

Electronic Procurement & Tracking of Chemicals

Systems ensure safety & improve efficiency

By Jeff L. Behar and John Houseman

THE JET PROPULSION LABORATORY'S (JPL) Just-In-Time (JIT) Procurement System supplies most of the site's hazardous materials. The JIT system uses state-of-the-art client/server architecture to provide a flexible, high-performance, reliable and stable-platform for supporting rapid material acquisition services. Technologies such as barcoding and electronic data interchange (EDI) are fully leveraged to provide fast, accurate support for the ordering, shipping, invoicing, receiving, canceling, returning, dispatching and delivering of pre-approved hazardous materials.

While most commercial JIT systems provide overnight delivery services, JPL's JIT system is operated by a separate contractor who applies a special JPL barcode to the package for various tracking purposes. This slows the overall system slightly, typically resulting in a three-day turnaround. In situations where this turnaround time is not acceptable, an alternate method of procuring pre-approved chemicals was needed.

In response, the site's Chemical Safety Committee developed a Chemical Purchase Card (P-Card) program to provide quicker procurement of chemicals when time is essential for project success. This committee consists of senior scientists who represent each technical division at the facility, as well as representatives of other key organizations such as the occupational safety program office (OSPO), the environmental affairs program office (EAPO), the on-site

fire department, the security office and the procurement division. Through the P-Card program, an approved employee uses a JPL credit card to order chemicals directly from the vendor by phone, a procedure that leads to overnight delivery in most cases.

The program includes the safety and environmental oversight needed to meet applicable regulations. It has proven to be an effective way to eliminate potential delays and risk to flight and research projects, thus avoiding associated critical downtime. Delays and downtime represent economic inefficiencies in general; in an aerospace environment, these factors (schedules) can be critical in meeting fixed launch windows. This article describes how the new system was developed, the process itself and the benefits realized; it also explains how safety and compliance are maintained throughout the process.

JPL

JPL, a division of the California Institute of Technology, is the lead NASA center for unmanned space exploration. JPL is known for the development and operation of highly complex, leading-edge space systems. It also conducts a variety of development projects, including microelectronics, optics, instruments, lasers, communications, materials, structures, rocket propulsion and biochemical research.

fairly benign ethyl and isopropyl alcohols to the very hazardous phosphine and arsine gases used for microchip development. In a typical day, chemicals can be used in any one of the many laboratories conducting a wide variety of chem-

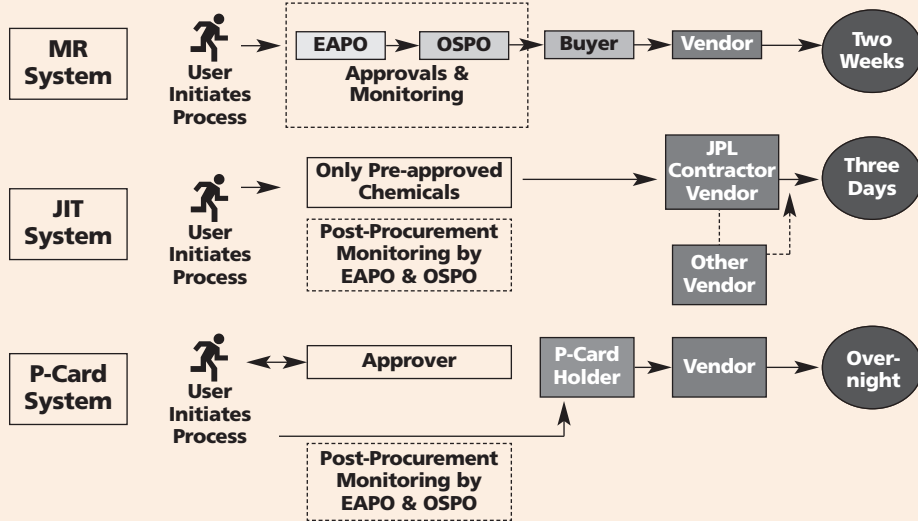
Three Electronic Acquisition Systems

JPL purchases and uses an array of chemicals—from the

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JPL's Chemical Acquisition Systems



ical experiments. As a result, many different chemicals and gases are purchased and used on a daily basis throughout the 45-acre facility. About one dozen frequently ordered chemicals—such as common solvents—are kept on site and are available for immediate use.

In 2001, JPL shifted from a paper procurement system to EDI, which had an immediate effect; it reduced the internal processing time required to process the requisition. As part of the site's program for continuous improvement regarding the purchase of chemicals, two separate electronic acquisition systems were introduced in 2002: the Oracle™ Materials Requisition (MR) System and the JIT Ordering System. Both allow chemical purchases to be completed via an online, multitiered safety approval and monitoring process. However, while these systems are an improvement over the paper-based system, they do not provide a scientist the opportunity to procure less-common chemicals within 24 hours. Because research activities often require quick decisions to try new materials, a system was needed to allow overnight delivery of hazardous materials, while still maintaining safety monitoring and use approvals. The Chemical P-Card program was developed to meet this need.

Comparing the Three Systems The MR System

Figure 1 offers a schematic presentation of the three systems now in use. The MR system (line 1) represents the electronic version of the old paper system. To buy chemicals, a purchase request is submitted to the procurement division. At JPL, all chemical purchases are approved and monitored by OSPO and EAPO (Houseman, et al). Both offices monitor chemical procurement for regulatory compliance, inventory control and hazardous material inventory reduction (8 CCR 5191; 8 CCR 5194; 29 CFR 1910.1450; 29 CFR 1910.132).

In the MR system, the request is first sent by e-mail to EAPO, then to OSPO. After due-diligence checks and subsequent environmental and safety approvals, the requisition is sent by e-mail to the chemical buyer in the procurement division who

then places the order. The overall process typically takes two to three weeks, primarily due to the time spent in the procurement division. An order can be expedited by making a series of phone calls and "hand walking" the requisition through the process; however, it still takes several days and cannot be made a routine procedure.

As noted, both EAPO and OSPO must approve the order before a purchase is made, and both offices monitor the location and use of the chemical. As part of this function, the groups consider various concerns:

- Is this chemical a regulated OSHA carcinogen?
- Has the requestor (user) received hazard communication and chemical hygiene training? Both Cal/OSHA 8 CCR 5194 and OSHA's 29 CFR 1910.1200 (HazCom Standard) require employers to develop, implement and maintain a written HazCom program for employees. This includes requirements for chemical inventory; methods the employer will use to inform employees of the hazards of nonroutine tasks; chemical labeling and other forms of warning; MSDS; and employee information and training. In addition, Cal/OSHA 8 CCR 5191 and OSHA 29 CFR 1910.1450 (Occupational Exposure to Hazardous Chemicals in Laboratories) require a chemical hygiene plan where hazardous chemicals (as defined by the regulations) are used in the workplace.
- Is any additional training needed?
- Has a hazard assessment been conducted for this laboratory operation (8 CCR 5191; 29 CFR 1910.1450)?
- Has appropriate PPE been identified? OSHA 29 CFR 1910.132 (PPE Standard) requires employers to perform a written hazard assessment, select appropriate PPE and maintain a written record indicating that affected employees have been trained before performing any task requiring PPE. Training requirements include when PPE is necessary; what PPE is necessary; how to properly don, remove, adjust and wear the gear; PPE limitations; and proper care, maintenance, useful life and disposal of the equipment.

JPL maintains an electronic database of all users who have attended training, including the date completed, as well as one that tracks hazard assessments (pre-operational safety reviews and chemical hygiene plans) completed for all labs. If any of these checks shows a deficiency, corrective action is taken. This may result in a materials requisition being put on hold or canceled. If no deficiencies are noted, EAPO and OSPO representatives approve the requisition, which is then sent electronically to the procurement division.

The JIT System

This system is depicted as line 2 of Figure 1. OSPO and EAPO have developed a catalog with a large number of fairly common and lower-hazard chemi-

HazMat Rating Systems

The NFPA and HMIS® hazard ratings are comprehensive safety programs that help employers comply with OSHA's HazCom Standard. The standard was developed to ensure that workers who are potentially exposed to hazardous substances receive useful information about the dangers of these substances and about protective measures needed to work with them safely. Both systems are numerical hazard rating systems that use color-coded labels to give information about health, flammability and reactivity hazards. HMIS also provides information on appropriate PPE. Recent revisions to HMIS reflect changes to OSHA's HazCom system, including placing greater emphasis on target organs; providing users with a variety of icons to enhance the utility of the HMIS label; modifying the criteria for the flammability rating by adopting OSHA's criteria; replacing the reactivity field with physical hazards, in accordance with OSHA's definition of hazards; and a new, more distinct label format.

icals and solvents used frequently at JPL. Items in this catalog have been pre-approved for use and can be ordered directly without waiting for OSPO/EAPO approval. Additionally, these chemicals were chosen based on their relatively benign chemical properties as shown by the NFPA and HMIS systems. (See sidebar at right.) These chemicals comprise the JPL-JIT chemical catalog and their respective MSDS are stored at JPL in a special binder system that is being converted into an electronic system. Only chemicals listed in this catalog can be ordered in this manner; similar catalogs exist for supplies, software, etc.

A purchase request for JIT chemicals goes directly via e-mail from the user to the buyer. A copy of the e-mail is sent to both OSPO and EAPO so these offices can monitor various issues, such as where the chemicals are going and who is using them. The chemical buyer in the JIT case is a contractor/vendor who supplies only chemicals and either obtains the chemicals directly from its own warehouse or from another supplier. This process is quite fast. However, JPL requires the chemical vendor to place a JPL barcode on each package so it can be delivered directly to the user from the site's receiving dock without opening the package. This barcoding process is performed at the vendor's central warehouse and takes one to two days; thus, the overall turnaround time in this system is about three days.

When a JIT order is delivered to the site, the package barcode is scanned into a handheld scanner/computer. The package is then delivered by JPL's certified transportation department to the specified delivery location, such as an expeditor's office or a laboratory. When the package is delivered to the specified location, its barcode as well as the badge of the person receiving the chemical are scanned.

Several safety measures and controls are built into this system. For example, chemicals can only be delivered to a person and cannot be left on a laboratory bench. Each chemical is accompanied by an MSDS for that chemical. The scanned information is then downloaded to a database for chemical inventory and accounting.

To place an order in the JIT system a user must go through a "certification" process. To become certified, an employee must 1) be authorized to place orders by his/her supervisor; and 2) attend a one-hour class to learn how to use the JIT system and understand the responsibilities of being permitted to order items for the facility. Ordering authorization is given at the catalog level (i.e., a user might be authorized to order office supplies but not chemi-

icals). Chemical procurement authority requires additional training in hazard communication.

Safety Monitoring Controls in the JIT System

Since deliveries of JIT orders can occur within 72 hours, a speedy monitoring process is needed. Although the catalog contents are pre-approved, OSPO and EAPO continue to exercise control of the following areas:

- quantity of the chemicals ordered (for inventory reduction);
- location of usage (to ensure proper ventilation and storage);
- personnel issues such as training, use of PPE and safe work practices.

As noted, when a JIT order is placed, both offices receive an e-mail. If any questions arise regarding the order, a quick phone call to the user normally resolves any concerns. Typical questions include: Is the large quantity ordered truly needed? Does the laboratory have a fume hood for the volatile chemical requested? Representatives in both offices have significant knowledge regarding the various laboratories and their normal activities. If a lab that primarily conducts nonhazardous operations (such as spot soldering of circuit boards) requests a highly toxic chemical, an inquiry is made about the use for the chemical ordered. Additional questions might concern user training and controls in place to prevent chemical exposure (8 CCR 5194; 8 CCR 5191; 29 CFR 1910.1200; 29 CFR 1910.132; 29 CFR 1910.1450).

If any concerns remain, the OSPO and/or EAPO representative can put the order on hold or cancel it by contacting the procurement representative. This procedure requires that orders be monitored at least once per day, since the materials being requested will be delivered to the user unless the order is stopped. If no concerns remain, no action is required and the order is executed automatically.

Chemical P-Card System

The Chemical P-Card system (line 3, Figure 1) transfers the approval function from OSPO and EAPO to the technical divisions (the user organization); it also transfers the buyer function to the user organization. When a user has an urgent need for a chemical, the user requests approval to use the Chemical P-Card system from the "approver," and must explain to the approver why overnight delivery is necessary and how the chemical will be used.

A special approver has been appointed in each technical division to carry out this function. The

Several measures and controls are built into this system to prevent errors and ensure site safety and security.

approver is typically a senior scientist/engineer or chemist in the technical division who is proactive in safety and who has the respect of the scientific/engineering personnel within the division. This person must consider whether the user has the experience, safety training and facilities (e.g., fume hood) to properly handle and use the hazardous material. S/he often knows the user personally and is familiar with the available facilities within the division. As a result, s/he can normally make an "on-the-spot" decision to approve use of the Chemical P-Card system.

The approval is then passed on to the Chemical P-Card holder. Each technical division has a holder, normally an expeditor who is a specially appointed, qualified and trained. This person now acts as the buyer and contacts the vendor, places the order and pays for it with the P-Card (a JPL credit card with a \$10,000 credit line). The holder enters the details of the purchase into the Chemical P-Card software. This module was developed specifically for JPL acquisitions with input from OSPO and EAPO to ensure that data needed for subsequent reporting requirements are collected. The software then sends the order details via e-mail to the acquisitions department for internal billing, as well as to OSPO and EAPO in real time so these offices can conduct the normal oversight and audit functions.

The chemical procurement module has built-in reporting features, such as a customizable and searchable monthly report that can be downloaded or imported into a program such as Microsoft Excel™. The module also provides a historical record of all purchases, including use location, quantity, item procured, manufacturer/distributor, quantity ordered and requestor. These customizable reports are also used to provide required environmental and business plan reports to regulatory agencies.

Under the P-Card system, the entire procurement process occurs within a single technical division, resulting in an extremely fast process—often producing an overnight delivery. OSPO and EAPO have delegated their approval authority and safety and environmental accountability to the approver (although the MSDS still come to both offices as an order is placed). The procurement department has delegated the buyer function to commit JPL funds to the Chemical P-Card holder, along with the associated accountability. Therefore, the approver and the P-Card holder now have new responsibilities in addition to their regular tasks.

The Chemical P-Card system is under local division control and is reviewed by the division safety coordinator working in the local area of use. The division safety coordinator (or appointed designee) is accountable for conducting all transactions in accordance with JPL policies and procedures.

Contacts between the user, the approver and the P-Card holder can be in person, by phone or by e-mail, depending on the location of the participants and on personal preferences. It is the Chemical P-Card holder's responsibility to finally enter the details of the transaction into the computer system.

Special Requirements of the P-Card System

To this point, the discussion has presented a summary of the P-Card system. Several additional restrictions and safeguards are in place to meet all JPL safety and environmental requirements.

- OSPO and EAPO, with input from the Chemical Safety Committee, have established a list of chemicals that cannot be ordered under the Chemical P-Card system. This list was developed with consideration of EPA Community Right-to-Know regulations, OSHA regulations, site requirements, and NFPA and the Hazardous Materials Identification System (HMIS) chemical hazard ratings (29 CFR 1910.1200; 22 CFR Section 12601; 40 CFR 302; NFPA 704; NFPA; J.J. Keller). Basically, this restricted list includes carcinogens and acutely hazardous chemicals that require special safety or environmental measures. It is the approver's responsibility to check this list when approving a P-Card purchase.

- Chemical P-Card holders are approved by the Chemical Safety Committee. In making this determination, the committee considers various factors about an applicant. S/he must have 1) completed all required JPL training, including hazard communication, JIT procurement and Chemical P-Card purchasing; 2) a history free from safety/environmental infractions; and 3) suitable qualifications and experience. It is the committee's responsibility to ensure that these criteria are met before approving an application.

- The P-Card holder (buyer) must ensure that a current MSDS is received from the user (chemical requestor), preferably as a PDF file, for attachment to the purchase order. This requirement enables the user to obtain a clear understanding of the chemical's hazards so that any necessary preparations can be made prior to its use. The holder must also provide copies (usually via e-mail) to OSPO and EAPO for appropriate monitoring. In addition, OSPO, EAPO and the procurement division must be notified (through the Chemical P-Card software) regarding all P-Card purchases. The holder must use the normal MR system to procure chemicals on the restricted chemicals list.

- As noted, an approver reviews all Chemical P-Card orders. This person, a scientist or engineer with significant expertise in chemistry, is approved by the Chemical Safety Committee. S/he is trained in the process and is familiar with the restricted chemicals list. In addition, this person is a local authority familiar with the research facilities available and is an expert source regarding chemical interactions who can add additional safety precautions that an SH&E professional may not provide.

The approver 1) reviews the Chemical P-Card purchase requests in accordance with the Chemical P-Card handbook and ensures that chemical requestors have completed all required JPL training and have a JPL-approved hazard evaluation (e.g., a pre-operational safety review) in place in accordance with JPL requirements; 2) reviews MSDS for a chemical purchase request to ensure that the requested substance does not contain any chemicals included

on the restricted chemicals list; 3) disallows procurement of restricted chemicals; and 4) informs the user that the procurement request is approved.

Quality Control

The system also features several quality control checkpoints.

- OSPO, EAPO and the procurement division monitor all P-Card procurements after an order is placed by reviewing the e-mail notifications.

- The division safety coordinator or approver reviews all such procurements for compliance with this procedure.

- The division safety coordinator or approver performs spot inspections of areas where chemicals are used or stored to ensure that safe work practices and storage practices are being followed.

- Chemical P-Card privileges may be suspended or terminated if any unauthorized approvals/procurements are discovered during a program audit.

- Violations of procedures are discussed at the next Chemical Safety Committee meeting.

- Electronic logs of procurements are generated for auditing and compliance purposes.

Benefits of Electronic Procurement

Electronic procurement systems provide a level of comfort that needed chemicals will arrive promptly. Such systems also generate electronic databases that are easily searchable and can provide custom reports and metrics. This can substantially reduce costs and minimize the labor required to complete reports. It also reduces the administrative work often required for regulatory compliance, which allows technical staff to perform technical functions. Furthermore, documents transferred directly from computer to computer move orders of magnitude more quickly than do paper documents with no loss of accuracy.

All three chemical procurement systems at JPL provide checks and balances to ensure the safe purchase of chemicals. However, chemical procurement requests processed through JPL's JIT and Chemical P-Card systems result in quicker procurement with reduced handling costs. Because chemicals can now be procured more quickly, chemical users do not over-stock chemicals; this results in lower warehousing costs, less hoarding of chemicals and lower disposal costs for unused chemicals. The electronic systems also provide a downloadable database of delivered chemicals, which can be used to update inventories used in right-to-know and Proposition 65 reporting. (*Note: In California, workplace exposures are subject to Proposition 65's prohibition against knowing and intentional exposure of any individual to listed chemicals without giving advance warning.*)

In addition, electronic procurement systems allow real-time monitoring of chemical purchases for compliance issues. For example, material requisitions can be monitored to help meet OSHA requirements to assess tasks whenever it is reasonable to suspect that employees may be exposed to concentrations of airborne contaminants. It can also help an employer

identify those employees who need hazard communication and task-specific training. The databases generated by these systems can also be used to provide required regulatory agency reports; assess internal company metrics; target work areas that may require chemical hygiene plans; and establish routine industrial hygiene monitoring.

Conclusion

JPL's experience illustrates just one of the many ways a business can profit by implementing an EDI system to procure chemicals. The major benefits include: administrative cost reduction; improved inventory control; strategic integration of EDI data and information processing; quick access to information; and competitive advantage gained from the increased speed of transactions and the reduction of paperwork. At JPL, the Chemical P-Card system has proven to be an efficient and safe method of procuring approved chemicals in situations where the turnaround time of JIT and regular MR purchases is not acceptable in today's competitive environment. ■

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Electronic procurement systems can improve inventory control and reduce costs associated with meeting various regulatory requirements.

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