7(4), 77-92.

3. Nichols, R.K., Ryan, D.J., and Ryan, J.J.C.H. (2000). *Defending Your Digital Assets*, McGraw-Hill: New York.

4. Ovacik, I.M. and Uzsoy, R. (1994). Exploiting Shop Floor Status Information to Schedule Complex Job Shops. *Journal of Manufacturing Systems*, 13(2), 73-84.