

# Five Steps to Managing Your OS/390 Batch Workload

BY MARTIN WILLS

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Thirty years ago, when I was an operator and then a systems programmer, batch management was a task carried out primarily by enthusiastic operators, eager to shine and earn promotion to more prestigious positions. We knew the job names of all the important production jobs. The nightly schedule was printed out for us so that we could ensure the correct sequence was followed. We recognized programmer's initials on non-production job names and knew how important their work was. And we managed the resources so they were not over-allocated.

Similarly, postal services used to be manual operations, with staff weighing parcels and letters, checking size limitations, categorizing them and then routing, controlling, tracking and ultimately delivering them.

Today, postal services around the world are heavily automated, with modern technology supporting their staff and providing the ability to manage vastly increased workloads.

The same must be true of the modern data center. When a data center runs 5,000 to 50,000 jobs per day, as many large sites do nowadays, human operators and support staff simply cannot meet the challenge alone.

Data centers have additional complexity because of variable workloads and multiple images upon which the work may run. Technology that supports people within a logical framework is essential.

Work comes in and must be categorized, routed, controlled and processed. Feedback mechanisms must be monitored to identify the inevitable roadblocks that must then be managed.

Job scheduling software is a necessary but not sufficient condition for complete batch workload management, since it can only manage the scheduled workload and is often quite labor-intensive itself to keep the scheduling data current.

In an environment where a job scheduler is in place, the following five steps are necessary for good batch management:

1. Analyze all incoming jobs.
2. Categorize and classify jobs.
3. Route jobs.
4. Control the flow.
5. Manage roadblocks.

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## ANALYZING JOBS

The first task that must be undertaken by the postal service is to analyze the incoming mail to determine how it should be processed. This consists of examining each piece for size, priority, destination, postage fee and registration so that it can be properly categorized and handled.

This analysis is no less necessary in the world of MVS batch. Instead of mail we have batch jobs, which should

FIGURE 1: CLASSING RULES EXAMPLE

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IF (PRODUCTION)
  IF (NO_MANUAL_DRIVES)
    SET CLASS (P)
  ORIF (10R2_MANUAL_DRIVES)
    SET CLASS (O)
  ORIF (3-5_MANUAL_DRIVES)
    SET CLASS (R)
  ORIF (6-10_MANUAL_DRIVES)
    SET CLASS (S)
  OTHERWISE
    SET CLASS (T) /* >10 drives */
  ENDIF
ELSE /* must be non-production */
  IF (NO_MOUNTS & NO_RECALLS & +
    CPU_UPTO_20SECS)
    SET CLASS (X) /* express class */
  ORIF (NO_MANUAL_DRIVES)
    SET CLASS (B)
  ORIF (10R2_MANUAL_DRIVES)
    SET CLASS (C)
  ORIF (3-6_MANUAL_DRIVES)
    SET CLASS (D)
  ORIF (7-10_MANUAL_DRIVES)
    SET CLASS (E)
  OTHERWISE /* >10 manual drives */
    EXIT FAIL /* flush the job */
  ENDIF
ENDIF

```

be named, classed and prioritized according to our standards.

Many data centers rely on their users to categorize their jobs and indicate the resources required, through proper use of the job class, the priority and perhaps the scheduling environment or other external parameters.

Unfortunately, non-technical users often don't know about the resource requirements of their jobs — and why should they? And worse, technical users sometimes don't tell you everything they should as they try to get the best turnaround for themselves.

Analysis ensures that standards are being followed and the resource and service requirements of each job are known. Given that this is a highly technical task involving catalogued procedure expansion, symbolic substitution, and catalog lookup for thousands of jobs, it can realistically only be done through software.

## CATEGORIZING AND CLASSIFYING JOBS

Analysis provides information about each job that enters the system. The next stage is to use that information to categorize the workload in a way that makes sense to your data center.

In our postal service example, the mail may be categorized as registered mail, ad mail, letter mail, a parcel or some other form of mail. Other categories that may be important are dependent on the shape and

weight of the package and its mode of travel (air or land).

In an MVS-OS/390 world the primary means of categorization of work is the job class, since that is what JES2 understands. It's also the primary means in most shops of deriving the Workload Manager (WLM) service class (which is itself another form of categorizing work, or organizing it into related groupings).

What criteria are job classes based on? Typically it's something like production vs. non-production, non-tape vs. one to two

tapes vs. three to five tapes and so on, and fast, small jobs vs. large CPU-intensive jobs. With Workload Manager batch initiators another consideration is JES2-managed vs. WLM-managed jobs.

Getting those classes correct is a major element in the ability of any data center to manage its workload. An automated mechanism, using the data determined by analysis, is guaranteed to be accurate.

Figure 1 shows an example of data center standards defined for simple job classing. In this "pseudo-code" example, classes are

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based on whether jobs are production or not and then on the high water mark of manual cartridge drives used by this job. Non-production jobs with no tape mounts, no recalls, and 20 seconds or less of CPU are placed in an Express class and those with more than 10 tape drives required are failed.

Other elements that are often used in categorizing the workload are whether a job needs access to a particular instance of a DBMS, whether it uses a program that has restricted licensing, and whether it can be run overnight or on the weekend.

## ROUTING AND DEPENDENCIES

A postal service has two forms of routing to be concerned with: internal routing to the correct area of the sorting plant, where the correct equipment is available and procedures are set up to handle a particular type of mail; and external routing to other postal services. Neither of these is static since, even though there is a preferred routing, the postal service must still meet its goals if equipment is down or the remote postal service is unavailable. Once again, the categorization is the key to making sure the mail gets to the place where it will be processed correctly.

A data center also has routing issues, some concerned with where work must, or should preferably, run and some with logical dependencies such as the availability of a particular DBMS region. Where is IMS Production Region 2 today? On which system(s) can COBOL compiles run? Where should production be running at this moment? What about development?

Traditionally much of this routing has been managed by using specific job classes, for example using class G for IMS Production and only starting class G initiators on the image where the particular IMS region is running. However, this approach is yet another use of job class, which is severely limited by the fact that only 36 classes are available. Worse, this approach doesn't work at all in the world of WLM Batch Initiators.

IBM has provided Resource Affinity Scheduling as a replacement for class-based routing but this is still dependent on the user coding the correct parameter. As discussed previously, user dependence can be fraught with problems. Once again a more automated approach, based on the analysis and categorization carried out earlier and including the ability to logically move the

resource around without having to change JCL, is preferable.

## CONTROLLING THE FLOW

The next task, given that the workload is properly categorized and routed, is to control the workload so that batch work keeps flowing, online goals are being met, no component is overloaded, and all the different categories of work get enough access to the available resources to meet their individual goals.

For the postal service this means that a certain mix of work must always be flowing, ensuring that high priority first-class mail and lower priority mail all meet the processing and delivery targets that have been established. A large flow of ad mail cannot be allowed to tie up all the resources while higher priority mail is held up, and yet the ad mail must also be processed. Similarly, first-class mail destined for Seattle cannot be allowed to hog all the resources while equivalent mail for Boston is left languishing in the queues.

The data center has similar issues. Batch access to DBMSes must meet the data center's goals while being controlled so that online users are still receiving response times within their targets. No individual user can monopolize all the available initiators so that other users are not being served. Tape drives must be managed so that jobs are not constantly waiting in initiators while allocation recovery is in progress.

Traditionally, flow control has been managed through the number and placement of initiators. However, this approach, as well as being dependent on users for accurate classing, cannot give fine enough distinctions to allow for sharing of available resources between jobs of the same class. Again an automated solution becomes necessary.

## MANAGING ROADBLOCKS

No matter how well planned an operation is, problems always occur. Machines break down; staff are sick; mail is mis-addressed; and weather is uncooperative. There is little doubt that Murphy is alive and well and living in your local postal service (and data center!).

It follows that we must all have procedures in place to deal with the inevitable breakdowns and roadblocks. The postal service must reassign resources on a rotating basis to meet their targets for all forms of

mail; the data center must effectively do the same.

What are the roadblocks for the data center? Hardware or software failure is obviously the most critical problem and one that almost all data centers have addressed in at least a rudimentary way. However, normal operation exposes a number of barriers that must be managed to achieve the required throughput and performance.

For example, recalls of archived datasets from tape can cause long delays of jobs that have been initiated and are uselessly holding various resources until the recall is complete. Clearly it would be preferable to get the recalls done before the job initiates and leave the initiators free to do useful work.

Similarly, dataset enqueue contention leaves jobs tying up initiators and holding other datasets while waiting for the contention to be resolved. Low priority work can tie up initiators, tape drives and other resources required by critical work. Allocation recovery is another all-too-frequent occurrence. Automated management is required to avoid getting into these situations in the first place.

## IMPLEMENTING THE FIVE STEPS

The only way to truly manage your batch workload is with some form of automated control. However, there are certainly benefits that can be achieved through improvements in your manual procedures, many of which will be necessary anyway if you decide to implement an automated solution.

A review of your classing standards, batch control policies, service level agreements (SLAs) and operational procedures is a good place to start. Every data center has room for improvement and an overall workload management approach, such as the one discussed here, provides useful issues to think about.

The second step is to look at what kind of automation tools you will use to address batch control. Many sites have spent years and thousands or even millions of dollars developing in-house solutions, initially through JES2 source modifications, and in recent years, through various exits. Again, there are useful things that can be done through exits, but don't underestimate the cost and practicality of maintaining those exits. Now that IBM provides a new operating system release every six months, often with JES2 updates as well, the maintenance task is non-trivial.


Major changes, such as those introduced with OS/390 Version 2 Release 4 with the new checkpoint structure, pose tremendous problems for data centers with their fingers in JES2. We are all aware of the dwindling workforce of available skilled staff who understand the OS/390 and JES2 environment sufficiently well to keep abreast of all these changes and ensure the exit code is fully compatible with the function provided by JES2. The lack of training and education for young people, together with the impending retirement of many of our JES gurus and the lack of documentation in many existing exits, makes the exit approach a difficult and potentially dangerous one.

IBM has something to offer with Workload Manager Batch Initiators for those sites at a sufficiently advanced level of the operating system who are comfortable enough with goal mode to take the next step. However, WLM has no analysis capability and is dependent on whatever parameters have been supplied by the user.

Therefore, you must resort to third-party products, as you did with job schedulers. One such product is ThruPut Manager from MVS Solutions Inc., which has been developed over the last 15 years solely for the purpose of managing batch. It provides the automated analysis discussed previously as well as a language in which to specify your data center standards. That language, known as Job Action Language, is actually the language used in Figure 1. It provides classification and categorization of your workload, based on accurate information, and both complements and cooperates with Workload Manager. It provides automatic routing to a CPU licensed for a software product, to a DBMS, or to any logical resource. It provides the ability to control the flow of work independently of the job class, service class, or routing of the work. And it manages enqueue contention, recalls and many other potential roadblocks to meeting the goals of the data center.

## SUMMARY

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There are worthwhile manual tasks you can and should do, including reviewing and updating your existing standards and procedures. But a full batch workload management approach needs more than manual procedures and cannot afford to be dependent on users to supply the required information. Dynamic and thorough analysis is a necessary step to provide the foundation for workload categorization, routing and control and the elimination of roadblocks. 

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