WENDY'S

ARTEMIS

ARTEMIS

ARTEMIS

ARTEMIS

ARTEMIS

ARTEMIS

Distributed Processing for Project Management

metier

ARTEMIS

DISTRIBUTED PROCESSING

FOR

PROJECT MANAGEMENT

Reading about **ARTEMIS** rather than actually seeing it in action is rather like reading the newspaper story of yesterday's football game instead of going to see it yourself.

However, not everyone has the time to go to the game and so this is our story of it.

Our apologies if it seems a rather long story. We have some very innovative ideas to get across and have found by experience that you the executive or engineer reading it have a very enquiring mind and ask a lot of searching questions - so you've only yourself to blame!

If this story stimulates your interest, give us a call and come and see the next game.

INDEX

SECTION 1 - GENERAL MANAGEMENT OVERVIEW

ARTEMIS is a distributed processing system for Project Management - Costing, Networking, Materials Management, Progress, etc.

It provides a substantially better chance of bringing projects in within budget and on time.

It offers a quantum jump in project control facilities - not just 5% better, but 500% better.

It achieves that quantum jump by providing the cost/scheduling engineer with enormously improved computer processing facilities measured in terms of:-

- Access and turnaround
- Ease of use
- Timely implementation of customized applications

To do it, it uses two kinds of technology:-

- The "chip" which has produced powerful computers at a low enough cost to "distribute" computer processing power.
- Advances in software technology (Relational Databases and Interactive Systems Design) which make it easy to use and provide rapid systems implementation.

ARTEMIS is a rugged, well proven system, tried and accepted by many of the major corporations concerned with project management.

The cost of **ARTEMIS** at $150,000, or a few thousand dollars per month, is easily justified on any large scale project by the major improvements in project control which it can generate.

ARTEMIS can be delivered immediately. It can be on site, helping solve your project problems, in weeks, not years. Metier has both the financial strength and the confidence in its product to offer rental facilities so that you can try **ARTEMIS** out.

Metier is a rapidly growing, profitable company owned and run by a group of individuals who are all engineers, with many years of experience in the Project Management computer field, a dedication to it and a proven track record of business sucess.

SECTION 2 - COST/SCHEDULING MANAGEMENT VIEW

A NEW SYSTEMS CAPABILITY

ARTEMIS is a self contained system for project management:-

- . Networking
- . Cost Engineering
- . Progress Measurement & Reporting
- . Materials Management
- . Job Lists
- . Productivity Analysis
- . Maintenance Management.
- . Integrated Cost/Scheduling (e.g. C/SCSC, PMS)
- . Estimating
- . Financial Modelling
- . Drawings Control
- . Transport and Crew Scheduling

etc.

Site & Home Office Operation - requiring only an ordinary office environment and power supply, it can be sited where it's needed.

English Language Driven - it can be used easily by any cost/scheduling engineer.

Integration with Main Frames - while providing large capacity in its own right it can also be integrated with home office mainframes.

Proven - with 70 installations in the U.S., Europe and Middle East and over 125,000 hours of usage.

A MAXI SYSTEM ON A MINI COMPUTER

ARTEMIS systems are currently being used in the management of several hundred projects ranging in value from $1 million to the multi billion $ level. It is a large program (over 2,500,000 bytes) representing a $1,500,000 development investment.

Multiple Usage - It can support multiple users engaged in different Project Management tasks on one or more projects simultaneously.

Storage Capacity - It can store information about hundreds of thousands of activities, resources, materials, costs, drawings, etc. and give users rapid access to any of the data.

Materials - It is capable of handling man-sized projects - for example it is currently being used to control 150,000 material items on one $4,000 million project.

Networking
- Multiple projects
- Up to 32,000 activities per project
- I/J & Precedence
- Up to 8 user-defined calendars per project with any time unit from hours to months, shift working and unequal work weeks for different trades.
- Multiple starts and finishes, targets, hammocks, dummies, subnetworks, libraries.
- Complex resources, up to 64 resources per activity and up to 256 resources per network.
- Target scheduling with any number of baselines.

Costing
- Integrated cost/scheduling systems of the C/SCSC & PMS type or more traditional cost engineering systems.
- Multiple WBS of any number of levels
- Spreading of costs over activities or groups of activities
- Multiple user-defined formulae for cost spread calculations
- Summarisation of costs by dept. and functional split.

Other Systems - Drawings; Bed Lists; Transport Schedules; Productivity Calculations; Estimating; etc.

System Facilities - Network plotting, graphics output, link to mainframes, etc.

THE DESIGN GOALS

The management of projects has become progressively more difficult over the last 20 years. Projects have become larger and technologically more complex; clients have sought for tighter control with more detailed and more frequent reports; and the tracking of progress, costs and materials has become more difficult.

Fortunately, there have been a series of major developments in computing which have allowed Project Management to make steadily improving use of computers for CPM, Costs, Progress, Materials, etc.

ARTEMIS provides DP Departments and Project Management with the next step forward. In providing distributed processing for projects it addresses three design goals:-

. Access & Turnaround

Any cost/scheduling engineer is likely to be familiar both with the frenetic pace in the project office and with the difficulties current computer systems have in matching it. Delays in getting data punched, delays in access to the machine, delays in getting run time, delays in correcting errors all lead to the production of reports giving the answer to last week's problem.

ARTEMIS provides the cost/scheduling engineer with instant access to a computer that he controls himself. Turnaround of his enquiries and reports, changes to data, location of data errors - all can be achieved in minutes.

. Ease of Use

The cost/scheduling engineer wishes to use a computer based system as a tool, but baulks at having to learn "computerese".

With **ARTEMIS** he needs only normal day-to-day English - he does not have to become a computer expert. **ARTEMIS** is a sort of giant pocket calculator for the cost/scheduling engineer.

. Timely Implementation of Customized Systems

Finally, each application system (Cost, Materials, Progress, CPM, etc.) must be customized to meet the requirements of each specific project. But Project Managers are all too familiar with the 3 year waiting list existing for programming new applications on the mainframe.

ARTEMIS provides radical new tools which dramatically speed up custom system implementation. A report customized to fit an ad hoc need can be produced in minutes. A complete cost or materials system can be implemented in weeks rather than months. A major change to an existing application can be made in days rather than weeks.

DISTRIBUTED PROCESSING

There is no doubt that Distributed Computing is where it's at. There has been a wealth of articles about the ubiquitous "chip" and the dramatic way in which it is bringing down the cost of electronics. Less attention has been given to the number of authoritative studies which have shown that this is not just a current phenomenon, but that since the first availability of the transistor in the 50's the cost of electronics has been falling at a fairly steady 30% p.a.

The $2.50 Rolls Royce

A 30% fall per annum is difficult to comprehend because it means a drop from 10,000 to 1 over the 20 year period 1959-1979. If applied to other technologies it would mean that a Rolls Royce would currently cost about $2.50 and a replacement for a Boeing 707 less than $1,000. By almost any standards it means that electronics were very expensive 20 years ago and are pretty cheap today.

The Mighty Mini

A computer, of course, reflects the cost not just of electronics but also of the (mechanical) peripherals. But even here the already substantial electronic content has been steadily increased; printers and terminals have fallen by a factor of at least 10 over the 20 year period, and discs (which were virtually unavailable 20 years ago) by a factor of perhaps 10 over the last 10 years.

The consequence of this is that a mini computer such as the HP1000 which is at the heart of **ARTEMIS** is in reality considerably more powerful than the "mainframe" of the early 60's at perhaps one-thirtieth of the cost.

The Message

In short, Distributed Computing is the recognition that computers - once regarded as an expensive commodity - are now relatively cheap.

When they were expensive it was sound business sense to centralise computers and use them sparingly. Now that they are cheap it is equally sound business sense to move them out "where the action is" and use them in a way which gives maximum help to the end user.

ARTEMIS does just this.

SECTION 3 - DATA PROCESSING MANAGEMENT VIEW

DISTRIBUTED PROCESSING & THE DP DEPARTMENT

ARTEMIS is just one example along with word processing, automatic draughting and many others of the fast growing range of distributed processing facilities.

The part played by the corporate Computing or DP Division will be vital to the success of **ARTEMIS** as it will be to most other forms of distributed processing.

Recognition

That part will recognise that:-

- Many computing tasks will continue to be done centrally. Not because its cheapest but because that's where they are best done for a variety of reasons.
- No matter how easy the task of programming is made the tasks of systems analysis, system design and system implementation require special skills. And the users of distributed systems will look to the DP Division for those professional skills.
- Independent acquisition and implementation of distributed systems by every user department leads to a state of corporate systems anarchy.
- Not all users are well equipped to choose the right distributed system to meet their needs.
- Distributed systems must be integrated into the larger corporate requirement - meeting the needs of home office and corporate management as well as local management.

DP's Central Role

The DP Department should play a central role in developing the corporation's use of distributed processing. The role includes:-

- Evaluation with end users of their needs and of available distributed systems.
- Choice with end users of use of mainframe or distributed system for each application system and each project.
- Assistance to end users in systems analysis, design and implementation of major customized applications.
- Establishment of systems standards and operational standards with end users for distributed systems.
- Linkage of distributed systems to mainframe and integration of distributed systems into central corporate systems.

PROCESSING OR COMPUTING?

It takes a lot of software to turn raw computing power into processing power. **ARTEMIS** provides it all in one integrated system:-

- Relational database
- Report generator
- Teleprocessing monitor
- Data dictionary
- Complete CPM/Networking facilities
- Screen formatting language
- Editor
- Network plotting
- Management graphics
- Query language
- Relational data manipulation language
- Sort and other utilities
- Job control language
- Spooling
- High level arithmetic processing language
- Mainframe communication
- Data security system
- Usage accounting
- Data back up and integrity system

DESIGNED FOR PROJECT MANAGEMENT

ARTEMIS isn't just a networking program on a mini - or even a networking program hastily glued on to a general purpose database system.

ARTEMIS is based upon extensive market research into the needs of Project Management - not the needs of bankers, airlines or stores - Project Management. And it's finely engineered to meet those very precise needs.

Application Range - It will handle Costs, Progress, Drawings and all the other project applications as well as networking.

Integrated Networking - CPM facilities are an integral part of the whole system. That means:

- A common user language, common reporting facility and common arithmetic extend across CPM and all the other applications like Costing, Materials, etc.
- Cost, Material, Progress and other non CPM reports can include CPM data - and vice-versa.
- Arithmetic can be carried out on CPM data in combination with non-CPM data. For instance, summarising hours from a job level up to an activity level, or spreading costs at WBS level across activities.
- CPM data sets can be extended to include non standard data. Also non standard arithmetic can be carried out on CPM data sets.

Rapid System Implementation & Evolution - **ARTEMIS** uses "relational database" technology, not because it's the newest and most exciting development in its field (although it is as it happens) but because it meets the particular needs of project management for:

- Quick implementation of customized systems
- Easy evolution of those systems to meet changing needs.

Those needs just simply aren't as important in relatively stable management environments like banking, insurance and retail chains. But any cost/scheduling engineer knows how real those needs are to him. He **must** have a system implemented in days, not months. And he **must** respond quickly to changes required by the client or by project managers.

The independence of data from procedures and reports given by a relational database makes applications much easier to set up and dramatically easier to change.

Reports - Barcharts, histograms and graphs can all be produced by the cost/scheduling engineer as easily as tabular reports.

And high quality barcharts, histograms and graphs can be plotted in four colors for inclusion in proposals and reports.

Dates - **ARTEMIS** "knows" about the calendar. The user can store dates about material items, drawings, etc. and do all the necessary calculations like calculating lead times, expediting dates, slippage, etc. And dates are what scheduling is all about.

Network Plotting - **ARTEMIS** includes network plotting facilities. Again, they're integral to the package and more flexible than most stand-alone mainframe packages.

Easy Changes - **ARTEMIS** allows the user to make all the common "blanket" changes such as increasing steel costs for inflation, reassigning all items on a work package to a new contractor, recalculating durations in the light of low productivity, etc. - all with one or two commands.

Easy Arithmetic - Calculations are specified by the cost/scheduling engineer in English - not in a computer language like Cobol or Fortran.

Completeness - **ARTEMIS** includes data security, accounting and protection against system failure.

Practical experience by users suggests that an application system such as costing, materials management, progress measurement, etc. can be implemented in **ARTEMIS** with between 3 to 20 times less effort and time than with other systems. Similar gains apply to making changes to the application.

One example involved a materials management system linked to networks for 150,000 material items which took 8 man months to implement and an elapsed time of 16 weeks, compared with the 60 man months and 78 weeks duration estimated for a conventional system.

AN ENGINEER'S COMPUTER

We evaluated some twenty or so mini computers.

We are engineers and we were choosing hardware for engineers to use. So it's no surprise that we made a choice mainly on engineering grounds.

We knew that a lot of the systems were going to be installed in Atcos and Porta-Kamps in some pretty rugged places. So we wanted hardware to suit. And for rugged engineering quality Hewlett Packard came out tops.

We checked out world wide maintenance coverage and found that Hewlett Packard came in number two. And they matched you-know-who real well in their ability to service machines in the wild places where a project management system is apt to be. We particularly like the fact that our system is all HP supplied - we don't have to buy in.

We looked at the development and production track records and concluded HP were up with the leaders.

And we ran system simulations to see how their hardware performed. There we have to admit that while HP tied for first place in performance they weren't exactly the cheapest on straight price/performance. But that's the price we think is worth paying for high quality, rugged engineering, maintenance coverage where you need it and an unsurpassed development performance.

Why the 1000 system? That's a question of system design. **ARTEMIS** is heavily optimised around the fastest disc channel we could lay hands on - because the characteristics of usage in an interactive, relational database environment point that way. Also the microcoding facilities available to us on the 1000 enable us to get maximum performance.

We're not tied down to the Hewlett Packard 1000 but we do think it enables us to offer a well engineered system right now!

AVAILABILITY AS SOFTWARE

On other hardware

Metier has no inescapable commitment to Hewlett Packard or to the HP1000 computer and is happy to discuss with any prospective user the implementation of **ARTEMIS** on another computer.

The system is written mainly in ASA Fortran and is therefore reasonably portable. The very strong user orientation inherent in the design of **ARTEMIS** is best implemented on distributed computers rather than a mainframe and it requires a fairly powerful hardware and operating system environment to support it.

On the HP1000

It might also be mentioned that while **ARTEMIS** is normally sold as a "turnkey" system incorporating both hardware and software it may also be acquired as a software only package for those who already have their own HP1000 or wish to buy it direct from HP themselves.

Unless the user is buying in considerable quantity this route is likely to be more expensive and to offer slow delivery. The burden of responsibility for system integration and system maintenance also of course shifts to the user.

SECTION 4 - COMMERCIAL VIEW

METIER

Metier operates as two essentially parallel companies - Metier Management Systems Inc., a Delaware corporation headquartered in Houston, Texas and Metier Management Systems Ltd., a British company headquartered in London, England.

Both share substantially common ownership and management.

Metier Ltd.

The earlier of the two companies, Metier Management Systems Ltd. (Metier Ltd.) was formed by a group of engineers each having ten years or more previous experience in the application of computers to interactive management systems particularly in the CPM and other project related systems area. The key individuals had previously been responsible for the founding of an extremely successful service bureau - the first independent time sharing bureau to be founded outside the USA, in 1967.

After an extensive period of market research, product development and quality assurance testing active marketing of **Artemis** (under the name Apollo at that time) was commenced in Spring 1977.

Audited financial information is available on request.

Metier Inc.

Metier Management Systems Inc. (Metier Inc.) was formed in summer 1978 and active marketing of **ARTEMIS** in the USA was started in the fall.

Audited financial information is available on request.

Inc. was initially 100% British staffed but it is the longer term intention that it should be 100% US staffed and a proportion of around 50% has already been reached (as at July 1979).

General

In general Metier Inc. handles all sales and support in the U.S.A., Canada and South America whilst Metier Ltd. handles sales in the UK and rest of the world.

The two companies between them employ about 70 staff (at July 1979).

Metier operates as an equal opportunities employer in all territories.

It is relevant that Metier uses exclusively Hewlett Packard equipment and that in excess of 60% of its business is with US corporations.

METIER - POLICIES

Metier are dedicated to the project management market to the exclusion of other application areas and other types of business.

Metier's business policies include:-

- Maintenance of a commanding software technology lead in a very specific application area. This involves spending a high proportion of operating revenues on R&D, utilising a small team of very high calibre specialists. There is common recognition in the computing industry of the unusual pool of software talent in the U.K.

- Integration of this software with hardware provided by a single manufacturer into a "turnkey" system, thereby providing the user with the benefits of something very close to a single source supplier, as well as securing the benefits of tight product rationalisation.

- Aggressive marketing of the product on an international basis.

- Provision of a product of the highest quality backed by excellent user support provided by staff skilled in project applications.

- Conservative financial management. Growth is financed from operational cash flow. Metier operates well within its borowing base. All software / R&D is expensed in the years in which costs are incurred. Hardware is depreciated over 4 years or less.

PRICES & AVAILABILITY

ARTEMIS is available on:-

- Purchase
- Lease (fixed long term contract with monthly payment for 2 to 5 years and equipment optionally becoming property of user or leasing company)
- Rental (monthly payments under a short term contract and equipment remaining Metier property)

The example prices given below are approximate indications only and do not constitute an offer or promise by Metier:-

Typical Systems	Purchase $	Lease 5 Year Term $	Rental $
Model 1A (basic single user system)	103,000	2,400	4,700
Model 1C (basic single user system, all application facilities)	130,000	3,000	5,900
Model 3C (3 user system, all applications)	165,000	3,800	7,500
Model 5C (5 user system, all applications)	202,000	4,600	9,200

On purchase or leased systems the price includes:-

- Hardware maintenance for 90 days
- Software support for 1 year including:
  - Training (6-10 days free training on user site)
  - Query answering via "Hot line"
  - Routine visits
  - Documentation
  - Software Updates

The user may take out a software support contract in second and subsequent years at typically 8% of purchase price p.a. A Hardware maintenance contract with Hewlett Packard will also typically cost 8% of purchase price p.m.

Rental prices **include** all hardware maintenance as well as software support as outlined above.

Delivery of a reasonably standard system (normally sufficient to get a user operational) can usually be made within 2-3 weeks of firm order. Delivery of upgrades may take 10-16 weeks.

Metier will provide any prospective user with facilities to run their own benchmarks on **ARTEMIS** at Metier's offices and will also provide names of existing users with whom they can discuss the performance of **ARTEMIS.**

Demonstrations of **ARTEMIS** can be provided at Metier offices upon request.

PRODUCT QUALITY

The fact that a number of **ARTEMIS** systems are currently operational in remote sites in the Middle East and elsewhere is testimony to the high quality of the system.

Robustness

- So that both hardware and software faults are few and far between and can be fixed promptly when they occur and so that it will operate in relatively hostile environments.

Recoverability

- So that the system can be restarted confidently without loss or corruption of data due to power failure, operator error or hardware/software breakdown.

Quality Assurance

- Metier expends a major amount of effort in exhaustive pre-testing of software before issue.

Zero Defects Policy

- Getting constant feedback on what the user finds missing, inadequate, difficult to use or just plain wrong and developing improvements to eliminate those defects.

SERVICE QUALITY

Many **Artemis** customers started with one system and now have contracted for 2, 3, 4 or more. That's proof that they are satisfied not just with the product but also with the service supporting **Artemis.** That service includes:-

Documentation - Highly readable, easy to follow manuals for users and system managers.

Regular Updates System updates are issued in the form of discs containing new versions of the system at three to six monthly intervals. System updates contain general improvements and fixes to software bugs.

Training - Courses include:-
- 2 day introductory for CPM users
- 1 day continuation for CPM users
- 2 day introduction course for non CPM applications
- 3 day systems implementation course for non CPM applications
- Occasional advanced courses on demand by users.

Generally training is done at customers site.

Support - A skilled Metier consultant is appointed at time of installation to provide support. He will answer queries by phone or in person, give the initial and continuation training, advise on new developments, make routine visits, etc. A "hot line" is maintained at local offices during normal working hours to answer urgent user queries.

Systems Implementation Service - Where the user wishes to implement a non CPM system, assistance in the systems analysis/design/implementation task is best obtained from the users own in house DP services dept. Alternatively, it can be obtained from consultants or, if required, from Metier who maintain a skilled team of professionals for this purpose (SDI - Systems Development and Implementation Service).

Temporary Staff - Metier can provide operators, planners and similar staff for brief periods - although this is done only as a special service and Metier does not wish to be in the "people" business on any scale.

Development - Whilst not ordinarily considered part of the supporting services for a product it's important for the intending user to know that there is a substantial continuing R&D effort which will provide a steady flow of improvements matched to his needs. Metier is currently spending around $600,000 p.a. on product development.

CURRENT USERS

The first **Artemis** system was installed with a user in June 1977. At the present time over 70 systems are operational at locations in the U.S.A., U.K., Holland, Norway and Saudi Arabia.

Among the current users of Artemis systems are:-

Shell
Fenix & Soisson
Brown & Root
McDermott Hudson
King Wilkinson
Crest Engineering
British Aerospace Corporation
Chrysler
British Leyland
Ferranti
Cable & Wireless
Redpath Engineering
Seltrust Offshore Services
Taywood Santa Fe
Aker Offshore Contracts
Pipework Engineering Development
Wimpey
B.P. Chemicals
Global Engineering

CURRENT PROJECTS

Among the current projects on which **Artemis** systems are being used:-

Offshore projects

- Engineering design
- Jacket fabrication
- Platform fabrication
- Module fabrication
- Hook up and commissioning
- Post completion expansion and maintenance

Automobile projects

- Facilities planning
- New model timing
- Tool and die timing

Civil Construction Projects

- Engineering design
- Construction (of major new city/industrial complex; townships; new airport facilities; etc.)

Petrochemical Projects

- Project evaluation
- Engineering design
- Construction

Aerospace, Electronics & Weapons Projects

- Evaluation
- Design and Development
- Production

CURRENT APPLICATIONS

Present applications for which **Artemis** is actually being used include:-

- Activity on arrow networking
- Precedence networking
- Resource scheduling
- Progress reporting
- Site warehousing
- Productivity calculations
- Costing
- Materials procurement
- Drawings control
- Timesheet analysis
- Task lists and detailed job schedules
- Inventory control
- Labour deployment
- Capital budgeting
- Manpower forecasting
- Payroll
- Economic feasibility studies
- Cost estimating
- Bid analysis
- Bill of materials processing
- Asset registers

SECTION 5 - THE DATABASE APPROACH

GENERAL PRINCIPLES

Data for the user's application systems (Costs, Materials, CPM, Progress, Job Lists, Drawings, etc.) is held as a database on discs.

On-line disc capacity can be anything from about 25,000 records (Cost Items, CPM Activities, Material Items, etc. in any mixture) to 1,000,000 records or more.

The database may simply contain data about one application on one project, or it may contain data about a number of applications (Costs, CPM, Drawings, etc.) on one or more projects. The design of the contents and layout of the database are in the hands of the user.

Users drive the system through keyboard CRT's. A number of users can be doing different kinds of tasks on different applications on different projects at the same time. Equally, a number may be running similar tasks on a single application in one project at the same time.

There are a wide range of tasks which the user can perform. With the exception of such specialised CPM tasks as network plotting, any of the following tasks can be performed on any application (Materials, Costs, CPM, Progress, etc.):-

Input/Output

- Data input
- Enquiries
- Printing reports
- Changing reports
- Creating new report formats
- Plotting of graphs, histograms and barcharts
- Network plotting
- Database updating

Data Base Set Up

- Creating the database structure
- Changing the database structure

Calculations

- CPM scheduling
- CPM summarising resource requirement
- CPM scheduling with resource constraints
- Running Costs, Materials and other Customized calculations.
- Creating or changing customized calculations

Extra Powerful Operations

- Changes if ---
- What if ---?
- Routine Jobs

The CPM portion of a typical database will contain data about a few thousand activities or events.

The data for each activity or event is held as a record consisting of a number of fields and for convenience each field is given a short name. A somewhat simplified example would include:-

PE - Preceding Event or I node
SE - Succeeding Event or J node
DU - Duration
AD - Activity Description
RES - Resource Code
QTY - Quantity of resources required
ES/EF - Early Start & Finish
LS/LF - Late Start & Finish
TF - Total Float

The user can directly interrogate the contents of this database by typing a "DISPLAY" command to which the system will respond more or less instantaneously:-

```
DISPLAY IF PE = 1086A


PE = 1086A   SE = 1092   DU = 2
AD = INSTAL GENERATOR
RES (1) = ELEC   QTY (1) = 2
RES (2) = LAB    QTY (2) = 3
ES = 1-AUG-80   EF = 3-AUG-80
LS = 2-AUG-80   LF = 4-AUG-80
TF = 1
```

The user can print a report using data from this database by typing a request for a particular report name

PRINT REPORT DP7

The user can design a limitless variety of reports of almost any kind of layout.

The following are examples of the range of reports which can be produced from a CPM database.

Apart from making enquiries and printing reports the user can also input new data, change existing data and run CPM calculations, plot networks and do other things.

WASTE DISPOSAL PLANT

RUN DATE: 1-JUL-79

PREC ACT.	SUCC ACT.	DESCRIPTION	PROJECT SECTION	WORK PACKAGE	DURATION	EARLIEST START	EARLIEST FINISH	LATEST START	LATEST FINISH	TOTAL FLOAT
86	88	COMPLETE REINF BASE TANK S1	S1	2212	6	8-OCT-79	15-OCT-79	23-NOV-79	30-NOV-79	34
18	22	COMPLETE REINF BASE TANK P1	P1	2112	14	8-OCT-79	25-OCT-79	8-OCT-79	25-OCT-79	0
18	20	FORM RING BEAM TANK P1	P1	2113	8	8-OCT-79	17-OCT-79	29-OCT-79	7-NOV-79	15
128	130	STRIKE WALLS (TANK P2)	P2	1415	8	8-OCT-79	17-OCT-79	19-NOV-79	28-NOV-79	30
208	210	STRIKE WALLS DUCT B		1435	2	8-OCT-79	9-OCT-79	18-FEB-80	19-FEB-80	95
256	258	FORM DUCT "A" (TANK P2)	P2	1426	8	8-OCT-79	17-OCT-79	4-DEC-79	13-DEC-79	41
210	212	BACKFILL DUCT B		1437	8	10-OCT-79	19-OCT-79	20-FEB-80	29-FEB-80	95
130	132	FORM (TANK P2) ROOF SOFFIT	P2	1416	8	18-OCT-79	29-OCT-79	29-NOV-79	10-DEC-79	30
130	134	COMMENCE FIX REINF TO ROOF CEN		1416	8	18-OCT-79	29-OCT-79	29-NOV-79	10-DEC-79	30
154	156	CONC RING BEAM TANK P1(1)	P1	2113	2	18-OCT-79	19-OCT-79	8-NOV-79	9-NOV-79	15
260	262	COMPLETE FIX REINF TO ROOF DUC		1426	2	18-OCT-79	19-OCT-79	14-DEC-79	17-DEC-79	41
156	158	STRIKE RB TANK P1(1) AND FORM	P1	2113	3	22-OCT-79	24-OCT-79	12-NOV-79	14-NOV-79	15
262	264	CONC ROOF DUCT A		1426	2	22-OCT-79	23-OCT-79	18-DEC-79	19-DEC-79	41
264	370	DELAY			1	24-OCT-79	24-OCT-79	20-DEC-79	20-DEC-79	41
264	266	DELAY			1	24-OCT-79	24-OCT-79	21-DEC-79	21-DEC-79	42
158	160	CONC RING BEAM TANK P1(2)	P1	2113	2	25-OCT-79	26-OCT-79	15-NOV-79	16-NOV-79	15
370	372	STRIKE FORM SOFFIT DUCT A		1426	2	25-OCT-79	26-OCT-79	21-DEC-79	24-DEC-79	41
266	268	STRIKE FORM ROOF DUCT "A"		1426	2	25-OCT-79	26-OCT-79	24-DEC-79	25-DEC-79	42
22	24	FIX FORM TO CTR BASE TANK P1	P1	2114	10	26-OCT-79	8-NOV-79	26-OCT-79	8-NOV-79	0
160	162	STRIKE FORM RB TANK P1(2)	P1	2113	2	29-OCT-79	30-OCT-79	19-NOV-79	20-NOV-79	15
372	268	DELAY			1	29-OCT-79	29-OCT-79	25-DEC-79	25-DEC-79	41
134	136	COMPLETE FIX REINF TO ROOF CEN		1416	2	30-OCT-79	31-OCT-79	11-DEC-79	12-DEC-79	30
268	270	BACKFILL DUCT A		1427	8	30-OCT-79	8-NOV-79	26-DEC-79	4-JAN-80	41
162	164	FORM RING BEAM TANK S1(1)	S1	2213	8	31-OCT-79	9-NOV-79	27-NOV-79	6-DEC-79	19
136	138	CONC ROOF CENT DUCT		1416	2	1-NOV-79	2-NOV-79	13-DEC-79	14-DEC-79	30
138	358	DELAY			1	5-NOV-79	5-NOV-79	17-DEC-79	17-DEC-79	30
138	140	DELAY			1	5-NOV-79	5-NOV-79	18-DEC-79	18-DEC-79	31
358	360	STRIKE FORM CENT DUCT		1416	2	6-NOV-79	7-NOV-79	18-DEC-79	19-DEC-79	30
140	142	STRIKE FORM CTR DUCT ROOF		1416	2	6-NOV-79	7-NOV-79	19-DEC-79	20-DEC-79	31
360	142	DELAY			1	8-NOV-79	8-NOV-79	20-DEC-79	20-DEC-79	30
24	26	CONC CTR BASE TANK P1	P1	2114	4	9-NOV-79	14-NOV-79	9-NOV-79	14-NOV-79	0
142	144	BACKFILL CENT DUCT		1417	3	9-NOV-79	13-NOV-79	21-DEC-79	25-DEC-79	30
270	374	EXC TRIM & BLIND TANK P2	P2	2122	12	9-NOV-79	26-NOV-79	7-JAN-80	22-JAN-80	41
164	166	CONC RING BEAM TANK S1(1)	S1	2213	2	12-NOV-79	13-NOV-79	7-DEC-79	10-DEC-79	19
144	362	COMMENCE EXC TRIM AND BLIND HH	HH	1451	2	14-NOV-79	15-NOV-79	26-DEC-79	27-DEC-79	30
166	168	STRIKE RB TANK S1(1) AND FORM	S1	2213	3	14-NOV-79	16-NOV-79	11-DEC-79	13-DEC-79	19
26	28	STRIKE FORM CTR BASE TANK P1	P1	2114	4	15-NOV-79	20-NOV-79	15-NOV-79	20-NOV-79	0
362	364	COMPLETE EXC TRIM AND BLIND HH	HH	1451	2	16-NOV-79	19-NOV-79	31-DEC-79	1-JAN-80	31
362	366	COMMENCE REINF BASES E & W DUC		1451	3	16-NOV-79	20-NOV-79	28-DEC-79	1-JAN-80	30
168	170	CONC RING BEAM TANK S1(2)	S1	2213	2	19-NOV-79	20-NOV-79	14-DEC-79	17-DEC-79	19
580	582	COMMENCE EXC TRIM & BLIND HH D	HH	1441	8	20-NOV-79	29-NOV-79	27-FEB-80	7-MAR-80	71
88	90	FIX FORM CTR BASE TANK S1	S1	2214	4	21-NOV-79	26-NOV-79	3-DEC-79	6-DEC-79	8
28	30	FIX SCREED & CONC INCL BASE TA	P1	2115	4	21-NOV-79	26-NOV-79	21-NOV-79	26-NOV-79	0
366	368	COMPLETE REINF BASES E & W DUC		1451	3	21-NOV-79	23-NOV-79	9-JAN-80	11-JAN-80	35

ARTEMIS REPORT RUN DATE : 1-JUL-79 PAGE NO. 1

PROJECT : WASTE DISPOSAL PLANT GENERAL SCHEDULE RESULTS

REPORT SHOWS DETAILS OF MILESTONE EVENTS ONLY

PREC ACT.	ACTIVITY DESCRIPTION	CURRENT EARLY START	CURRENT EARLY FINISH	CURRENT TOTAL FLOAT	ORIGINAL EARLY START	ORIGINAL EARLY FINISH	ORIGINAL TOTAL FLOAT	SLIPPAGE
2	PROJECT START		27-APR-79		23-APR-79	26-APR-79	0	-1
6	START OF SITE WORK		5-JUL-79		28-JUN-79	3-JUL-79	404	-2
235	PILING COMPLETE		30-AUG-79		23-AUG-79	28-AUG-79	364	-2
536	WEST DUCT COMPLETE	19-DEC-79	24-DEC-79	30	13-DEC-79	18-DEC-79	30	-6
534	EAST DUCT COMPLETE	31-DEC-79	3-JAN-80	30	25-DEC-79	28-DEC-79	30	-6
658	SOUTH DUCT COMPLETE	19-MAR-80	24-MAR-80	71	13-MAR-80	18-MAR-80	71	-6
660	NORTH DUCT COMPLETE	5-JUN-80	10-JUN-80	12	30-MAY-80	4-JUN-80	12	-6
926	CONSOLIDATION TANK NO.1 COMPLETE	5-JUN-80	10-JUN-80	163	30-MAY-80	4-JUN-80	163	-6
74	SECONDARY TANK NO.1 COMPLETE	30-JUN-80	3-JUL-80	42	24-JUN-80	27-JUN-80	42	-6
606	PRIMARY TANK NO.1 COMPLETE	25-AUG-80	28-AUG-80	2	19-AUG-80	22-AUG-80	2	-6
994	SECONDARY TANK NO.2 COMPLETE	22-OCT-80	27-OCT-80	64	16-OCT-80	21-OCT-80	64	-6
859	PRIMARY TANK NO.2 COMPLETE	17-DEC-80	22-DEC-80	0	11-DEC-80	16-DEC-80	0	-6
802	HEATER HOUSE COMPLETE	23-DEC-80	26-DEC-80	0	17-DEC-80	22-DEC-80	0	-4
1000	CONSOLIDATION TANK NO.2 COMPLETE	26-JAN-81	29-JAN-81	0	20-JAN-81	23-JAN-81	0	-6
1002	SITE WORK COMPLETE	5-FEB-81	10-FEB-81	0	30-JAN-81	4-FEB-81	0	-6

PRODUCED BY METIER/ARTEMIS

PROJECT : INTERNET PROJECT

SECTION : CRANE

BAR CHART SHOWS THE ORIGINAL AND CURRENT SCHEDULE FOR ALL ACTIVITIES WHOSE CURRENT EARLY START BEFORE 15-JAN-79
CRITICAL ACTIVITIES ARE SHOWN WITH THE SYMBOL C

PREC ACT.	SUCC ACT.	ACTIVITY DESCRITPTION	7.AUG.78	4.SEP.78	2.OCT.78	30.OCT.78	27.NOV.78	25.DEC.78
536	538	COMMENCE EXTEND TCRANE TRACK 1		**- -XXX				
538	540	CONTINUE EXTEND CRANE TRACK 1		**- --CC				
540	498	COMPLETE EXTEND CRANE TRACK 1		* **--C	CC			
498	500	EXTEND CRANE TRACK 2		***	***XX XXX			
560	562	TAKE UP CRANE TRACK SECTION 1				* ****X XXX		

SECTION : HEATER HOUSE

BAR CHART SHOWS THE ORIGINAL AND CURRENT SCHEDULE FOR ALL ACTIVITIES WHOSE CURRENT EARLY START BEFORE 15-JAN-79
CRITICAL ACTIVITIES ARE SHOWN WITH THE SYMBOL C

PREC ACT.	SUCC ACT.	ACTIVITY DESCRITPTION	7.AUG.78	4.SEP.78	2.OCT.78	30.OCT.78	27.NOV.78	25.DEC.78
596	598	COMMENCE STRIKE BASE N DUCT AND FORM		*** *XXX				
598	608	COMPLETE STRIKE BASE N DUCT AND FORM		**-XX				
608	620	COMMENCE REINF WALLS N DUCT		***X XX				
612	614	STRIKE BASE S DUCT		*- X				
614	616	COMMENCE REINF WALLS S DUCT		* *XX				
620	622	COMPLETE REINF WALS N DUCT		** *XXX				
616	618	COMPLETE REINF WALLS S DUCT		***X X				
660	662	BLIND HH FLOOR SLAB				* **-XX X		
662	670	COMMENCE REINF HH FLOOR SLAB				*** -XXX		
670	664	COMPLETE REINF HH FLOOR SLAB				***** XXXX		
666	668	HH PLINTHS					***** ***** ***** XXXX	
668	802	HH SUPER STRUCT. FRAME					*****	*** **** ***** ***** **

SECTION : PRIMARY DIGESTION TANK NO.2

BAR CHART SHOWS THE ORIGINAL AND CURRENT SCHEDULE FOR ALL ACTIVITIES WHOSE CURRENT EARLY START BEFORE 15-JAN-79
CRITICAL ACTIVITIES ARE SHOWN WITH THE SYMBOL C

PREC ACT.	SUCC ACT.	ACTIVITY DESCRITPTION	7.AUG.78	4.SEP.78	2.OCT.78	30.OCT.78	27.NOV.78	25.DEC.78
270	374	COMMENCE EXC TRIM AND BLIND P2 AND S2	**	***** XXX				
374	378	COMMENCE CUT DOWN PILES AND REINF P2		* ***XX X				
378	382	COMMENCE REINF BASE P2		***** XXX				
378	380	COMPLETE CUT DOWN PILES AND REINF P2		****X XX				
382	388	FORM RING BEAM P2(1)		* **XXX				
382	384	COMPLETE REINF BASE P2		* ***XX X				
632	634	CONC WALLS N DUCT P2		*-X				

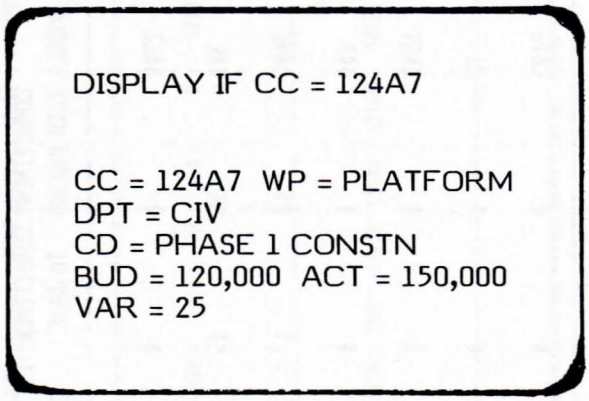
LEGEND : '*' FROM ORIGINAL EARLY START TO ORIGINAL EARLY FINISH : ' - ' FROM ORIGINAL EARLY FINISH TO CURRENT EARLY START : ' X ' FROM CURRENT EARLY START TO EARLY FINISH
'C' DENOTES A CRITICAL ACTIVITIY

COSTS

The database might also carry data about a few thousands cost records. Over-simplified, the contents of each record might include the fields shown below. Note that the content and layout of the data, including field names, is determined by the user:-

CC - Cost Code
WP - Work Package Number
DPT - Department
CD - Description
BUD - Budgeted Cost
ACT - Actual Cost
VAR - Variance Percentage

Then an enquiry about Cost Code 124A7 would get the response:-



In practice, the costs portion of a database is always a good deal more complex and contains information about work breakdown structure, scope changes, etc.

Again, any number of different reports may be derived from the database - such as the following examples - and the user may input new data, change existing data, run calculations, etc.

MMS SUMMARY COST ANALYSIS REPORT

PROJECT - METIER MATERIAL COSTING DEMONSTARTION

ALL COSTS IN THOUSAND POUNDS

AFE NO & TITLE: 8701 - SECTION 1 OF MAIN CONTRACT

MONTH ENDING - 31-OCT-78

SUB CODE	DESCRIPTION	BUDGET	COMMITTMENT THIS PERIOD	COMMITTMENT TO DATE	ESTIMATE TO COMPLETE	FORECAST	VARIANCE	CHANGE IN VARIANCE	REMARKS
10	DESIGN AND ENGINEERING	2500	0	0	701	701	1799	1799	
20	PROCESS EQUIPMENT	301	15	15	90	105	196	196	
40	MATERIALS	2690	12	12	458	470	2220	2220	
50	CONSTRUCTION	600	0	0	158	158	442	442	
70	CONSTRUCTION SUPPORT SERVICES	1540	0	0	558	558	982	982	
80	OTHER COSTS	92	0	0	16	16	76	76	
90	CONTINGENCY	5172	0	0	922	922	4250	4250	
	GRAND TOTAL:	12895	27	27	2903	2930	9965	9965	

(REPORT WAS PRODUCED ON 27-OCT-78)

PRODUCED BY METIER MANAGEMENT SYSTEMS USING ARTEMIS

METIER MANAGEMENT SYSTEMS

DEVELOPMENT COST PLAN

BY DEPARTMENT

DEPT	DESCRIPTION	MONTHLY LABOUR MAN WEEKS	MONTHLY LABOUR COST $	WEEKLY LABOUR WH5 MAN HOURS	WH5 COST $	WH8 MAN HOURS	WH8 COST $	WH10 MAN HOURS	WH10 COST $	TOTAL COST $	MAT'LS $	OTHER COSTS $	OVERALL TOTAL COST $
X1	X1	0	0	9960	19920	16320	26520	12120	18180	64620	158025	EQP 18900 SUB 765000	1006545
X2	X2	285	33992	3600	7200	0	0	0	0	7200	0	EQP 24231 SUB 0	65423
X3	X3	57	6577	9960	19920	9360	15210	11400	17100	52230	30435	EQP 22050 SUB 0	111292
	TOTAL	342	40569	23520	47040	25680	41730	23520	35280	124050	188460	EQP 65181 SUB 765000	1183260

EQP = EQUIPMENT

SUB = SUB-CONTRACTORS

PROJECT : WEAPON SYSTEM — 30-MAY-79

APRIL 1981 / MARCH 1982 — TABLE : 3

TASK REF. NO.	TASK DESCRIPTION	MAN POWER MAN/YEARS ENG. LOW O/HD	STAFF HIGH O/HD	WORKS HIGH O/HD	COST INCLUD OVERHEAD ENG. LOW O/HD	STAFF HIGH O/HD	WORK HIGH O/HD	DIRECT CHARGES (IN POUNDS) SUB CONTRACT	MATERIAL & BOF	COMPUTER CHARGES	GENERAL EXPENSES	TOTAL
11	AIRFRAME	0.75	0.00	0.00	11377	0	0	0	0	0	225	11602
12	DESIGN INST'N	0.13	0.00	0.00	2138	0	0	0	0	0	0	2138
13	TRIALS	0.00	3.50	0.38	0	115017	10046	0	1150	0	7300	133513
21	CONTROL COMPUTER	0.34	0.00	0.00	5792	0	0	0	500	0	0	6292
22	WEAPON SYSTEM	1.75	0.00	0.63	30000	0	16744	0	0	0	500	47244
31	D.A.T.E.	0.83	0.00	0.00	14279	0	0	0	0	0	0	14279
32	PACKAGING & HANDLING	0.38	0.00	0.00	5684	0	0	0	0	0	0	5684
33	SHIP SYST LOGISTICS	0.44	0.00	0.00	5132	0	0	0	0	0	0	5132
34	ARMAMENT SUPPLY	0.88	0.00	0.00	10270	0	0	0	0	0	25	10295
41	HANDBOOKS	4.75	0.19	0.00	64684	6149	0	3000	0	0	0	73832
42	MODELLING	0.25	0.00	0.00	3506	0	0	0	0	500	0	4006
51	P.M.MISSILE	2.75	0.00	0.00	50143	0	0	0	0	0	1400	51543
52	P.M.SHIP SYSTEM	1.75	0.00	0.00	31909	0	0	0	0	0	700	32609
53	SUPPORT SERVICES	1.41	0.00	0.00	16771	0	0	0	0	800	150	17721
	TOTAL	16.39	3.69	1.00	251684	121166	26790	3000	1650	1300	10300	415890

MATERIALS

A very simple materials section of the database might contain records including the following fields:-

MC - Material Code
MD - Description
SUP - Supplier#
QY - Quantity
DRS - Date Required on site
OD - Order Date
PO - Purchase Order Number

And an enquiry about one of these items would give:-

```
DISPLAY IF MC = 104AD

MC  = 104AD
MD  = CABLE
SUP = 2243
QY  = 400
DRS = 5-NOV-79
OD  = 5-SEP-79
```

A practical materials application will generally hold 10 times as much information as this simple example, of course. A couple of rather more realistic sample reports printed from materials data follow.

MMS

OUTSTANDING PURCHASE ORDERS

(ALL ORDERS ARE SORTED FIRST BY AFE NUMBER
THEN BY DATE ORDERED AND ORDER NUMBER
THE ORDERS PRINTED BELOW REPRESENT ALL ORDERS WHICH HAVE NO YET BEEN DELIVERED)

PROJECT - METIER MATERIAL COSTING DEMONSTRATION

AFE NO & TITLE - 8701 - SECTION 1 OF MAIN CONTRACT

ORDER NUMBER	COST CODE	SUPPLIER NUMBER	SUPPLIER NAME	ORDERED DATE	MATERIAL REFERNCE	MATERIAL DELIVER	QUANTITY
1037	7303	110	FORD	2.JUL.78	RUR	10.JUL.78	1
					RTY456	10.AUG.78	1
					REU789	25.AUG.78	1
					REB789	30.AUG.78	1
					RED378	10.AUG.78	1
					RFY789		1
					DEF790		1
					RGY905		1
					FTY563		1
					RUI890		1
1030	4102	105	HIRE A CRANE	2.SEP.78	HT341		1
1042	4203	110	FORD	5.SEP.78	T3456	26.SEP.78	0
					T5678		1
					R4567		2
1032	4504	110	FORD	16.SEP.78	FR519		2
7202	7202	110	FORD	1.OCT.78			
7314	7304	110	FORD	1.OCT.78	4120	12.OCT.78	1
					41310	14.OCT.78	1
					4140		3
					41510		2
7510	7403			1.OCT.78	21415	21.OCT.78	1
					21515		2
1031	4201	109	MATERIALS LTD	2.OCT.78	F5671		1
					R5134		1
					R5671		1
1026	2304	109	MATERIALS LTD	6.OCT.78	MT1214		1
					MT3145		1
1025	2301	108	EHV ELECTRICS	7.OCT.78	MT712		1
5120	2510	110	FORD	11.OCT.78	41210		1

PROJECT : INTERNET PROJECT

COST ANALYSIS REPORT

PERIOD BEGINS	1ST CASE NO DELAY PAYMENTS	REVENUE	P.V. PAYMENTS	P.V. REVENUE	I	2ND CASE 1 MONTH DELAY PAYMENTS	REVENUE	P.V. PAYMENTS	P.V. REVENUE
1.MAY.77	1700009	0	1679609	0	I	0	0	0	0
1.JUN.77	2296986	0	2244155	0	I	2154203	0	2104657	0
1.JUL.77	2875118	0	2774489	0	I	2615234	0	2523701	0
1.AUG.77	1086521	0	1035455	0	I	2379795	0	2267945	0
1.SEP.77	1008843	0	951339	0	I	1037210	0	978089	0
1.OCT.77	1062035	0	988755	0	I	1034883	0	963476	0
1.NOV.77	949488	0	873529	0	I	915581	0	842334	0
1.DEC.77	0	0	0	0	I	842094	0	765464	0
1.JAN.78	0	0	0	0	I	0	0	0	0
1.FEB.78	0	28333	0	24848	I	0	0	0	0
1.MAR.78	0	66667	0	57800	I	0	0	0	0
1.APR.78	0	76667	0	65627	I	0	31667	0	27455
1.MAY.78	0	478333	0	404670	I	0	76667	0	65627
1.JUN.78	0	1216667	0	1017133	I	0	73333	0	62040
1.JUL.78	0	3833333	0	3166334	I	0	535000	0	447260
1.AUG.78	0	6000000	0	4896000	I	0	1816667	0	1500567
1.SEP.78	0	0	0	0	I	0	3500000	0	2856000
1.OCT.78	0	0	0	0	I	0	5666667	0	4567334
GROSS TOTALS AND NET PRESENT VALUES	10979000	11700000	10547331	9632412	I	10979000	11700000	10445665	9526282

GROSS PROFIT OR LOSS : CASE 1 : 721000
: CASE 2 : 721000

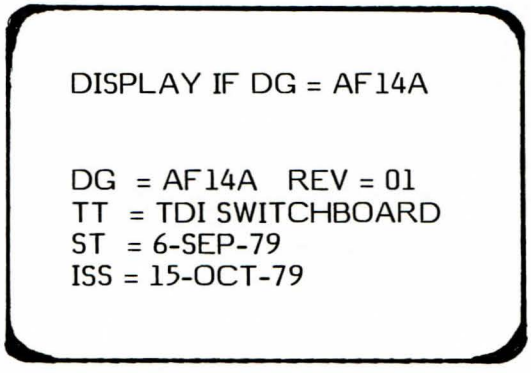
NET NET PRESENT VALUE : CASE 1 : -914919
: CASE 2 : -919383

DRAWINGS, etc.

Another part of the database might be given over to drawings. A simplified view of the contents of each record might include:-

DG - Drawing#
RGV - Revision#
TT - Title
JOB - Job #
ST - Start Date
ISS - Issue Date

And an enquiry would give:-



Some example reports from drawings data follow.

Again, the user can perform a variety of other operations on the drawings data, including inputting new data, making changes, calculating manhours required and progress, etc.

The database can go on to contain data about vendors, job lists, progress, plant, etc.

NCCM - DRAWING SCHEDULE

WORK IN PROGRESS

C-300-600-000 CLAMP FABRICATION PLANNED START 2-JAN-79

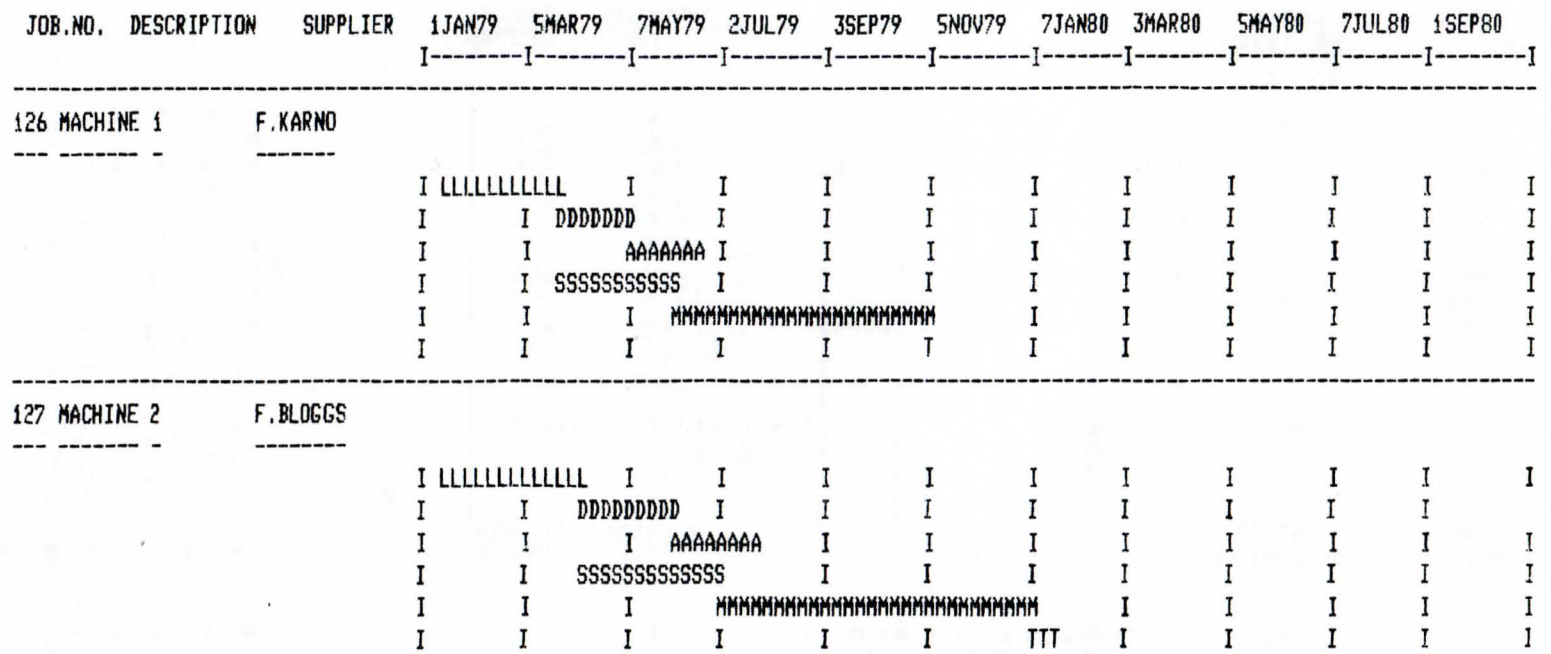
DRAWING NUMBER	LATEST REVISION	TITLE	DRAWING TYPE	DRAWING DESIGN	MILESTONE
A03	02	REAGENT PLANT	X	E	A * A * A C *
A04	01	TAILINGS RECLAMATION	X	E	A D * B
A05	01	TAILINGS RECLAMATION TD2	X	E	A D * B
A06	00	LOAD SUMMARY	X	E	A C D
A07	00	MUNTIMPA AREA	X	E	A C D
A08	00	WORKSHOP	X	E	A C D
B01	00	TD1 SWITCHBOARD	D	E	A
B02	00	TD2 SWITCHBOARD	D	E	A
B03	00	RECLAIM MCC1 SWITCHBOARD	D	E	A

C-300-600-001 TANK FABRICATION PLANNED START 9-JAN-79

DRAWING NUMBER	LATEST REVISION	TITLE	DRAWING TYPE	DRAWING DESIGN	MILESTONE
A01	01	INSTRUMENT PIPING ROUTINE	G	I	A C * C C
A03	00	INSTRUMENT CABLE ROUTING-UPPER	G	I	A
A04	00	INSTRUMENT CABLE ROUTING	G	I	A
A05	00	CABLE ROUTING CCD1	G	I	A C
A06	00	CABLE ROUTING CCD2	G	I	A C
A07	01	CABLE ROUTING BACKGROUND	G	I	A C * C
A08	00	CABLE RACKING CCD1 UNDERFLOW	I	I	A C D
A09	00	CABLE RACKING CCD1 PIPE TRACK	I	I	A C D
A10	00	CABLE RACKING CCD1 RAKE ARM	I	I	A C D
A11	00	CABLE RACKING CCD2 UNDERFLOW	I	I	A C D
A12	00	CABLE RACKING CCD2 PIPE TRACK	I	I	A C D
A13	00	CABLE RACKING CCD2 RAKE ARM	I	I	A C D

METIER ENGINEERING CO. LTD. SHEET NO. 1

CONTRACT NO:-Z999 CUSTOMER:-A.B.C. PRODUCERS LTD TARGET COMPLETION:-16-JUN-79



LEGEND: LLL - LAYOUT DRAWINGS SSS - ENQUIRY/ORDER
DDD - DETAIL DRAWINGS MMM - MANUFACTURE & ASSEMBLY
AAA - ARRANGEMENT DRAWINGS TTT - DELIVERY

ISSUES TO CUSTOMERS REPORT

C-300-600-000 A03 02 REAGENT PLANT

	ISSUED TO	NO OF COPIES	ISSUE DATE
1000 C S D ENGINEERING - BARNSLEY	MR F B HARLAND	1	23-APR-78
3000 A B TAYLOR - BASINGSTOKE	MR M K PORTLOCK	2	23-FEB-78
3000 A B TAYLOR - BASINGSTOKE	MR M K PORTLOCK	1	5-DEC-78
4000 FROST WYNARDE - EDMONTON	J L STILLWELL TEL 96	1	13-DEC-78
4000 FROST WYNARDE - EDMONTON	J L STILLWELL TEL 96	3	12-JAN-78

C-300-600-000 A06 00 LOAD SUMMARY

	ISSUED TO	NO OF COPIES	ISSUE DATE
2000 W L P U - ALDERSHOT	MR G S STONE	1	20-APR-79
3000 A B TAYLOR - BASINGSTOKE	MR M K PORTLOCK	1	23-FEB-78
5000 FINCH & PARTNERS - LUSAKA	MR B RANGER	1	13-FEB-79
5000 FINCH & PARTNERS - LUSAKA	MR B RANGER	1	23-FEB-79

C-300-600-000 A08 00 WORKSHOP

	ISSUED TO	NO OF COPIES	ISSUE DATE
5000 FINCH & PARTNERS - LUSAKA	MR B RANGER	1	13-FEB-79

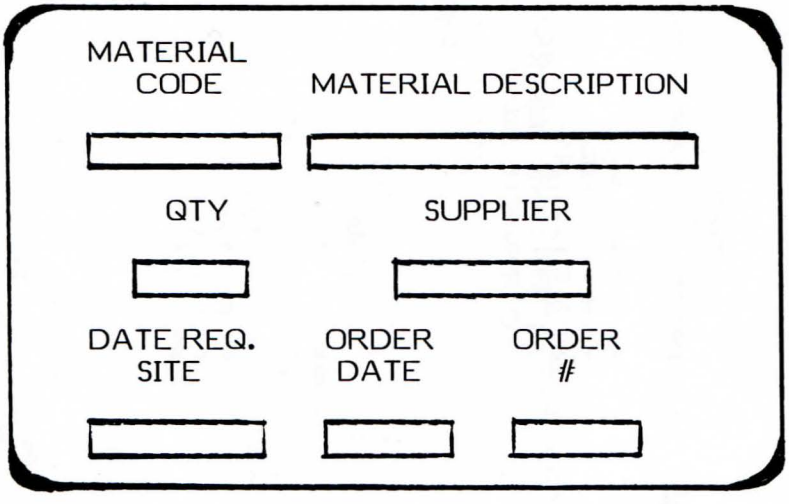
C-300-600-000 B02 00 TD2 SWITCHBOARD

	ISSUED TO	NO OF COPIES	ISSUE DATE
2000 W L P U - ALDERSHOT	T M HARVEY	2	13-JAN-79
3000 A B TAYLOR - BASINGSTOKE	MR M K PORTLOCK	1	13-MAR-79

SECTION 6 - INPUT & OUTPUT

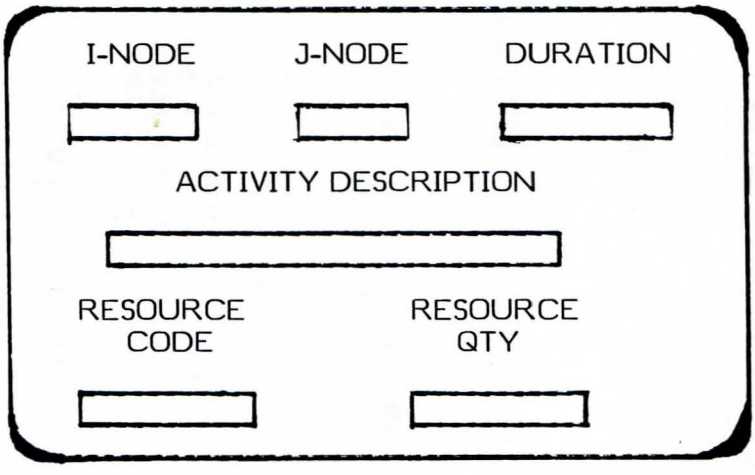
DATA INPUT

Entering data into the database is most commonly done through the CRT keyboard. The user can "fill up the form" on the screen, entering for example material items:-



and the data will be entered directly into the database. Automatic checking is carried out at the time of entry so that many errors are detected and corrected there and then.

The user can select within seconds an alternative form to fill up, say for entering CPM data:-



The user can also design new formats or change existing ones in minutes. Apart from the "FILL-IN-THE-FORM" mode of input the user also has the choice of other modes of input - in particular an "unprompted" mode which can save 20% or more keystrokes on inputting many kinds of data.

In addition, data can be input from cards, paper tape, magnetic tape or cassette tapes. Magnetic tape is used frequently to transfer data from existing systems to **ARTEMIS.**

WHAT -------?

The very nature of project management entails constant questions:-

"What can we do to limit cash expenditure to $4 million up to September?"

"We're a crew short. What welding jobs are scheduled next week?"

"The steelfixers' productivity is down 20%. What effect will it have if it continues?"

Almost any kind of query can be directed at the database either as a DISPLAY IF or a PRINT IF command. For example:

"What valves are we waiting on for sub-station 12?"

becomes

DISPLAY IF MATERIAL CONTAINS VALVE AND WP = SS12
AND DELIVERY ABSENT

while

"Which major items for subcontractor Brown are heavily over-budget?"

becomes

PRINT IF BUD = 50,000 AND SC = BROWN AND VARIANCE 20

and

"What lifting jobs are due to start in October in site areas AP1, AP2 and AP3?"

becomes

DISPLAY IF RES IS CRANE AND ES AFTER 1-OCT-79
AND AREA BEGINS AP

Each of these queries will yield all the information on all the records meeting the particular question. The results are displayed or printed more or less immediately and can be sorted and formatted for output if required. Any field (numeric, date or alphabetic) can be searched individually or in any combination (up to 10 conditions at one time).

PRINT and DISPLAY are interchangeable and the user can obtain both a screen display and a hard copy at the same time if he wishes.

STANDARD REPORTS

So far we've mentioned that reports can be printed from the database and given a few examples. Each report is printed according to a **specification.**

Typically, the user (or Metier if desired) will set up a library of twenty or more standard report specifications covering all the routine and commonly used kinds of output required. To produce one of these reports then involves no more than typing:-

PRINT REPORT WEEK1

where "WEEK1" is the name given to a particular report specification by a user.

It should be made clear that there are no standard reports issued as such to all users by Metier. Each set of standard reports is unique to a user or specific project. Metier does however maintain a library of "model" reports to help the user design his own in an easy and speedy fashion.

An example of the practical orientation behind **ARTEMIS** is the recognition that access to a reducing photocopier is frequently difficult in the project environment. Use of a "compact print" facility on the printer allows most reports to be printed on a page size which can be reproduced on a standard $8\frac{1}{2}$" x 11" photocopier without reduction. An example, unreduced, is given overleaf.

The same compact print feature can be used on regular computer printout to produce extra wide reports in all their 230 column wide glory. An example (photoreduced of course) follows.

And just for good measure you'll notice that some of the sample reports elsewhere in this book use "enlarged" print to emphasize titles, etc.

COSTING OF WORK PACKAGES

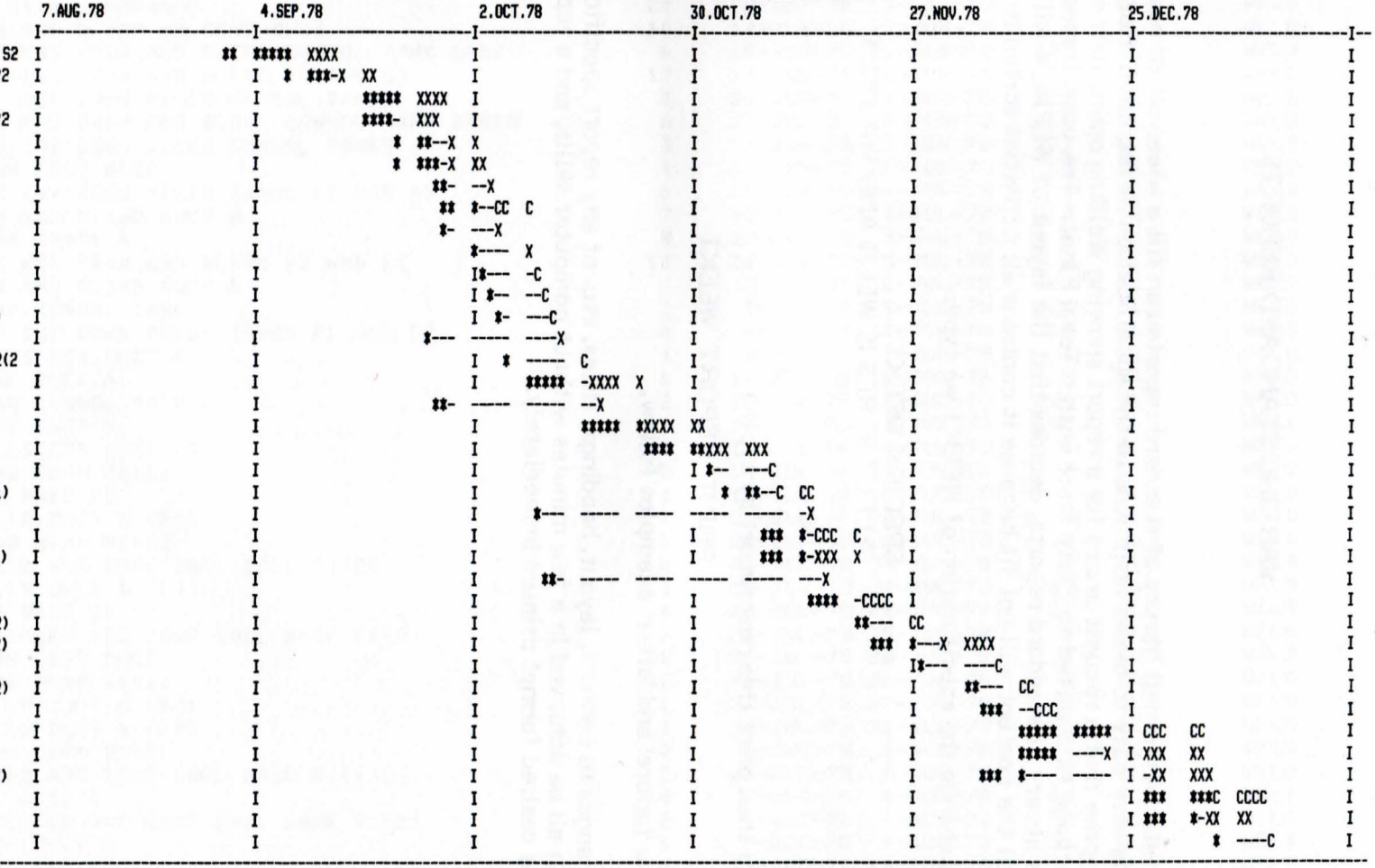
WORK PACKAGE			TIME STATUS		COST STATUS								
BEGIN EVENT NO.	END EVENT NO.	WORK PACKAGE NO.	PLANNED COMPLETION DATE	FLOAT (WEEKS)	MONTHLY LABOUR	WH5	WH8	WH10	WEEKLY LABOUR	TOTAL LABOUR	MAT'L COSTS	OTHER COSTS	TOTAL COST
6	16	X11A	28:JUL:80	6	0	1440	0	2160	3600	3600	10000	32100	45700
16	18	X11B	20:OCT:80	6	0	2880	0	4320	7200	7200	8000	64200	79401
18	20	X11C	22:DEC:80	6	0	2160	0	2160	4320	4320	1000	48150	53470
20	22	X11D	16:MAR:81	0	0	1440	0	1440	2880	2880	2000	32100	36980
22	24	X11E	29:JUN:81	0	0	3600	0	3600	7200	7200	2850	80250	90300
8	18	X11F	29:SEP:80	9	0	480	1950	0	2430	2430	22500	32100	57031
6	26	X12A	20:OCT:80	0	0	1440	5850	0	7290	7290	675	90000	97965
26	28	X12B	12:JAN:81	0	0	960	3120	0	4080	4080	24000	60000	88080
26	10	X12C	2:FEB:81	0	0	1200	0	4500	5700	5700	60000	75000	140700
28	30	X12D	23:FEB:81	0	0	480	1560	0	2040	2040	12000	30000	44041
30	34	X12E	6:APR:81	0	0	480	1950	0	2430	2430	8250	30000	40680
34	42	X12F	21:SEP:81	12	0	1920	6240	0	8160	8160	4500	120000	132660
34	14	X12G	10:AUG:81	0	0	1440	5850	0	7290	7290	2250	90000	99540
2	4	X21A	14:APR:80	0	5885	1200	0	0	1200	7085	0	3462	10546
4	6	X21B	16:JUN:80	0	3531	720	0	0	720	4251	0	2077	6328
24	36	X21C	31:AUG:81	0	3115	720	0	0	720	3835	0	2077	5912
14	36	X21D	31:AUG:81	0	1038	240	0	0	240	1278	0	692	1971
36	38	X21E	4:JAN:82	0	4154	1440	0	0	1440	5594	0	4154	9748
38	40	X21F	21:JUN:82	0	8308	1920	0	0	1920	10228	0	5538	15766
42	44	X21G	4:JAN:82	12	5192	0	0	0	0	5192	0	3462	8654
44	40	X21H	29:MAR:82	12	2769	960	0	0	960	3729	0	2769	6498
6	32	X31A	12:JAN:81	6	0	0	3900	7200	11100	11100	3800	10500	25400
32	46	X31B	20:JUL:81	6	0	0	3510	8100	11610	11610	6000	9450	27060
46	48	X31C	31:AUG:81	6	0	0	780	1800	2580	2580	12450	2100	17130
48	40	X31D	10:MAY:82	6	0	0	7020	0	7020	7020	2250	0	9270
6	8	X32A	18:AUG:80	3	1038	2880	0	0	2880	3918	1540	0	5458
8	10	X32B	12:JAN:81	3	2423	8400	0	0	8400	10823	1350	0	12173
10	12	X32C	27:APR:81	0	1385	3840	0	0	3840	5225	1470	0	6695
12	14	X32D	10:AUG:81	0	1731	4800	0	0	4800	6531	1575	0	8106

PROJECT : INTERNET PROJECT

SECTION : PRIMARY DIGESTION TANK NO.2

PREC ACT.	SUCC ACT.	ACTIVITY DESCRIPTION
270	374	COMMENCE EXC TRIM AND BLIND P2 AND S2
374	378	COMMENCE CUT DOWN PILES AND REINF P2
378	382	COMMENCE REINF BASE P2
378	380	COMPLETE CUT DOWN PILES AND REINF P2
382	388	FORM RING BEAM P2(1)
382	384	COMPLETE REINF BASE P2
384	386	FIX FORM CENTRE BASE P2
880	882	STRIKE RB P2(1) AND FRORM RB P2(2)
860	862	CONC CTR BASE P2
864	866	STRIKE FORM CTR BASE P2
882	884	CONC RB P2(2)
884	886	STRIKE FORM RB P2
886	888	FIX SCREED AND CONC INCL BASE P2(1)
632	634	CONC WALLS N DUCT P2
888	890	STRIKE SCREED AND CONC INCL BASE P2(2
890	892	FIX SCAFFOLD WALLS P2(1)
636	638	STRIKE WALLS N DUCT (P2)
892	894	REINF WALLS P2(1)
894	896	FIX FORM WALLS P2(1)
896	898	CONC WALLS P2(1)
970	972	COMMENCE STRIKE P2(1) AND FORM S2(1)
649	652	CONC WALLS S DUCT P2
972	996	FIX SCAFFOLD P2(2)
972	974	COMPLETE STRIKE P2(1) AND FORM S2(1)
654	656	STRIKE WALLS S DUCT P2
996	976	REINF WALLS P2(2)
976	978	COMMENCE STRIKE S2(1) AND FORM P2(2)
978	980	COMPLETE STRIKE S2(1) AND FORM P2(2)
980	982	CONC WALLS P2(2)
982	984	COMMENCE STRIKE P2(2) AND FORM S2(2)
984	840	COMMENCE FIX SCAFFOLD P2 ROOF
844	846	COMMENCE FORM ROOF P2
840	842	COMPLETE FIX SCAFFOLD P2 ROOF
984	986	COMPLETE STRIKE P2(2) AND FORM S2(2)
846	848	COMPLETE FORM ROOF P2
846	850	FIX REINF TO ROOF P2
848	852	CONC ROOF P2

BAR CHART SHOWS THE ORIGINAL AND CURRENT SCHEDULE FOR ALL ACTIVITIES WHOSE CURRENT EARLY START BEFORE 15-JAN-79
CRITICAL ACTIVITIES ARE SHOWN WITH THE SYMBOL C



LEGEND : '*' FROM ORIGINAL EARLY START TO ORIGINAL EARLY FINISH : ' - ' FROM ORIGINAL EARLY FINISH TO CURRENT EARLY START : ' X ' FROM CURRENT EARLY START TO EARLY FINISH
'C' DENOTES A CRITICAL ACTIVITIY

PRODUCED BY METIER MANAGEMENT SYSTEMS
*

VARYING STANDARD REPORTS

A relatively small library of standard reports can fill a wider set of needs because it is very easy to make variations to the specification as required. For example, suppose that a request arises for a report showing Welding operations on Work Package GL3 sorted to Early Start within Total Float. The user, inspecting his library of standard reports, decides that the **layout** of WEEKLY will do but that the **content** will not fit because it contains all activities sorted by department.

To change the specification of WEEK1 we type:-

```
SPECIFY WEEK1
SELECT IF RES IS WELD AND WP = GL3
ORDER ES, TF
END
```

and then print this new report by typing

```
PRINT REPORT WEEK1
```

The 'before' and 'after' examples follow.

Changes to content, layout, headings, titles, etc. of any report specification can all be achieved in a few minutes without computer skills, and a report in the desired format printed immediately.

WEEKLY ACTIVITY SCHEDULE

28-JUN-79

PREC. EVENT	SUCC. EVENT	DESCRIPTION	DURATION	PLANNED START	PLANNED FINISH	TOTAL FLOAT	WORK PACKAGE	RESOURCE CODE
4	8	GENERAL SITE CLEARANCE	20	2-MAY-78	15-MAY-78	0	GL3	WELD
98	100	EXC TRIM AND BLIND HH CENT DUCT	10	14-JUN-78	20-JUN-78	1	GL3	WELD
234	236	COMMENCE EXC TRIM AND BLIND CONSOL TANK BASES	6	19-JUN-78	21-JUN-78	224	GL3	WELD
12	14	COMMENCE EXC TRIM AND BLIND P1 AND S1	12	19-JUN-78	26-JUN-78	2	GL3	WELD
236	272	COMMENCE CUT DOWN PILES CONSOL TANKS	3	22-JUN-78	23-JUN-78	227	GL3	WELD
236	238	COMPLETE EXC TRIM AND BLIND CONSOL TANK BASES	6	22-JUN-78	26-JUN-78	224	GL3	WELD
272	274	COMPLETE CUT DOWN PILES CONSOL TANKS	3	27-JUN-78	28-JUN-78	227	GL3	WELD
104	106	CONC BASE CENT DUCT	1	27-JUN-78	27-JUN-78	1	GL3	WELD
14	16	COMMENCE CUT DOWN PILES TANKS P1 AND S1	6	28-JUN-78	30-JUN-78	6	GL3	WELD
214	216	EXC TRIM AND BLIND DUCT A	7	28-JUN-78	3-JUL-78	3	GL3	WELD
150	152	LAY CRANE TRACK A	8	28-JUN-78	3-JUL-78	6	GL3	WELD
14	96	COMPLETE EXC TRIM AND BLIND P1 AND S1	12	28-JUN-78	5-JUL-78	0	GL3	WELD
216	218	EXC TRIM AND BLIND DUCT B	7	3-JUL-78	6-JUL-78	62	GL3	WELD
280	282	CONC BASE COBSOL TANK 1	2	5-JUL-78	5-JUL-78	224	GL3	WELD
16	84	COMPLETE CUT DOWN PILES TANKS P1 AND S2	6	6-JUL-78	10-JUL-78	10	GL3	WELD
116	118	CONC WALLS CTR DUCT P1	1	7-JUL-78	7-JUL-78	1	GL3	WELD
184	186	CONC BASE DUCT A	1	10-JUL-78	10-JUL-78	3	GL3	WELD
286	288	CONC BASE CONSOL TANK 2	2	12-JUL-78	12-JUL-78	224	GL3	WELD
222	224	CONC BASE DUCT B	1	13-JUL-78	13-JUL-78	62	GL3	WELD
124	126	CONC WALLS CTR DUCT P2	1	14-JUL-78	14-JUL-78	1	GL3	WELD
154	156	CONC RING BEAM P1(1)	2	14-JUL-78	14-JUL-78	0	GL3	WELD
24	26	CONC CTR BASE P1	1	18-JUL-78	18-JUL-78	6	GL3	WELD
242	244	CONC WALLS DUCT A (P1)	1	20-JUL-78	20-JUL-78	3	GL3	WELD
158	160	CONC RING BEAM P1(2)	2	20-JUL-78	20-JUL-78	0	GL3	WELD
28	30	FIX SCREED AND CONC INCL BASE P1(2)	2	24-JUL-78	24-JUL-78	0	GL3	WELD
196	198	CONC WALLS DUCT B (P1)	1	24-JUL-78	24-JUL-78	62	GL3	WELD
90	92	CONC CTR BASE S1	1	25-JUL-78	25-JUL-78	12	GL3	WELD
30	32	STRIKE SCREED AND CONC INCL BASE P1(2)	2	25-JUL-78	25-JUL-78	0	GL3	WELD
136	138	CONC ROOF CENT DUCT	1	26-JUL-78	26-JUL-78	0	GL3	WELD
164	166	CONC RING BEAM S1(1)	2	26-JUL-78	26-JUL-78	2	GL3	WELD
250	252	CONC WALLS DUCT A (P2)	1	27-JUL-78	27-JUL-78	3	GL3	WELD
204	206	CONC WALLS DUCT B (P2)	1	31-JUL-78	31-JUL-78	62	GL3	WELD
168	170	CONC RING BEAM S1(2)	2	1-AUG-78	1-AUG-78	2	GL3	WELD
172	174	FIX SCREED AND CONC INCL BASE S1(1)	2	3-AUG-78	3-AUG-78	2	GL3	WELD
210	212	BACKFILL DUCT B	4	3-AUG-78	4-AUG-78	62	GL3	WELD
174	176	STRIKE SCREED AND CONC INCL BASE S1(2)	2	4-AUG-78	4-AUG-78	2	GL3	WELD
262	264	CONC ROOF DUCT A	1	7-AUG-78	7-AUG-78	1	GL3	WELD
142	144	BACKFILL CENT DUCT	6	10-AUG-78	14-AUG-78	0	GL3	WELD

NEW REPORTS

Each report specification is written in a fairly natural English way using an extension of the **ARTEMIS** command language examples given so far. Learning to write report specifications takes a cost/scheduling engineer about one day and involves no prior knowledge of computing. Producing a new report specification (and getting it right!) might take anywhere from a few minutes to a few hours, depending on the complexity of the report and the experience of the user.

For example, to produce the following report R1 involves the specification below:-

```
SPECIFY R1
NETWORK REPORT
LENGTH 60
WIDTH 132
SPACE 0
TITLE
     SKIP 2
     "ACTIVITY SCHEDULE", 63" ", "PAGE", NUMBER
     UNDERLINE =
     SKIP 1
     DATE
     UNDERLINE =
     SKIP 2
     HEADINGS
     UNDERLINE -
     SKIP 1
     END
HEADINGS
     AD /DESCRIPTION
     PE PREC./EVENT
     SE SUCC./EVENT
     DU / DURATION
     ES PLANNED/START
     EF PLANNED/FINISH
     TF TOTAL/FLOAT
     END
FIELDS PE SE AD DU ES EF TF
ORDER ES
SELECT IF ES BEFORE 8-JUL-78 AND DU    0
FORMAT
     AD 50#
     DU 3" ", 2#, 3" "
     TF 5#
     DAT DD-MMM-YY
     CODES 4#, 2" "
     END
END
```

Not shown in this example are facilities for producing bar charts, histograms and graphs, carrying out calculations and totalling, footnotes, sectioning of reports, etc.

ACTIVITY SCHEDULE PAGE 1

28-JUN-79

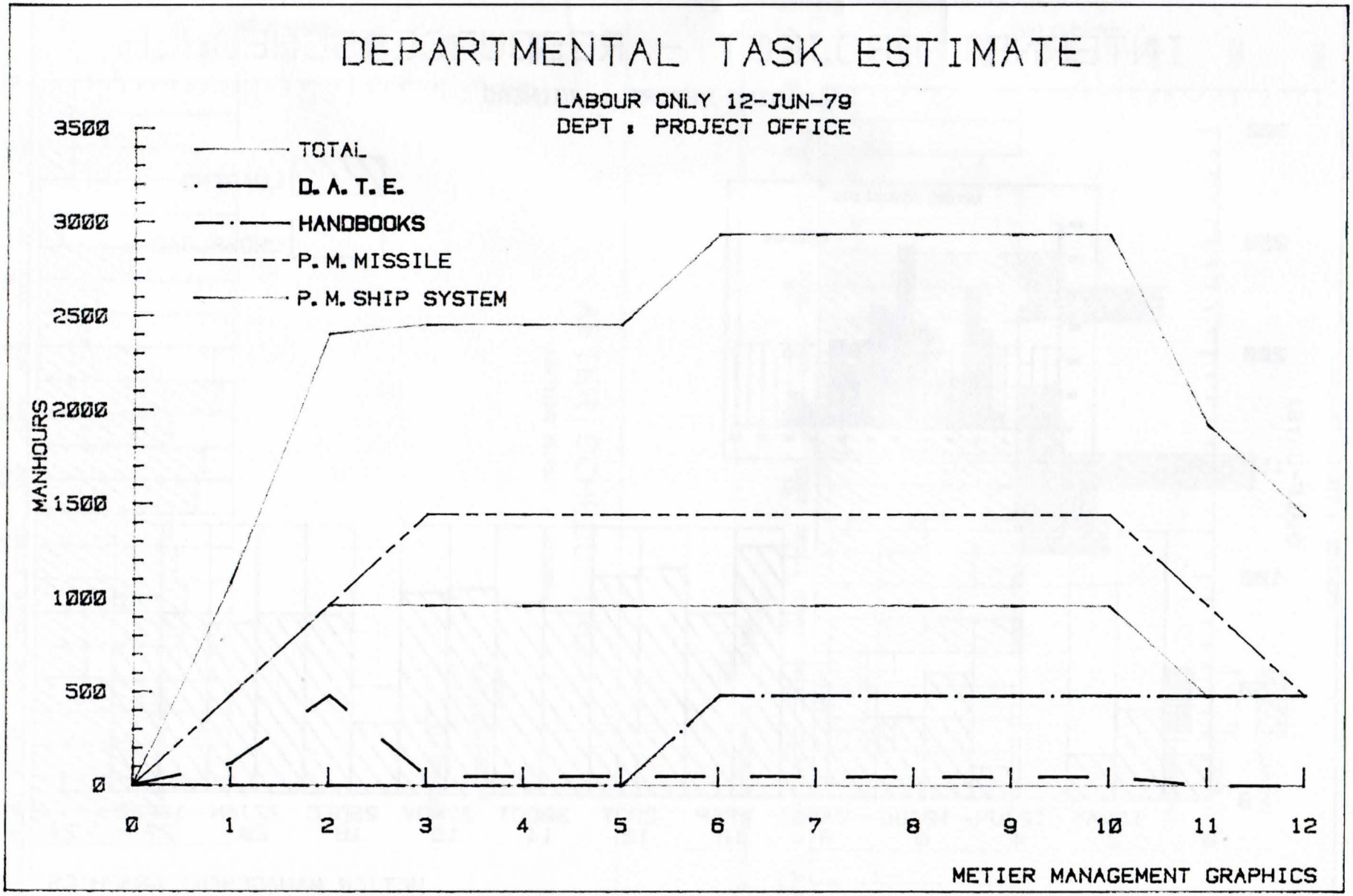
PREC. EVENT	SUCC. EVENT	DESCRIPTION	DURATION	PLANNED START	PLANNED FINISH	TOTAL FLOAT
652	654	DELAY	2	1-JAN-78	1-JAN-78	2
654	656	STRIKE WALLS S DUCT P2	2	3-JAN-78	3-JAN-78	0
600	602	STRIKE FORM ROOF P1	16	3-JAN-78	12-JAN-78	0
656	658	BACKFILL S DUCT	4	4-JAN-78	5-JAN-78	0
602	604	MAKE GOOD AND STRIKE SCAFF P1	20	13-JAN-78	26-JAN-78	0
604	606	TEST TANK P1	30	27-JAN-78	16-FEB-78	0
4	8	GENERAL SITE CLEARANCE	20	2-MAY-78	15-MAY-78	0
4	6	SET UP SITE OFFICE	40	2-MAY-78	30-MAY-78	8
8	10	PILE TESTING	30	16-MAY-78	6-JUN-78	0
10	98	PILE HEATER HOUSE	10	7-JUN-78	13-JUN-78	1
10	12	COMMENCE PILE TANKS P1 AND S1	16	7-JUN-78	16-JUN-78	1
10	234	PILE CONSOL TANKS	16	7-JUN-78	16-JUN-78	224
10	214	PILE TANKS P2 AND S2	30	7-JUN-78	27-JUN-78	3
98	100	EXC TRIM AND BLIND HH CENT DUCT	10	14-JUN-78	20-JUN-78	1
234	236	COMMENCE EXC TRIM AND BLIND CONSOL TANK BASES	6	19-JUN-78	21-JUN-78	224
12	14	COMMENCE EXC TRIM AND BLIND P1 AND S1	12	19-JUN-78	26-JUN-78	2
12	150	COMPLETE PILE TANKS P1 AND S1	14	19-JUN-78	27-JUN-78	1
100	102	REINF BASE CENT DUCT	4	21-JUN-78	22-JUN-78	1
236	272	COMMENCE CUT DOWN PILES CONSOL TANKS	3	22-JUN-78	23-JUN-78	227
236	238	COMPLETE EXC TRIM AND BLIND CONSOL TANK BASES	6	22-JUN-78	26-JUN-78	224
102	104	FORM BASE AND KICKER CTR DUCT	5	23-JUN-78	27-JUN-78	1
272	274	COMPLETE CUT DOWN PILES CONSOL TANKS	3	27-JUN-78	28-JUN-78	227
272	276	COMMENCE REINF BASES CONSOL TANKS	6	27-JUN-78	29-JUN-78	224
104	106	CONC BASE CENT DUCT	1	27-JUN-78	27-JUN-78	1
106	108	DELAY	2	28-JUN-78	28-JUN-78	1
14	16	COMMENCE CUT DOWN PILES TANKS P1 AND S1	6	28-JUN-78	30-JUN-78	6
214	216	EXC TRIM AND BLIND DUCT A	7	28-JUN-78	3-JUL-78	3
150	152	LAY CRANE TRACK A	8	28-JUN-78	3-JUL-78	6
14	96	COMPLETE EXC TRIM AND BLIND P1 AND S1	12	28-JUN-78	5-JUL-78	0
108	110	STRIKE BASE CENT DUCT	2	29-JUN-78	29-JUN-78	1
110	112	COMMENCE REINF WALLS CENT DUCT	4	30-JUN-78	3-JUL-78	1
276	278	COMPLETE REINF BASES CONSOL TANKS	6	30-JUN-78	4-JUL-78	228
276	280	FORM BASE AND KICKER CONSOL TANK 1	6	30-JUN-78	4-JUL-78	224
216	182	REINF BASE DUCT A	4	3-JUL-78	5-JUL-78	3
216	218	EXC TRIM AND BLIND DUCT B	7	3-JUL-78	6-JUL-78	62
112	114	COMPLETE REINF WALLS CENT DUCR	4	4-JUL-78	5-JUL-78	7
112	116	FORM WALLS CTR DUCT P1	6	4-JUL-78	6-JUL-78	1
152	154	ERECT TOWER CRANE	10	4-JUL-78	10-JUL-78	6
280	282	CONC BASE COBSOL TANK 1	2	5-JUL-78	5-JUL-78	224
182	184	FORM BASE AND KICKER DUCT A	5	5-JUL-78	7-JUL-78	3
282	284	COMMENCE STRIKE BASE 1 AND FORM BASE 2	2	6-JUL-78	6-JUL-78	224
16	84	COMPLETE CUT DOWN PILES TANKS P1 AND S2	6	6-JUL-78	10-JUL-78	10
16	18	COMMENCE REINF BASE P1	8	6-JUL-78	11-JUL-78	0
116	118	CONC WALLS CTR DUCT P1	1	7-JUL-78	7-JUL-78	1
392	394	COMMENCE REINF WALLS C1(1) AND C2(1)	2	7-JUL-78	7-JUL-78	229
218	220	REINF BASE DUCT B	4	7-JUL-78	10-JUL-78	62

MANAGEMENT GRAPHICS

For many purposes reports are best presented graphically rather than in tabular form. A high proportion of the present reports produced by users incorporate bar charts, histograms and graphs (such as S-curves) and are printed on the regular printer.

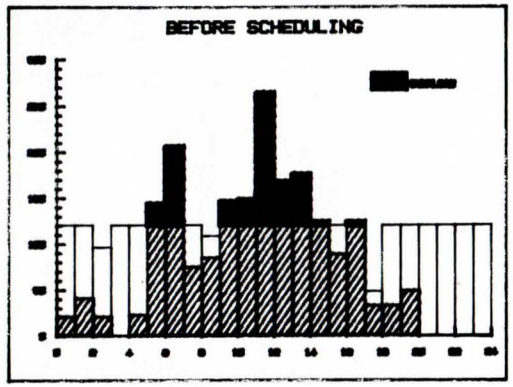
Where very high quality presentation (in multiple colors) is required, use may be made of a desk top pen plotter to produce graphical output, as shown in the following examples.

Design of the output is carried out quickly and easily by the cost/scheduling engineer via an interactive graphics CRT. The commands used have all the power and simplicity of other **ARTEMIS** commands and are totally compatible with them.


DEPARTMENTAL TASK ESTIMATE
LABOUR ONLY 12-JUN-79
DEPT : PROJECT OFFICE
TOTAL
D. A. T. E.
HANDBOOKS
P. M. MISSILE
P. M. SHIP SYSTEM
MANHOURS
3500
3000
2500
2000
1500
1000
500
0
0 1 2 3 4 5 6 7 8 9 10 11 12
METIER MANAGEMENT GRAPHICS

INTERNET PROJECT - RESOURCE SCHEDULE

LOADING REPORT : JOINERS



LOADING

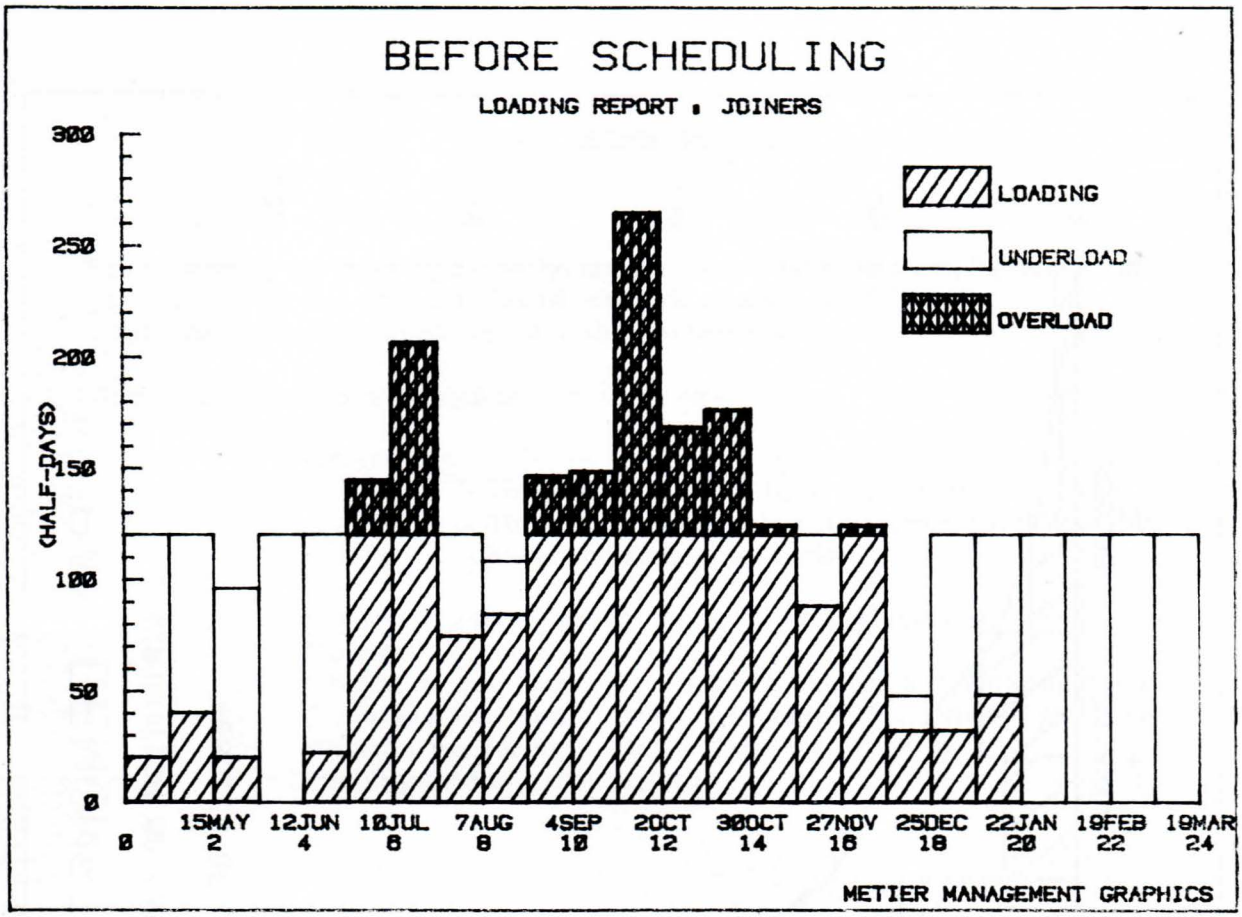
UNDERLOAD

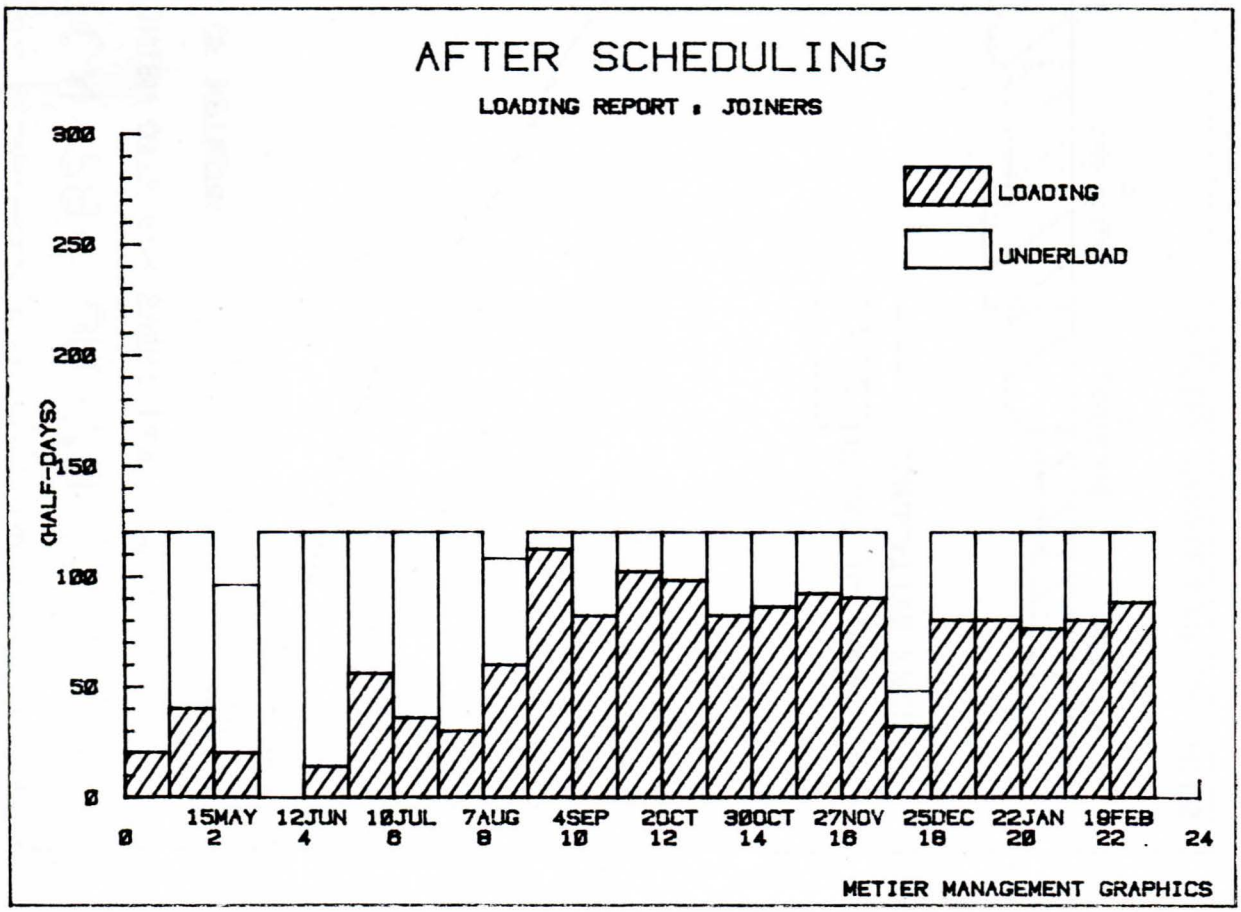
(HALF-DAYS)

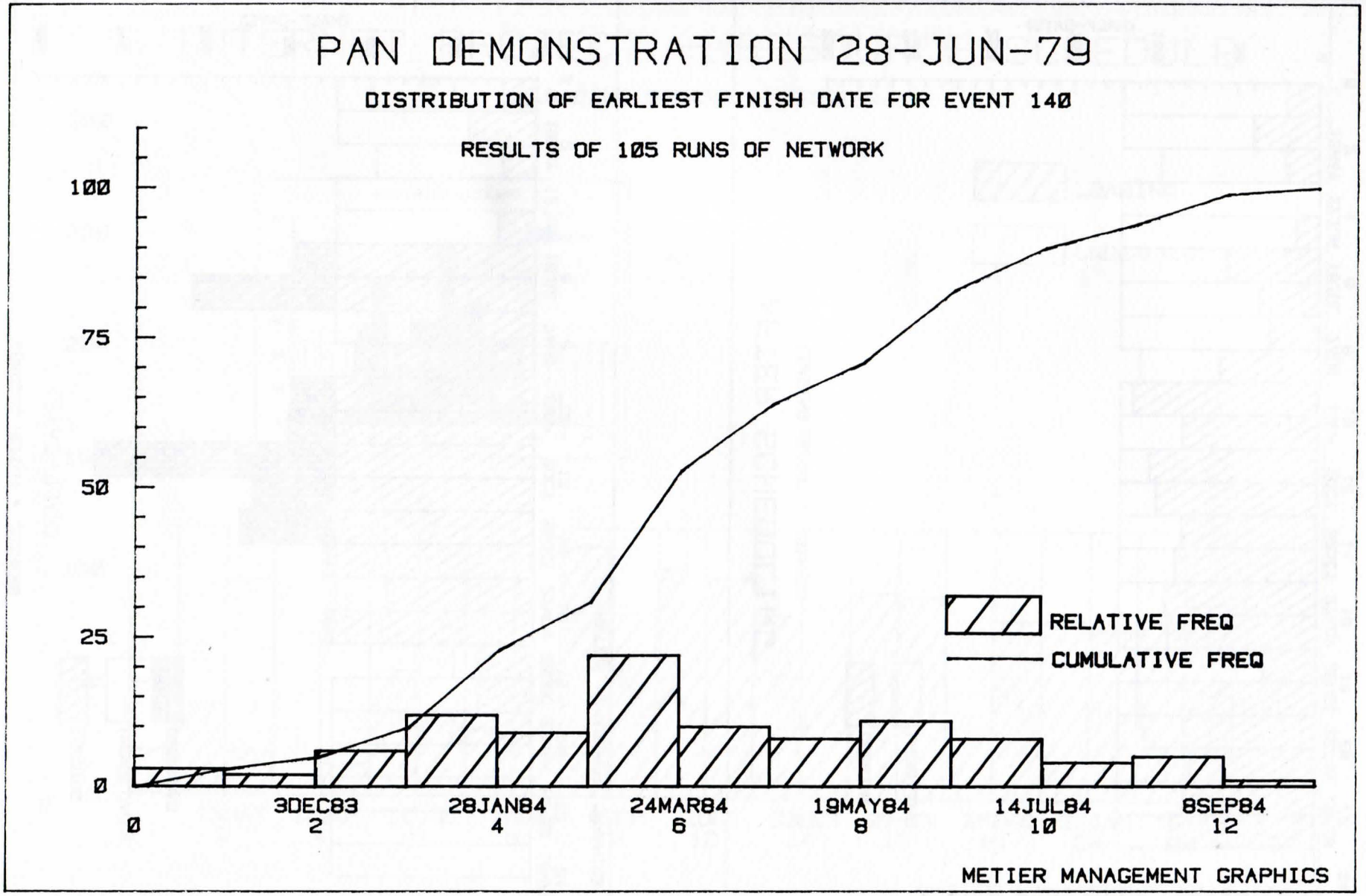
300
250
200
150
100
50
0

0 15MAY 2 12JUN 4 10JUL 6 7AUG 8 4SEP 10 20CT 12 30OCT 14 27NOV 16 25DEC 18 22JAN 20 19FEB 22 24

METIER MANAGEMENT GRAPHICS


BEFORE SCHEDULING
LOADING REPORT : JOINERS
LOADING
UNDERLOAD
OVERLOAD
(HALF-DAYS)
300
250
200
150
100
50
0
0
15MAY 2
12JUN 4
10JUL 6
7AUG 8
4SEP 10
20CT 12
30OCT 14
27NOV 16
25DEC 18
22JAN 20
19FEB 22
19MAR 24
METIER MANAGEMENT GRAPHICS


AFTER SCHEDULING
LOADING REPORT : JOINERS
LOADING
UNDERLOAD
(HALF-DAYS)
300
250
200
150
100
50
0
0
15MAY 2
12JUN 4
10JUL 6
7AUG 8
4SEP 10
20CT 12
30OCT 14
27NOV 16
25DEC 18
22JAN 20
19FEB 22
24
METIER MANAGEMENT GRAPHICS

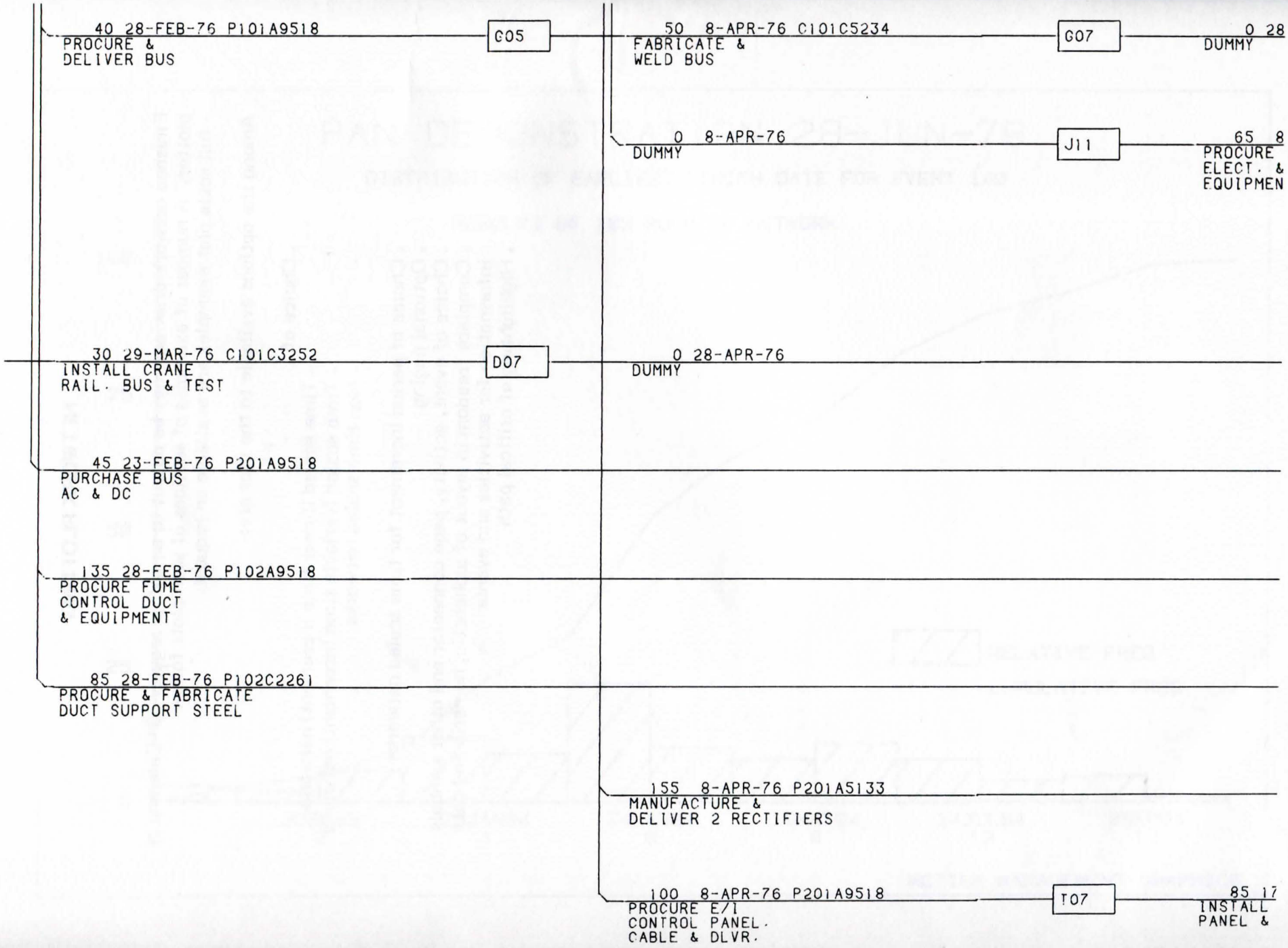

PAN DEMONSTRATION 28-JUN-79
DISTRIBUTION OF EARLIEST FINISH DATE FOR EVENT 140
RESULTS OF 105 RUNS OF NETWORK
100
75
50
25
0
RELATIVE FREQ
CUMULATIVE FREQ
0
3DEC83
2
28JAN84
4
24MAR84
6
19MAY84
8
14JUL84
10
8SEP84
12
METIER MANAGEMENT GRAPHICS

NETWORK PLOTTING

Finished network drawings may be output to an online regular 30" Calcomp plotter. A number of examples of sections of such plots follow - full scale plot examples are available on request.

Among the options available to the user are:-

- Choice of
  - Time scaled (linear time increment) networks
  - Time scaled (variable time increment) networks
  - Non time scaled networks
- Choice of period increment for time scaled networks
- Optional paging
- Choice of event, activity, page connector and other symbols
- Complete freedom in layout of alphabetic, numeric and date information for activities and events
- Highlighting of critical path


40 28-FEB-76 P101A9518
PROCURE &
DELIVER BUS
G05
50 8-APR-76 C101C5234
FABRICATE &
WELD BUS
G07
0 28
DUMMY
0 8-APR-76
DUMMY
J11
65 8
PROCURE
ELECT. &
EQUIPMEN
30 29-MAR-76 C101C3252
INSTALL CRANE
RAIL. BUS & TEST
D07
0 28-APR-76
DUMMY
45 23-FEB-76 P201A9518
PURCHASE BUS
AC & DC
135 28-FEB-76 P102A9518
PROCURE FUME
CONTROL DUCT
& EQUIPMENT
85 28-FEB-76 P102C2261
PROCURE & FABRICATE
DUCT SUPPORT STEEL
155 8-APR-76 P201A5133
MANUFACTURE &
DELIVER 2 RECTIFIERS
100 8-APR-76 P201A9518
PROCURE E/I
CONTROL PANEL.
CABLE & DLVR.
T07
85 17
INSTALL
PANEL &

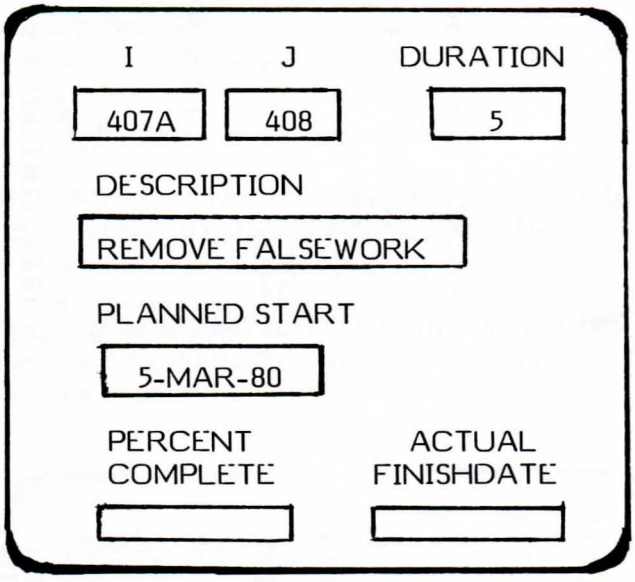
UPDATING

Progress information can be entered on each activity in the form of:-

Actual Start Date	Remaining duration
Percentage completion	Actual finish date

Progress information on activities worked out of sequence may be entered, and completed activities re-opened for additional work.

It's usually convenient to use a form of input and update called REVIEW in which the user can call for individual activities and input the update information immediately:-



Frequently the update information is written by project staff onto a turnaround document (such as overleaf) which is printed by the system and issued weekly.

Before rescheduling in the light of the progress information, the user may also wish to incorporate any changes to the network arising from scope variations, revisions to resource availability or operational plans, etc. Thus the new schedules can give a picture of the project up to date within a matter of hours.

It goes without saying that among the practical advantages of **ARTEMIS** is that inaccurate progress data is generally found quickly and that the scheduling run can be repeated with corrected data with a delay of only an hour or so.

In the same way Costs, Materials, Drawings, Jobs, etc. can all be updated by entering the data about Hours; Expenditure; Material Bid Approvals, Orders, Deliveries; Drawing completions; Job progress; etc. and REVIEWing the records affected. Variance reports, schedules, summaries, etc. can then be printed out immediately after running the necessary re-calculation.

UPDATING SHEET 16-OCT-78

TO : MILTON KRAUSPE

PLEASE WRITE IN YOUR ACTUAL OR ESTIMATED COMPLETION DATE FOR EACH JOB

JOBS DUE FOR COMPLETION THIS WEEK	DATE DUE		ESTIMATED COMPLETION DATE
STRIKE FORM CTR BASE P2	2:OCT	....	
STRIKE RB P2(1) AND FRORM RB P2(2)	2:OCT	....	
CONC RB P2(2)	3:OCT	....	
STRIKE FORM RB P2	4:OCT	....	
FIX SCREED AND CONC INCL BASE P2(1)	5:OCT	....	
STRIKE SCREED AND CONC INCL BASE P2(2)	6:OCT	....	
CONC WALLS S DUCT P2	10:OCT	....	
STRIKE WALLS S DUCT P2	12:OCT	....	
FIX SCAFFOLD WALLS P2(1)	13:OCT	....	

PLEASE RETURN TO K.BRIGHTS - PLANNING OFFICE BY RETURN

SECTION 7 - CALCULATIONS

CPM - SCHEDULING

Each user wishes to perform a range of calculations on data drawn from the database - to calculate costs to date and print cost reports; to reschedule material requirements, comparing and printing out those that are overdue; to calculate progress and print productivity performance reports; etc. Many of these calculations are specific to a particular project or user and must be customized appropriately.

However, in doing CPM scheduling there are a number of fairly standard calculations which are provided as built-in features of **ARTEMIS** Thus to carry out a straightforward Time Analysis on a network without taking resource constraints into account the user types:-

ANALYSE

and this will calculate Early/Late Start/Finish and Floats.

The performance of **ARTEMIS** compares favourably with conventional mainframe computers - a typical 2500 activity network taking under 30 minutes to schedule for example.

During analysis any 'dangling' or looped activities will be reported to the user. For example he might be told by Artemis that the activity starting at PE = 1080 was a dangle. To correct it he might first look at it:-

```
DISPLAY IF PE = 1080


PE = 1080  SE = 1010  DU = 4
AD = INSTALL FUEL LINE
ES = 10-JUL-78  EF = 14-JUL-78
LS = 15-JUL-78  LF = 19-JUL-78
TF = 5
```

and then type in a correction:-

CHANGE PE = 1008 IF PE = 1080

Similarly, if the time schedule looks unacceptable he can get rapid printouts to help him decide on possible changes to logic or duration estimates before carrying out a further re-analysis. A typical diagnostic printout of this type for a precedence network is given overleaf.

The cycle of making changes or corrections, re-analysis and examining the results can be repeated until a satisfactory schedule is obtained.

INTERNET PROJECT

RUN DATE : 6-MAR-79

ACTIVITY NUMBER	DESCRIPTION	EARLIEST START	EARLIST FINISH	LATEST START	LATLST FINISH	DUR	TOTAL FLOAT	PREC/ SUCC	ACTIVITY	LINK TYPE	DEL
11	ON SITE	1-MAY-79	15-MAY-79	3-MAY-79	17-MAY-79	20	4	S	12	FS	0
								S	13	FS	0
12	SET UP SITE OFFICE	16-MAY-79	13-JUN-79	29-FEB-80	27-MAR-80	40	402	S	368	FS	0
								P	11	FS	0
13	GENERAL SITE CLEARANCE	16-MAY-79	30-MAY-79	18-MAY-79	1-JUN-79	20	4	S	14	FS	0
								P	11	FS	0
14	PILE TESTING	31-MAY-79	20-JUN-79	4-JUN-79	22-JUN-79	30	4	S	24	FS	0
								S	23	FS	0
								S	21	FS	0
								S	28	FS	0
								P	13	FS	0
21	PILE TANKS P1 AND S1	21-JUN-79	11-JUL-79	12-JUL-79	1-AUG-79	30	30	S	36	FS	0
								S	32	SS	16
								S	32	FF	12
								P	14	FS	0
23	PILE TANKS P2 AND S2	21-JUN-79	11-JUL-79	28-JUN-79	19-JUL-79	30	11	S	33	FS	0
								P	14	FS	0
24	PILE HEATER HOUSE	21-JUN-79	27-JUN-79	25-JUN-79	29-JUN-79	10	4	S	37	FS	0
								S	36	FS	0
								P	14	FS	0
28	PILE CONSOL TANKS	21-JUN-79	2-JUL-79	3-DEC-79	13-DEC-79	16	233	S	38	FS	0
								P	14	FS	0
32	EXC TRIM AND BLIND	3-JUL-79	19-JUL-79	30-JUL-79	14-AUG-79	24	36	S	42	SS	12
								S	42	FF	6
								P	21	SS	16
								P	21	FF	12
33	EXC TRIM AND BLIND DUCT A	12-JUL-79	17-JUL-79	19-JUL-79	24-JUL-79	7	11	S	43	FS	0
								S	44	FS	0
								P	23	FS	0

CPM - SUMMARIZING RESOURCE REQUIREMENTS

Another standard requirement in many CPM applications is that of summarising the resources required to support a particular schedule.

The command AGGREGATE summarizes resource requirements by type of resource and period. The user can choose to aggregate on the early or late schedule or on some intermediate schedule. Similarly, he can choose to aggregate only over a particular window of time or resources and can choose to summarize by week, day, month, 30 day period or any other time period. Finally, he can group resources together (e.g. summarizing all personnel requirements regardless of trade to determine required amount ofbed space). For example:-

```
AGGREGATE
        FROM 1-MAY-79
        PERIOD 1 MONTH
```

ARTEMIS defaults to the obvious choices if the user does not choose particular options (e.g. defaulting in this case to aggregation on an Early Start schedule from 1-May-79 until the end of the project and aggregating all resource types separately).

After aggregation the user can print out the resource requirements compared with resources available and decide whether to make any further changes before going ahead with a resource constrained schedule.

Again the immediate access to the network database provides him with immensely powerful facilities. He can, for example, list out all the activities contributing to a particular resource overload by typing:-

```
PRINT IF RESOURCE = WELDERS AND ES AFTER 6-JUL-80
```

and might perhaps go on to remove an activity:-

```
DELETE 1120 - 1130
```

and change another one:-

```
CHANGE 1134 - 1140
        DU = 20
```

and then re-run a time analysis and an aggregation to see if those changes have helped remove the overload.

Some examples of typical resource reports follow.

RESOURCE LOADING FORECAST

INTERNET PROJECT

2-JUL-79

9 MONTHS TO 30-APR-78

PERIOD TO	CARPENTERS MEN	CARPENTERS AVAIL	LABOURERS MEN	LABOURERS AVAIL	SCAFFOLDERS MEN	SCAFFOLDERS AVAIL	IRONWORKS MEN	IRONWORKS AVAIL
5-AUG-78	10.6	106.0	6.0	60.0	2.4	24.0	0.8	8.0
12-AUG-78	5.6	56.0	5.8	58.0	1.6	16.0	3.2	32.0
19-AUG-78	1.8	18.0	2.2	22.0	4.0	40.0	2.6	26.0
26-AUG-78	3.6	36.0	5.2	52.0	0.0	0.0	0.4	44.0
2-SEP-78	6.0	48.0	7.0	56.0	1.0	8.0	2.8	22.0
9-SEP-78	6.8	68.0	6.8	68.0	2.4	24.0	3.4	34.0
16-SEP-78	7.8	78.0	9.2	92.0	0.8	8.0	2.0	20.0
23-SEP-78	6.4	64.0	7.4	74.0	2.4	24.0	7.8	78.0
30-SEP-78	8.4	84.0	7.0	70.0	0.8	8.0	7.6	76.0
7-OCT-78	14.8	148.0	8.6	86.0	4.8	48.0	0.4	4.0
14-OCT-78	11.6	116.0	7.4	74.0	10.2	102.0	0.2	2.0
21-OCT-78	8.4	84.0	6.8	68.0	6.2	62.0	7.4	74.0
28-OCT-78	8.4	84.0	4.6	46.0	3.8	38.0	4.4	44.0
4-NOV-78	6.0	60.0	7.8	78.0	1.6	16.0	4.4	44.0
11-NOV-78	11.6	116.0	3.8	38.0	4.2	42.0	3.6	36.0
18-NOV-78	7.2	72.0	7.8	78.0	6.2	62.0	6.8	68.0
25-NOV-78	5.2	52.0	10.8	108.0	8.6	86.0	0.0	0.0
2-DEC-78	2.8	28.0	7.4	74.0	3.0	30.0	3.2	32.0
9-DEC-78	6.0	60.0	2.6	26.0	2.4	24.0	0.0	0.0
16-DEC-78	8.4	84.0	4&0	40.0	4.8	48.0	0.0	0.0
23-DEC-78	4.0	40.0	7.2	72.0	4.0	40.0	0.0	0.0
30-DEC-78	4.0	24.0	7.3	44.0	2.7	16.0	4.0	24.0
6-JAN-79	3.0	24.0	7.5	60.0	0.0	0.0	1.0	8.0
13-JAN-79	0.0	0.0	7.6	76.0	0.0	0.0	0.0	0.0
20-JAN-79	4.0	40.0	9.2	92.0	0.0	0.0	0.0	0.0
27-JAN-79	2.4	24.0	5.6	56.0	1.6	16.0	0.0	0.0
3-FEB-79	0.0	0.0	8.0	80.0	4.0	40.0	0.0	0.0
10-FEB-79	0.0	0.0	7.2	72.0	2.4	24.0	0.0	0.0
17-FEB-79	0.0	0.0	6.0	60.0	0.0	0.0	0.0	0.0
24-FEB-79	0.0	0.0	2.0	20.0	0.0	0.0	0.0	0.0
3-MAR-79	0.0	0.0	2.8	28.0	0.0	0.0	0.0	0.0
10-MAR-79	0.0	0.0	4.0	40.0	0.0	0.0	0.0	0.0
17-MAR-79	0.0	0.0	2.4	24.0	0.0	0.0	0.0	0.0

WASTE DISPOSAL PLANT

MANPOWER REQUIREMENTS BY TRADE

REPORT DATE : 1-JUL-79 PAGE 2

TRADE : LABOURERS
***** * *********

PERIOD START	USAGE (DAYS)	HISTOGRAM CONDENSE FACTOR IS 25 (0 200 400 600 800 1000 1200 1400 1600 1800 2000 2200)	RESOURCE AVAIL.
21-JAN-80	1312	I**********A I I I I I I I I I I I	1840
21-FEB-80	544	I**********A I I I I I I I I I I I	1680
21-MAR-80	144	I*****A I I I I I I I I I I I	1680
21-APR-80	1104	I**********A I I I I I I I I I I I	1760
21-MAY-80	1824	I**********A I I I I I I I I I I I	1840
21-JUN-80	928	I**********A I I I I I I I I I I I	1600
21-JUL-80	528	I**********A I I I I I I I I I I I	1840
21-AUG-80	1424	I**********A I I I I I I I I I I I	1760
21-SEP-80	1616	I**********A I I I I I I I I I I I	1680
21-OCT-80	1296	I**********A I I I I I I I I I I I	1840
21-NOV-80	928	I**********A I I I I I I I I I I I	1680
21-DEC-80	544	I**********A I I I I I I I I I I I	1760
21-JAN-81	96	I***A I I I I I I I I I I I	1840

TRADE : RIGGERS
***** * *******

PERIOD START	USAGE (DAYS)	HISTOGRAM CONDENSE FACTOR IS 25 (0 200 400 600 800 1000 1200 1400 1600 1800 2000 2200)	RESOURCE AVAIL.
21-APR-79	0	I A I I I I I I I I I I I	640
21-MAY-79	0	I A I I I I I I I I I I I	736
21-JUN-79	0	I A I I I I I I I I I I I	704
21-JUL-79	176	I******A I I I I I I I I I I I	672
21-AUG-79	888	I**********A++++++++ I I I I I I I I I I	736
21-SEP-79	913	I**********A++++++++++ I I I I I I I I I I	672
21-OCT-79	183	I******A I I I I I I I I I I I	704
21-NOV-79	760	I**********A++ I I I I I I I I I I I	704
21-DEC-79	1432	I**********A++++++++++++++++++++++++++++++ I I I I I I	672
21-JAN-80	256	I*********A I I I I I I I I I I I	736
21-FEB-80	832	I**********A++++++ I I I I I I I I I I	672
21-MAR-80	96	I***A I I I I I I I I I I I	672
21-APR-80	352	I**********A I I I I I I I I I I I	704
21-MAY-80	512	I**********A I I I I I I I I I I I	736
21-JUN-80	480	I**********A I I I I I I I I I I I	640
21-JUL-80	128	I****A I I I I I I I I I I I	736
21-AUG-80	960	I**********A++++++++++ I I I I I I I I I I	704
21-SEP-80	672	I**********A I I I I I I I I I I I	672

\+ = RESOURCE OVERLOAD
\- = RESOURCE UNDERLOAD
A = RESOURCE AVAILABILITY

CPM - SCHEDULING WITH RESOURCE CONSTRAINTS

The last of the "standard" CPM scheduling calculations available in **ARTEMIS** gives the ability to run a resource-constrained schedule by typing the command SCHEDULE followed by any options he wishes to exercise. The options include:-

- Setting a time window over which a schedule is to be produced (typically for example there is limited value in producing detailed schedules more than a few weeks out)
- Constraining only one or more of the resources. It's usually good practice to do the first run with only the one tightest constrained resource set as a restraint (e.g. in North Sea operations the number of bed spaces; in other cases crane availability; etc.) Having achieved a satisfactory schedule within the constraints of that one resource, further runs can then be carried out with the next most difficult resource constrained and so on.
- Choosing time as the primary constraint (in which case resources will be allowed to go into overload) or choosing resources as the absolute constraint (in which case the end date will be allowed to slip).
- Other facilities such as grouping of resources, change of shift-working patterns during the scheduling period, setting of priority rules, use of alternate resources, etc.

For example:-

```
SCHEDULE
FROM 14-MAY-80
UNTIL 1-OCT-81
TIME LIMITED
SELECT IF RES IS CRANE OR RES IS BEDS
END
```

Having completed a scheduling run the user can again AGGREGATE the resource requirements by period, using the new schedule and then produce printed reports to examine the acceptability of the schedule (see following example). Once more, the user can examine the data, perhaps looking at particular items which have been delayed by the schedules because lifting capabilities were not available at the original scheduled Early Start date:-

```
DISPLAY IF RES IS CRANE AND DELAY> 0
```

and perhaps go on to make changes to the data prior to a further scheduling run.

An example report showing the start delays introduced by resource constrained scheduling is shown overleaf.

INTERNET PROJECT

RUN DATE: 31-JAN-79

PREC ACT.	SUCC ACT.	DESCRIPTION	DURATION	SCHEDULED START	SCHEDULED FINISH	REMAIN. FLOAT	SCHEDULED DELAY	RES	QTY	DUR	DEL
628	630	COMMENCE STRIKE WALLS P1 AND F	3	4-OCT-78	5-OCT-78	43	5	JOIN	4	3	0
58	62	CONC WALLS P1(2)	2	5-OCT-78	5-OCT-78	12		CONC	100	2	0
								LABS	6	2	0
384	386	FIX FORM CENTRE BASE P2	2	5-OCT-78	5-OCT-78	4		JOIN	2	2	0
880	882	STRIKE RB P2(1) AND FRORM RB P	6	5-OCT-78	9-OCT-78	0		JOIN	4	6	0
60	62	REINF WALLS S1(2)	8	6-OCT-78	11-OCT-78	4	8	STFX	4	8	0
860	862	CONC CTR BASE P2	1	6-OCT-78	6-OCT-78	4		CONC	20	1	0
								LABS	6	1	0
630	632	COMPLETE STRIKE WALLS P1 AND F	4	6-OCT-78	9-OCT-78	43		JOIN	4	4	0
862	864	DELAY	2	6-OCT-78	7-OCT-78	8					
864	866	STRIKE FORM CTR BASE P2	1	10-OCT-78	10-OCT-78	3	2	JOIN	2	1	0
882	884	CONC RB P2(2)	2	10-OCT-78	10-OCT-78	0		CONC	50	2	0
								LABS	6	2	0
632	634	CONC WALLS N DUCT P2	1	10-OCT-78	10-OCT-78	43		CONC	20	1	0
								LABS	6	1	0
634	636	DELAY	2	10-OCT-78	11-OCT-78	59					
884	886	STRIKE FORM RB P2	2	11-OCT-78	11-OCT-78	0		JOIN	4	2	0
636	638	STRIKE WALLS N DUCT (P2)	2	11-OCT-78	12-OCT-78	43		JOIN	4	2	0
886	888	FIX SCREED AND CONC INCL BASE	2	12-OCT-78	12-OCT-78	2		CONC	90	2	0
								LABS	6	2	0
								JOIN	2	2	0
942	944	COMPLETE REINF BASE S2	6	12-OCT-78	16-OCT-78	5	8	STFX	4	6	0
952	954	FORM RB S2(1)	4	12-OCT-78	13-OCT-78	0		JOIN	4	4	0
62	64	COMMENCE STRIKE WALLS P1(2) AN	4	12-OCT-78	16-OCT-78	3	1	JOIN	4	4	0
638	660	BACKFILL N DUCT	4	12-OCT-78	16-OCT-78	57		EXCR	1	4	0
								LABS	2	4	0

CUSTOMIZED CALCULATIONS

For Costs, Materials, Progress, Drawings and other applications customized calculations are required and it is not possible to "prepackage" them as is done with some of the CPM calculations.

ARTEMIS provides facilities for the cost/scheduling engineer to write the calculations himself in an easy, familiar way. For example, calculating a variance percentage on all the records in the progress part of the database involves typing only:-

```
SET IN PROGRESS
VAR = 100 * (ACT - BUD)/BUD
```

Calculations can be done selectively. For example, increasing the cost on all steel items by 8% for those items after June and by 20% for those items after December:-

```
SET IN COSTS
SELECT IF TYPE IS STEEL
COST = COST * 1.08 IF DTE BEFORE 1-DEC-80
                      AND DTE AFTER 1-JUN-80
COST = COST * 1.20 IF DTE AFTER 30-DEC-80
END
```

The same calculation written in Cobol or a similar programming language would be completely unfamiliar to most cost/scheduling engineers as well as taking perhaps ten times as many statements.

Calculations can be carried out on dates. For example calculating Order Date from Required on Site Date in a Materials application:-

```
SET IN MATERIALS
ODTE = RDTE - 90 IF TYPE = STEEL
ODTE = RDTE - 60 IF TYPE = ELECTRICAL
```

User written calculations can be carried out on network data just like any other data. For example, to calculate Slippage (SLP) on network activities by comparing Original Scheduled Date (OSD) with current Early Start date (ES):-

```
SET IN NETWORK
SLP = OSD - ES
```

A report showing the use of this kind of calculation is given overleaf.

Generally, the user writes a sequence of calculations to which he gives a name such as WKCOST and puts it away in the library on disc. He can then call it as required by typing /WKCOST. There is no limit to the length of such a sequence, nor to the number of sequences which can be stored away, and any sequence can be changed easily by the user as needs evolve.

PROJECT : INTERNET PROJECT

GENERAL SCHEDULE RESULTS

SECTION : HEATER HOUSE

PREC ACT.	SUCC ACT.	ACTIVITY DESCRITION	CURRENT EARLY START	CURRENT EARLY FINISH	CURRENT TOTAL FLOAT	ORIGINAL EARLY START	ORIGINAL EARLY FINISH	ORIGINAL TOTAL FLOAT	SLIPPAGE	CHANGE IN FLOAT
596	598	COMMENCE STRIKE BASE N DUCT AND FOR	11/SEP/78	14/SEP/78	57	6/SEP/78	11/SEP/78	53	6	4
598	608	COMPLETE STRIKE BASE N DUCT AND FOR	14/SEP/78	15/SEP/78	57	11/SEP/78	12/SEP/78	53	6	4
608	620	COMMENCE REINF WALLS N DUCT	15/SEP/78	19/SEP/78	57	12/SEP/78	14/SEP/78	53	10	4
612	614	STRIKE BASE S DUCT	18/SEP/78	18/SEP/78	74	14/SEP/78	14/SEP/78	68	8	6
614	616	COMMENCE REINF WALLS S DUCT	19/SEP/78	20/SEP/78	74	15/SEP/78	18/SEP/78	68	4	6
620	622	COMPLETE REINF WALS N DUCT	19/SEP/78	21/SEP/78	63	14/SEP/78	18/SEP/78	59	6	4
616	618	COMPLETE REINF WALLS S DUCT	21/SEP/78	25/SEP/78	80	19/SEP/78	21/SEP/78	74	8	6
660	662	BLIND HH FLOOR SLAB	9/NOV/78	13/NOV/78	22	3/NOV/78	7/NOV/78	20	12	2
662	670	COMMENCE REINF HH FLOOR SLAB	14/NOV/78	16/NOV/78	22	8/NOV/78	10/NOV/78	20	12	2
670	664	COMPLETE REINF HH FLOOR SLAB	17/NOV/78	23/NOV/78	31	13/NOV/78	17/NOV/78	29	12	2
666	668	HH PLINTHS	1/DEC/78	21/DEC/78	22	27/NOV/78	15/DEC/78	20	12	2
668	802	HH SUPER STRUCT. FRAME	22/DEC/78	20/FEB/79	22	18/DEC/78	14/FEB/79	20	12	2

REPORT SHOWS ONLY ACTIVITIES IN PROGRESS

SECTION 8 - EXTRA POWERFUL OPERATIONS

CHANGES

Apart from the routine progress updating data there are all the other non-routine changes:-

"Reassign everything on Work Package BLDG31 to sub-contractor Brown"
"Split the costs on code DL14H-041 into two new codes - 046 and - 047"
"Increase all Carpentry items by 20%"
"Delete those two activities and change the duration on that one"

ARTEMIS allows all these changes and almost any other to be made in a very relaxed and direct way:-

CHANGE SC = BROWN IF WP = BLDG31

for instance, carries out the first of the examples above. It will have the effect of changing **all** BLDG31 items (perhaps several hundred of them) with **one** command. On the other hand:-

DELETE IF COSTCODE = DL14H

and

CHANGE DU = 42 IF PE = 2783

might be used to change just one item apiece.

To handle escalation we type commands such as:-

BUDGET = BUDGET * 1.25 IF ITEM = STEEL

And to handle low productivity we can raise the duration estimates for all welding activities by typing:-

DU = DU * 1.1 IF RES IS WELD

And if the client tells us he wants an extra 7 days for bid approval on one work package we can move all the dates back in Materials by typing:-

BAP = BAP + 7 IF WP = DL14

Remember that each one of these commands will cause **ARTEMIS** to inspect all the appropriate records - maybe 10 or 100,000 of them - select only those which meet a particular set of conditions (perhaps 200 records out of the 10,000 examined) and change them.

This can take a tremendous work load off the cost/scheduling engineer as well as allowing him to respond to a change within hours rather than days.

WHAT IF -----?

The "what if" game

A lot of the questions posed in the cost/scheduling office are exploratory in nature.

"What if we put another crew on -----"
"What if we could get productivity up 10% -----"
"What if we changed the way we construct that module so that -----"

Answering these questions quickly, mulling over the results, posing more questions - this is the process by which the cost/scheduling engineer feels his way towards the best solution. And it's the process at which **ARTEMIS** excels.

Protecting live data

The questions involve making some changes to the project data, running calculations and then examining the results.

To avoid corrupting the live project data the most common method is to take a copy of the data (COPY NETWORK TO TRIAL, for example) and then operate on this copy. It's sometimes appropriate to take several such copies for different comparitive purposes.

A quick change

We might wish to make a number of changes including investigating the effects of Carpentry productivity being 20% down and one type of material being late:-

```
SET IN NETWORK
DU = DU * 1.2 IF RESOURCE = CARP
END

SET IN MATERIALS
DEL = DEL + 90 IF MATERIAL CONTAINS VALVE
END
```

And look at the results

Having made those, and other changes, we can rerun the necessary calculations and then DISPLAY or PRINT information to examine the consequences almost immediately. Then of course we can repeat with more changes, recalculate and look at results and so on.

An example of a report comparing two "what if" runs on a Present Value Cost basis is given overleaf.

METIER MANAGEMENT SYSTEMS

BREAKDOWN OF ITEMS & SUPPLIERS BY CONTRACT NO.

CONTRACT NO. 1025

ITEM AND SUPPLIER	ORD NO.	ORDER DATE	EX WORKS DATE	SHIP CLO DATE	SHIP & PORT	SAIL. DATE	DOCKING DATE	PORT OF ARRIVAL	CLEAR PORT	ARRIVE ON SITE	CONTAINER CRATE NO.	SHIP NO.
RUBBER GROMMETS LONDON RUBBER	1045	7/01/78	18/03/78	10/02/78	M.V.AUGUSTA BALTIMORE	24/03/78	19/06/78	LONDON	22/03/78	15/07/78	X169	B24
SWITCH GEAR ..S.CONTROLS	1089	7/01/78	11/02/78	28/02/78	BY ROAD LEICESTER	17/02/78	20/03/78	LONDON		8/04/78		C35
GENERATOR G.E.C.	2100	7/01/78	15/04/78	2/02/78	BY ROAD COVENTRY	21/04/78	5/06/78			17/06/78	A12	X16
CABLING G.E.C.	3427	7/01/78	18/02/78	22/01/78	BY RAIL RUGBY	24/02/78	24/04/78	LONDON		29/04/78		B25

CLIENT G WIMPEY & CO LTD

JOB DUBB ALUMINIUM

DESCRIPTION MATERIAL SHIPPING

SCALE 1:250 REF 10256
CONTRACT NO. 1025 DATE 6-FEB-78

RUNNING ROUTINE JOBS

In addition to all the ad hoc enquiries, reports and changes, there are of course a number of routine procedures which have to be run each day, week, month, etc. Each of these procedures may involve a series of **ARTEMIS** tasks:-

e.g. Input some update information,
carry out an update,
run a report,
run another calculation process,
print two more reports,
copy some summary figures out to a new file,
print a further report, and so on.

ARTEMIS simplifies the running of these routine tasks by allowing the user to store a "command file" on disc which contains the sequence of commands required (e.g. REVIEW, SET calculations, PRINT REPORT, COPY, etc.). The command file can then be run when required by simply typing its name.

e.g. /MONTHEND

Taken with REVIEW (to put in routine updates) and the "FILL-IN-THE-FORM" mode of data input (for original data entry) this enables all routine tasks to be performed by relatively unskilled personnel.

Any number of command files can be created and they can be amended easily. A command file can include **any** command which can otherwise be typed directly and can also include a dialogue with the user (e.g. to set up Week No. and Dept. for which a report is required.)

SECTION 9 - SETTING UP THE APPLICATION

CONSTRUCTING THE DATABASE

Datasets

Before the user can put data into the database and do all the calculations, enquiries, changes, printing of reports, etc. he first has to tell **ARTEMIS** what the layout of the database is going to look like.

To do this, he divides the data into different "sets". To take a simple example he might wish to set up three datasets:-

- Costs Dataset
- Materials Dataset
- Drawings Dataset

Defining datasets

The structure of each of these must be spelled out to **ARTEMIS.** For example, setting up the simple Costs dataset would involve defining all the fields which he is going to use:-

```
DEFINE
        FIELD CC  : COSTCODE        ALPHA
        FIELD WP  : WORKPAK         TEXT
        FIELD DPT : DEPARTMT        ALPHA
        FIELD CD  : DESCRIPN        TEXT
        FIELD BUD : BUDGET          DECIMAL
        FIELD ACT : ACTUAL          DECIMAL
        FIELD VAR : PCENTVN         DECIMAL
```

and then defining the contents of the dataset in terms of those fields, the expected number of records and the "key" field (the importance of the key field will become apparent later):-

```
DEFINE DATASET COSTS
        FIELDS CC, WP, DPT, CD, BUD, ACT, VAR
        SIZE 10,000
        KEY CC
        PASSWORD  PNUT
```

Once the Costs dataset has been defined in this manner data can be entered into it, calculations run on the data, enquiries made, reports printed, changes carried out, etc.

Standard datasets

In the case of CPM data there is sufficient uniformity between all users to allow several standard datasets to be set up in advance by Metier so that the individual user only has to DEFINE any extensions he wants to those datasets (the standard datasets deal with activities and events; resources required; resources available and calendars).

For other applications Metier can often offer "model" datasets so that the user has only to modify them to meet his particular needs.

DATASET RELATIONSHIPS

In practice, very few applications can be designed easily and economically around a single dataset. The database will contain a number of datasets and for any particular task it may be necessary to relate several of them together.

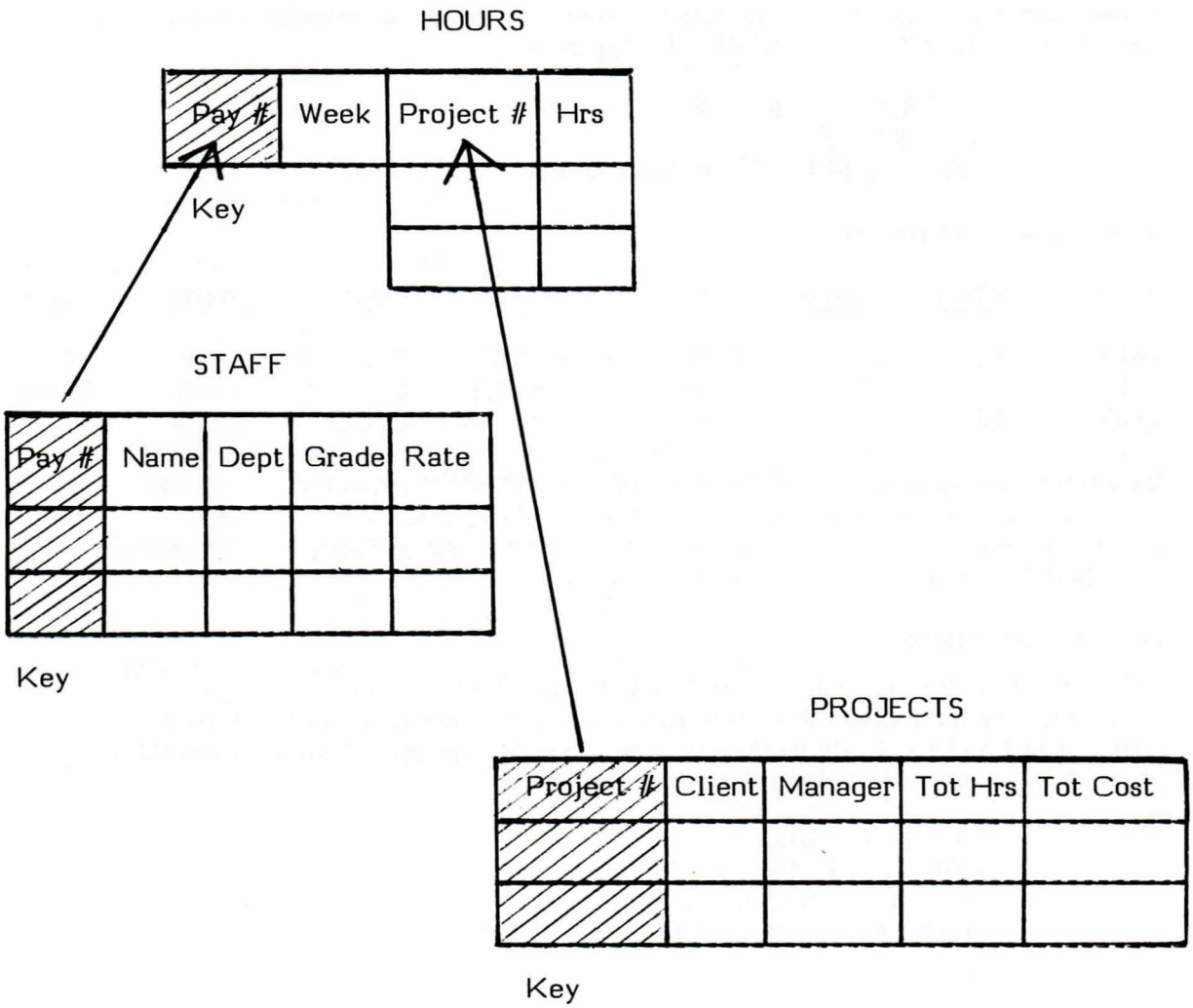
For example, in a simple engineering application there might be:-

An HOURS dataset derived from weekly Time Sheets input.

A PROJECTS dataset containing the total manhours and cost information for each project.

A STAFF dataset containing the details and rates for each man.

Relationships between these datasets are achieved by using the fields designated as "keys".



USE in enquiries

The purpose of the relationships using key fields becomes a bit clearer if we imagine that we want to look at anyone who has put in more than 40 hours on a project last week. If we say:-

```
DISPLAY IN HOURS IF HRS  40 AND WEEK = 13
```

then we get back the response from dataset HOURS:-

Pay #	Week	Project #	Hrs
1415	13	K11	42
2419	13	K11	41.5
1104	13	X12	46

If we can't remember the individuals' names it may be more helpful to extract data from both HOURS and STAFF by typing:-

```
DISPLAY IN HOURS
USE STAFF
SELECT IF HRS  40 AND WEEK = 13
```

when we will get back:-

Pay #	Week	Proj #	Hrs	Name	Dept	Grade	Rate
1415	13	K11	42	HOGG	CIV	SENG	62.50
2419	13	K11	41.5	JAMES	CIV	JENG	35.00
1104	13	K12	46	BROWN	ELEC	SENG	65.00

By simply saying USE STAFF we have related STAFF to HOURS (using the Pay # as a link - because it was defined as the key field in HOURS) and caused the Name, Dept., Grade and Rate to be picked up from each record and attached to the appropriate HOURS record.

USE in calculations

This same USE process can be used to carry out calculations on related datasets. For example, we should need to update the total hours and total cost in the PROJECTS dataset each week and this involves taking **Hours** data from HOURS as well as **Rate** data from STAFF:-

```
SET IN HOURS
USE STAFF, PROJECTS
TOTHRS = TOTHRS + HRS
TOTCOST = TOTCOST + HRS * RATE
END
```

USE in reports, etc.

USE also allows a report to contain data from two or more datasets. Thus the example overleaf contains data from the three datasets, HOURS, STAFF and PROJECT.

REPORT DATE : 6-MAR-79 WEEK NO. 13

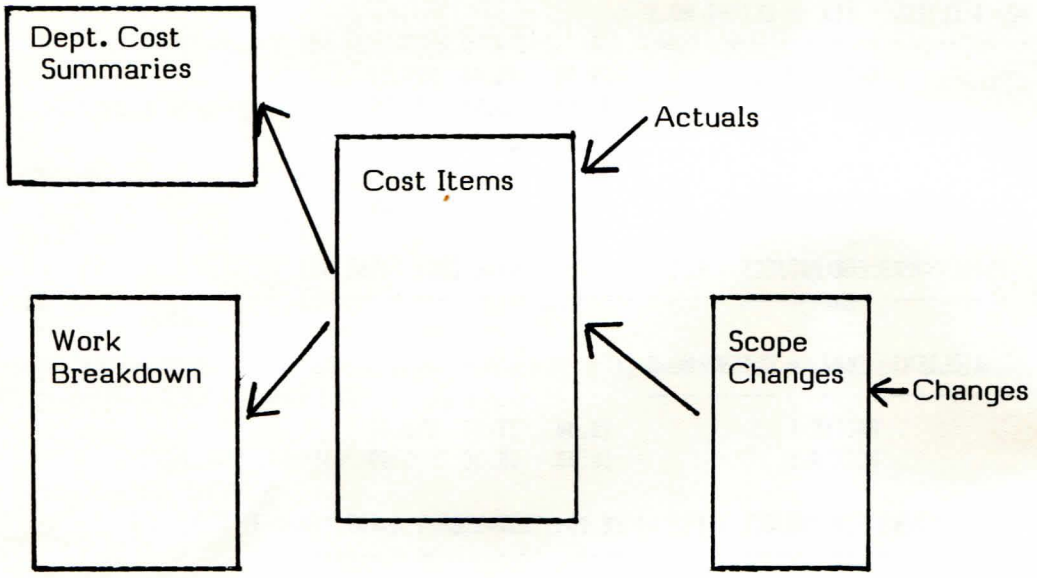
WEEKLY BOOKING REPORT - ALL PROJECT

PERSONS NAME	HOURS	RATE	COST PER MAN
PROJECT NO. & CLIENT : K11 - CLIENT NO.1			
BADGER R. J.	29.00	25.00	725.00
BULL Y.I.	37.50	26.50	993.75
DAVY J.L.	40.00	26.80	1072.00
HOGG A.S.	37.50	18.50	693.75
SISKIND R.F.	4.00	19.50	78.00
TOTAL HOURS FOR PROJECT : K11 =	148.00	TOTAL COST	=3562.50
PROJECT NO. & CLIENT : K12 - CLIENT NO.2			
BADGER R. J.	10.00	25.00	250.00
HOGG A.S.	10.00	18.50	185.00
TOTAL HOURS FOR PROJECT : K12 =	20.00	TOTAL COST	= 435.00
PROJECT NO. & CLIENT : X11 - CLIENT NO.3			
BADGER R. J.	1.50	25.00	37.50
DAVY J.L.	14.00	26.80	375.20
SISKIND R.F.	10.30	19.50	200.85
TOTAL HOURS FOR PROJECT : X11 =	25.80	TOTAL COST	= 613.55
PROJECT NO. & CLIENT : X12 - CLIENT NO.4			
SISKIND R.F.	30.50	19.50	594.75
TOTAL HOURS FOR PROJECT : X12 =	30.50	TOTAL COST	= 594.75

TOTAL HOURS BOOKED - ALL PROJECTS : 224.30 TOTAL COST =5205.80

COSTING APPLICATIONS

A typical WBS based costing system includes datasets for Cost Items, Work Breakdown Structure, Scope Changes, Dept. Cost Summary and other data. (A cost engineering system not based on a WBS approach is equally feasible)



Actuals may be derived at the basic level (e.g. from actual recorded manhours and other records), or picked up at a higher level (e.g. from the financial accounting records). In either case some preliminary **ARTEMIS** calculation may be used to get the data into appropriate form. For example, actual manhours would be extended to cost and summarised up from job level to cost code. At the higher level, financial accounting records may be processed against an intermediate dataset to relate A/cs Codes to Cost Codes and possibly spread one Accounting record across several Cost records.

In addition to actuals the Cost Item dataset must be updated by scope changes and other data.

Relational Links

Relational links to a separate WBS dataset allow use of a WBS coding system which is independent of the Cost Code (i.e. **not** using significant digit coding). Using these relationships cost summaries by WBS can be built up. There are no limits to the number of levels in the WBS nor to the number of Work Packages or WBS items.

Similarly, relational links to a Department Cost dataset allow summaries to be built up by functional departments as in the following sample report.

The use of what might be called "intermediate" datasets relating Ac/s Codes to Cost Codes, or Cost Codes to WBS, provides great flexibility. For example, a "new" Cost Code structure can be related to an existing A/cs Code without difficulty. And a "foreign" WBS can be related to an existing Cost Code. It is even possible to have more than one WBS if required.

MATERIAL APPLICATIONS

Variety in needs

The system may start at the take off stage, cover the whole bid-listing, procurement, expediting and shipping process and extend right the way through to site inventory control. Or it may embrace just one part of that process.

It can cover just items of major equipment, or it may control right down to the galvanised nails level.

It may be initiated by the client and only partially operated by the contractor, or it may form an integral part of an engineer and construct contract.

It may encompass containerization, several stages of transport and multiple warehousing points, or it may be a simple, single stage, single stockholding system.

It may need just one **ARTEMIS** installation, or several. For instance, one current user has a home office installation where the initial stages of the materials system takes place and four systems at remote sites where the latter stages occur.

It can cope with the fact that even in one corporation the materials management needs on one project differ significantly from those on another project (because of size, client or location).

Variety in structure

In all cases, the structure of the datasets must reflect the system requirements. If containerization is called for, a Container dataset is likely to be needed. If there are multiple warehouses this will probably be reflected in a separate dataset for each warehouse and so on.

Variety in calculations

In the same way calculation procedures reflect specific needs. A large proportion of the calculations will revolve around dates. For example, a material item record may well contain 30 dates (Bid Date, Client Approval Date, Urge Date, Ship Date, Required on Site Date, etc.). It's easy to write a simple set of **ARTEMIS** calculations to calculate most of these dates automatically. Usually, most will be calculated backwards from Required on Site date:-

Ship Date = Required on Site Date - Shipping Time
Urge Date = Ship Date - Lead Factor.

Constants such as Shipping Time and Lead Factor can be varied to allow for different methods of shipping, supplier lead times, type of material, etc.

Reports

From the datasets an immense variety of reports can be produced:

- Expediting Lists for chasing suppliers
- Procurement Status Lists for chasing clients for Bid Approval
- Warehouse lists
- Overdue lists
- Container lists

etc.

A sample report showing data drawn from a Materials dataset and a related Supplier dataset follows.

MMS
****

SUPPLIERS REPORT
********** *******

PROJECT - METIER MATERIAL COSTING DEMONSTRATION

REPORT DATE: 26-OCT-78

AFE NO. & TITLE: 8701 - SECTION 1 OF MAIN CONTRACT

SUPPLIER NUMBER	SUPPLIER NAME	SUPPLIER ADDRESS	TELEPHONE NUMBER	ORDER NUMBER	ORDERED DATE	PRICE	DELIVERED DATE	MATERIAL REF.	MATERIAL DELIVERED
103	WIRE & CABLE	PORTVALE IND ESTATE	LIVERPOOL 24421						
				1028	4/OCT/78	5200.00	23/OCT/78	MT7712	23/OCT/78
				1309	3/OCT/78	133.90	11/OCT/78	MT1170	
				1710	1/OCT/78	200.00	15/OCT/78		
				2151	15/SEP/78	10000.00	30/OCT/78	T4121	
				4341	24/OCT/78	18795.00		F1214	
				5304	17/OCT/78	6000.00		CABLE1 CABLE2	23/OCT/78
				8813	22/OCT/78	4000.00			
104	OFFICE CATERING	54 FOOD LANE	NORWICH 4450						
				5010	26/OCT/78	9750.00		T1314 T1412	27/OCT/78
105	HIRE A CRANE	61 HAMMERSMITH BRAODWAY	01-484-1124						
				1030	2/SEP/78	45000.00		HT341	
107	PCPD CONSULTANT	45 PRIMORSE LANE	LUTON 2192						
				1202	14/OCT/78	95475.20			
				4191	2/OCT/78	69750.00	22/OCT/78		
108	EHV ELECTRICS	CRAWLEY IND. ESTATE	CRAWLEY 2242						
				1025	7/OCT/78	7000.00		MT712	
				1027	5/OCT/78	14950.00	11/OCT/78	MT3415	11/OCT/78
				4472	31/OCT/78	25650.00			
109	MATERIALS LTD	44 RAWMAT RD	01-443-9920						
				1024	9/OCT/78	7850.00	21/OCT/78		

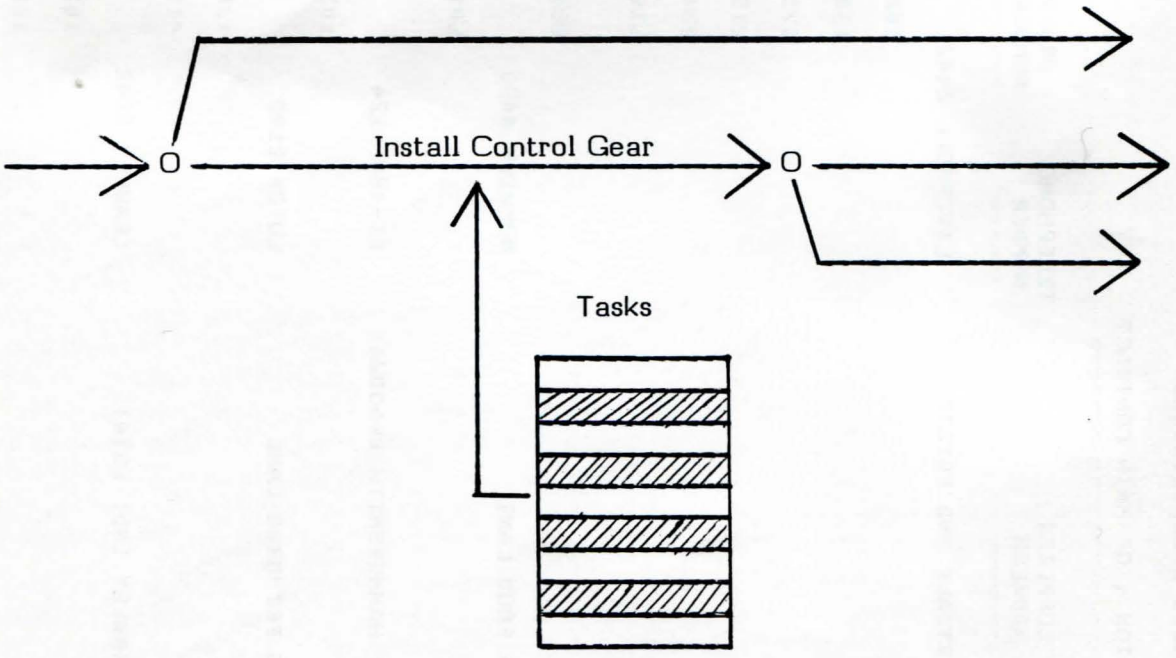
The ability to relate one dataset to others extends to the network datasets - a new kind of capability which allows networking to be seen in a completely new light.

Network Level

For example, we can find an excellent solution to the problem of "what level should the network be at?"

Suppose that one group of jobs relates to installing control gear. The group of jobs might involve about 40 things - pulling cables, connecting cable ends and so on. Conventionally, an uneasy choice has to be made between representing this as one activity and representing it as 40 activities. On the one hand there is imprecision over what the single activity really involves and inability to measure progress, and on the other hand the network becomes over large, errors abound and the schedules are ignored by site personnel because they are too detailed and impractical.

With **ARTEMIS** it becomes possible to represent it as one activity with a related dataset of Tasks. In this dataset of, say, 5000 tasks there would be 40 relating to this one activity:-



Each Task has a Job #, Description, Allowed Manhours and other information.

Every week, following a broad CPM scheduling run, a Task list can be produced for each supervisor showing the detailed jobs on which he is expected to make progress. Detailed scheduling of those tasks is left to the supervisor.

Progress

The progress reported on each task by the supervisor is input to the Tasks dataset. There it is summarised up to provide progress information which is in turn used to update the Network dataset.

Quite large numbers of changes to Tasks can be made without materially affecting the summary positions at the Network level. And the Tasks data can even contain some errors without throwing out the whole network.

The benefits

Thus, everyone's happy.

- The site supervisor gets a detailed Task List of jobs for the week but has freedom to do his own scheduling in the light of the practical, detailed problems.
- The cost/scheduling engineer has his own smaller and more manageable network.
- The project manager gets accurate reports because detailed progress information at the Task level is summarised up to the Activity level.

DEMON NORTH SEA U.K COMPANY

DATE 28-JUN-79

TEXASHELL SOUTH SEA PLATFORM

ACTIVITIES DETAILING TASKS FOR STAGE 1 COMPLETION

ACTIVITY - 005 - 010 STAGE 1 P.W SYST AIR & HYDRO TEST & COMMISSION DURATION = 18

JOB CARD NUMBER	ITEM DESCRIPTION	STAGE NO	SYSTEM NO	PLANNED MAN HRS	ACTUAL MAN HRS	REMAINING MAN HRS	WORK PACKAGE CODE
A022-12	INSTALL 130 OFF BESTOBELL SEALS AT PIPE IN MODULE	1	1	70	60	10	MF
A023-13	SI 4681 PROVIDE LABOUR TO CHANGE OUT ACTIVATOR SEA	1	1	40	30	10	MF
A024-14	TEST AIR LINES COMMISSION HYDRO PLANT (STAGE 1)	1	1	80	60	20	MF

ACTIVITY - 060 - 065 COMMN MECH EQUIPT TEST EMERG SW,BD IN ACC MOD (STAGE 1) DURATION = 20

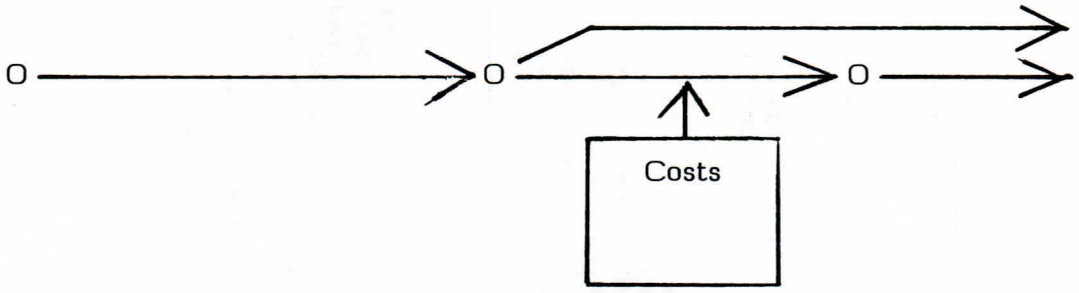
JOB CARD NUMBER	ITEM DESCRIPTION	STAGE NO	SYSTEM NO	PLANNED MAN HRS	ACTUAL MAN HRS	REMAINING MAN HRS	WORK PACKAGE CODE
C023-23	INSTALL SW,BD 1-4 GROUND EARTH AND TEST	1	1	50	40	10	AC
C023-24	LAY CABLE TRAYS TO MODS ACC TO MODS ADD,GLAND AND	1	1	90	60	30	AC
C023-25	CHECK SWI BOARDS 1-8 LIVE TEST AND SEAL	1	1	60	40	20	AC
C023-26	TEST & COMMISSION EMERG GENARATORS FOR ACC MOD	1	1	20	20		AC

ACTIVITY - 105 - 110 INSTALL & CHECK-OUT WATER SYSTEM TO STAGE 1 REQTS DURATION = 26

JOB CARD NUMBER	ITEM DESCRIPTION	STAGE NO	SYSTEM NO	PLANNED MAN HRS	ACTUAL MAN HRS	REMAINING MAN HRS	WORK PACKAGE CODE
B021-21	INSTALL PIPES FOR MODS 1-4 SEAL AT FIT CAMERON VAL	1	1	70	50	20	LF
B022-22	INSTALL HOT WATER SYSTEM (STAGE 1) MODS 1-4 & SEAL	1	1	50	40	10	LF

INTEGRATED COST/SCHEDULING SYSTEMS

The key to implementing an Earned Value or Integrated Cost/Scheduling System of the C/SCSC or PMS type is to **relate** a Costs Dataset to the network.



Then:-

BCWS	is calculated once using Costs related to the Network on the basis of the original agreed schedule
ACWP	is built up from the actuals input to Costs.
BCWP	is recalculated monthly using Costs related to Network on the basis of percentage work completed.
Variances	(both Schedule and Cost) are recalculated at the same time.

Reports by work breakdown level and by functional split can then be produced from the Costs datasets. Some sample reports follow.

Scope changes, estimates and forecasts can be handled in a similar fashion.

Costs can be related to network either via a Work Package dataset or a Cost Item dataset as is appropriate.

The system can be implemented to handle:-

- More than one cost item per network activity.
- The spreading of a single cost item over more than one network activity.
- The use of a number of alternative formulae for spreading costs over activities (e.g., linear, non linear, allocated to an event, etc.)

COST PERFORMANCE REPORT

WORK BREAKDOWN STRUCTURE

REPORT DATE : 1-JUL-79

METIER/ARTEMIS :
DEMONSTRATION OF AN EARNED VALUE SYSTEM
AACE CINCINATTI 15-JUL-79

PROJECT NAME : WASTE DISPOSAL PLANT
CONTRACT TYPE/NUMBER : FP. 1/08/1932
LEVEL 1 SUMMARY : TANKS

LEVEL 2 SUMMARY : SECONDARY TANKS

COMPANY : XYZ COMPANY
CONTRACTOR : BUCKSHEE ENG.
LOCATION : CINCINATTI

REPORT PERIOD : OCT-1979

ITEM	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL	VARIANCE		BUDGETED COST		ACTUAL	VARIANCE				
	WORK SCHEDULED	WORK PERFORM'D	COST WORK PERF'D	SCHED ULE	COST	WORK SCHEDULED	WORK PERFORM'D	COST WORK PERF'D	SCHED ULE	COST	BUDGETED	LATEST REVISED ESTIMATE	VARIANCE
SECONDARY TANK NO.1	9486	12591	9100	3105	3491	27668	27248	28201	-420	-953	80876	81604	-728
SECONDARY TANK NO.2	1283	2422	336	1138	2086	3786	9462	9722	5676	-260	79524	82581	-3057
SECONDARY TANKS	10770	15013	9436	4243	5577	31455	36710	37922	5255	-1212	160400	164185	-3785

CURRENT BUDGET = $ 160400

ESTIMATED FINAL COST = $ 164185

COST PERFORMANCE INDEX = 0.97
SCHED PERFORMANCE INDEX = 1.17

COST PERFORMANCE REPORT

FUNCTIONAL STRUCTURE

REPORT DATE : 1-JUL-79

METIER/ARTEMIS :
DEMONSTRATION OF AN EARNED VALUE SYSTEM
AACE CINCINATTI 15-JUL-79

PROJECT NAME : WASTE DISPOSAL PLANT
CONTRACT TYPE/NUMBER : FP, 1/08/1932
SUPERINTENDENT : GENERAL SITE - I.ROBERTS

SUPERVISOR : CRANAGE - D.WAYNE

COMPANY : XYZ COMPANY
CONTRACTOR : BUCKSHEE ENG.
LOCATION : CINCINATTI

REPORT PERIOD : OCT-1979

ITEM	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL	VARIANCE		BUDGETED COST		ACTUAL	VARIANCE				
	WORK SCHED ULED	WORK PER FORM'D	COST WORK PERF'D	SCHED ULE	COST	WORK SCHED ULED	WORK PER FORM'D	COST WORK PERF'D	SCHED ULE	COST	BUDGETED	LATEST REVISED ESTIMATE	VARIANCE
TOWER CRANE MOBIL	1029	2880	288	1851	2592	2880	2880	3108	0	-228	2880	3108	-228
TOWER CRANE DEMOB.	0	0	0	0	0	0	0	0	0	0	1512	1512	0
TOTAL - SUPERVISOR	1029	2880	288	1851	2592	2880	2880	3108	0	-228	4392	4620	-228

CURRENT BUDGET = $ 4392

ESTIMATED FINAL COST = $ 4620

WORK PACKAGE / SCHEDULE REPORT -- WP 2317

METIER/ARTEMIS :
DEMONSTRATION OF AN EARNED VALUE SYSTEM
AACE CINCINATTI 1-JUL-79

REPORT PERIOD : OCT-1979
CONTRACT NUMBER - 1/08/1932

WORK PACKAGE # 2317 DESCRIPTION : TANK WALLS (C1)
SUMMARY WBS CODE 231 DESCRIPTION : CONSOLIDATION TANK NO.1

WORK PACKAGE SUMMARY

DATES :

BUDGET DATES : START = 31-JAN-80 FINISH = 15-MAY-80
CURRENT DATES : START = 6-FEB-80 FINISH = 21-MAY-80

COST INFORMATION

CURRENT BUDGET : $20932.00 ACTUAL COST TO DATE : $ 0.00 REVISED ESTIMATE : $20932.00

PERCENTAGE COMPLETION TO DATE : 0.00

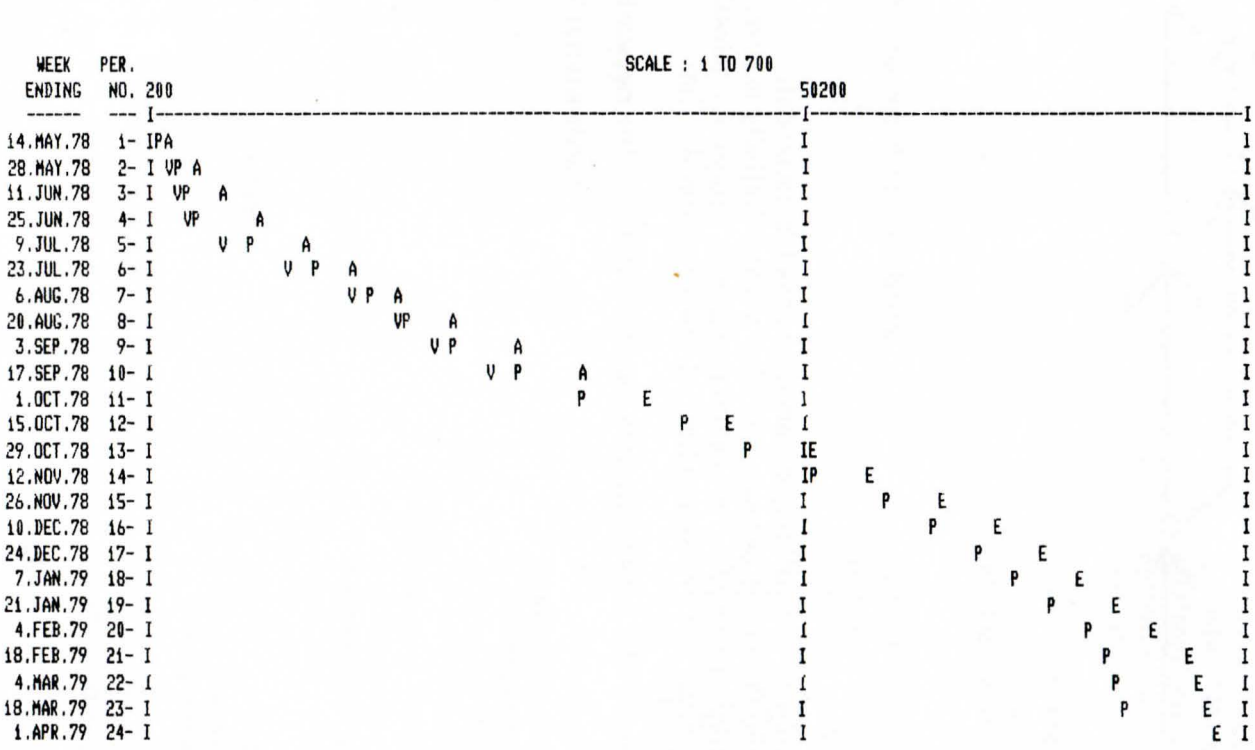
DETAILS OF CURRENT SCHEDULE

PREC EVENT	SUCC EVENT	DUR	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL FLOAT	ACTIVITY DESCRIPTION
296	298	3	6-FEB-80	8-FEB-80	20-AUG-80	22-AUG-80	140	FORM WALLS TANK C1(1
298	300	2	11-FEB-80	12-FEB-80	25-AUG-80	26-AUG-80	140	CONC WALLS TANK C1(1
302	304	8	14-FEB-80	25-FEB-80	28-AUG-80	8-SEP-80	140	STRIKE TANK C1 (1)
402	404	2	14-MAR-80	17-MAR-80	26-SEP-80	29-SEP-80	140	COMPLETE STRIKE TANK
404	406	2	18-MAR-80	19-MAR-80	30-SEP-80	1-OCT-80	140	CONC WALLS TANK C1(2
408	410	8	21-MAR-80	1-APR-80	3-OCT-80	14-OCT-80	140	STRIKE TANK C1 (2)
904	906	2	23-APR-80	24-APR-80	5-NOV-80	6-NOV-80	140	CONC WALLS TANK C1 (
908	910	8	28-APR-80	7-MAY-80	10-NOV-80	19-NOV-80	140	COMMENCE STRIKE TANK
910	924	10	8-MAY-80	21-MAY-80	23-DEC-80	5-JAN-81	163	STRIKE SCAFF C1

REPORT SHOULD BE RETURNED TO SUPERVISOR : GENERAL CIVIL WORKS - J.MAHER

PROJECT : INTERNET PROJECT

PROJECT COST CONTROL ANALYSIS



WEEK ENDING	PER. NO.	GRAPH P EST.LAB.COST EARLY DATES CUMUL ..COST	GRAPH A ACT.LAB.COST ACTUAL DATES CUMUL ..COST	GRAPH V PLANNED VALUE OF WORK COMPLET CUMUL ..COST	EST.VALUE REMAINING WORK CUMUL ..COST	GRAPH E EST.COST TO COMPLETE CUMUL ..COST
14.MAY.78	1-	723.00	1674.00	0.00	0.00	1674.00
28.MAY.78	2-	2128.30	3708.00	1807.50	0.00	3708.00
11.JUN.78	3-	2670.10	6102.00	2529.30	0.00	6102.00
25.JUN.78	4-	3658.55	8856.00	3033.70	0.00	8856.00
9.JUL.78	5-	7858.85	11970.00	6037.95	0.00	11970.00
23.JUL.78	6-	12610.05	15444.00	11008.20	0.00	15444.00
6.AUG.78	7-	17234.70	19278.00	15446.10	0.00	19278.00
20.AUG.78	8-	20090.25	23472.00	19284.75	0.00	23472.00
3.SEP.78	9-	23314.28	28026.00	21865.43	0.00	28026.00
17.SEP.78	10-	28224.98	32940.00	26322.03	0.00	32940.00
1.OCT.78	11-	33183.98	0.00	0.00	4835.63	37775.63
15.OCT.78	12-	40525.03	0.00	0.00	11523.33	44463.33
29.OCT.78	13-	45672.85	0.00	0.00	17418.38	50358.38
12.NOV.78	14-	50603.60	0.00	0.00	22153.38	55093.38
26.NOV.78	15-	56319.85	0.00	0.00	27423.13	60363.13
10.DEC.78	16-	59443.40	0.00	0.00	31918.83	64858.83
24.DEC.78	17-	63469.55	0.00	0.00	35385.13	68325.13
7.JAN.79	18-	65818.95	0.00	0.00	38208.33	71148.33
21.JAN.79	19-	68682.75	0.00	0.00	40736.63	73676.63
4.FEB.79	20-	71295.35	0.00	0.00	43810.93	76750.93
18.FEB.79	21-	73208.15	0.00	0.00	46339.13	79279.13
4.MAR.79	22-	73846.95	0.00	0.00	47147.63	80087.63
18.MAR.79	23-	74709.35	0.00	0.00	48063.93	81003.93
1.APR.79	24-	0.00	0.00	0.00	48387.33	81327.33

VARIANCE CALCULATIONS AT 17-SEP-78

BUDGET VARIANCE (GRAPH A - GRAPH P) = 4715.03

WORK VALUE DEFICIT (GRAPH V - GRAPH P) = -1902.95

TOTAL OVER EXPENDITURE (GRAPH A - GRAPH V) = 6617.98

RATIO OF PLANNED WORK TO WORK COMPLETE TO DATE = 0.93

PROJECT COST SUMMARY

PLANNED PROJECT COST 74709.35

NEW ESTIMATED PROJECT COST 81327.33

PLANNED COMPLETION DATE : 14-MAR-79:2

NEW COMPLETION DATE :21-MAR-79:2

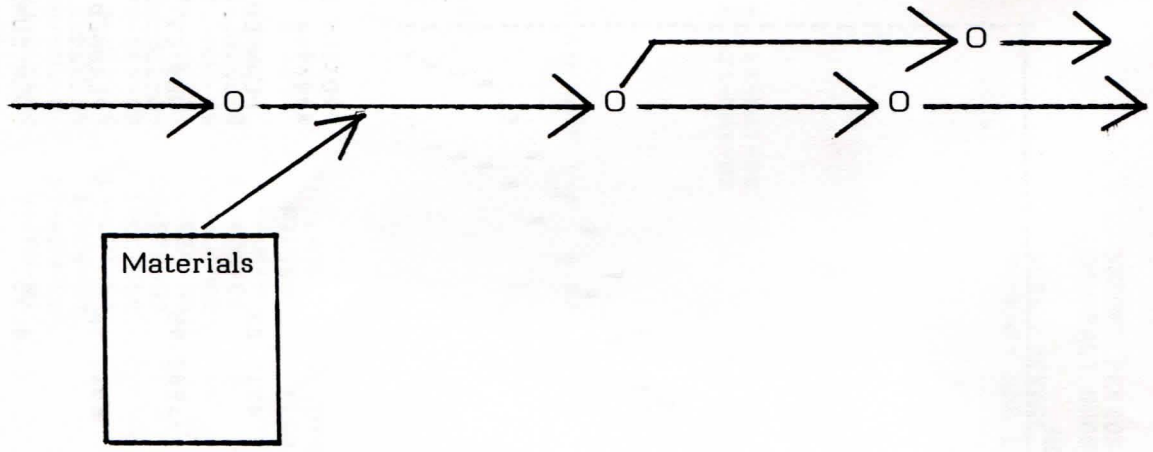
TOTAL PROJECT VARIANCE -6617.98

PRODUCED BY METIER MANAGEMENT SYSTEMS

RELATING OTHER APPLICATIONS TO NETWORKS

By relating Materials to network activities it becomes possible to:-

- Transfer dates from network to material items. e.g. Early Start becomes the Required on Site Date (less a margin) in all related material items.
- Transfer dates from material records to activities. e.g. Expected Delivery Date is used to update a Latest Material Arrival date on the network - which can then be compared with current Early Start Date to throw up any delays due to expected material shortage.
- Produce lists of materials required for next week's activities for issue to supervisors.



Similarly, by relating Drawings to networking it becomes possible to transfer dates from the network to the Drawings dataset and vice versa - initially setting target dates by which drawings are required and then comparing progress against new scheduled requirement dates and producing lists of drawings running late.

Obviously plant, crew, transport and other datasets can be related to the networks or to each other as required.

SECTION 10 - DESIGN PHILOSOPHY

THE NEW CPM

If you've managed to follow all of this so far you will probably be ahead of us and will have perceived that **ARTEMIS** enables you to take a radically new kind of approach which has several characteristics:-

Network Simplification

- Networks can be drawn at a fairly high and manageable level of detail. More detail can then be added as required by relating jobs, costs, drawings, materials or whatever else to the network.

Computerise where it hurts

- If costing is where the main task is then a costs system can be implemented quickly. Networking and all the other applications can be left as manual systems. If it's a materials problem then that can be implemented.

  And of course the application that's giving you pain on one project may not be the one that hurts on the next one.

Use the existing rule book

- The flexibility of **ARTEMIS** allows you to retain your existing cost codes, accounts codes, WP codes, etc. An existing cost code can be related to existing accounts code via an intermediate dataset. And if the client has his own ideas on Work Package coding they can be related to cost codes in the same way.

Integrate slowly

- A fully integrated system is a nice kind of goal but is apt to be elusive. It is better to put up a drawings control system on its own and a network on its own, then relate them later by adding a little more data to one of the datasets - and then maybe develop a timesheet system and integrate that later and so on.

Make the changes

- There's constant pressure for application system change. **ARTEMIS** is designed to handle change - so make the changes.

  The result will be better user acceptance of the application system.

SYSTEM EVOLUTION

The truth is that it's very difficult to get the design of an application system right first time - users' needs crystallise and evolve when they see the first reports and then evolve some more at the next version and so on.

It's also true that systems just won't stand still - they evolve on a continuing basis. Nowhere is this more true than in Project Management. The reasons aren't hard to find:-

- Each project is different - just plain different
- Each client wants different reports and different control systems - and changes his mind as he goes
- The project management team change their minds on their system needs as the project develops - and the personnel changes create more changes.
- The real control needs for the project actually change as it goes through different phases, hits different problems, is run by different people, etc.

ARTEMIS provides facilities for handling this constant change. That doesn't just mean being able to change a few report formats (important though that is). The relational database technology used in ARTEMIS makes it possible:-

- To add a couple of new fields to the network dataset when the client decides he wants to see slippage against original schedule;
- To change the Jobs dataset when the site manager wants to see a productivity index;
- To amend the Costs dataset when management call for cost to completion estimates.
- And a hundred more such changes.

All of these changes can be effected with minimal effort and disruption because the **structure** of the data is separate from the **data** itself.

HELP!!!

The **ARTEMIS** language is a subset of normal English - using words and syntax which are "natural" to the user and which hardly need to be "learned" in the conventional sense.

Inevitably, however the user finds himself having temporarily forgotten how to do something in **ARTEMIS.** Rather than turning to the user manual he can gain help in one of three ways:-

- Typing "?" will cause the system to respond with a helpful message about what he can or can't do at that point. (User input is in heavy type.)

e.g. * **CALENDAR**
> ?

THE CALENDAR COMMANDS ARE:

BASEDATE - TO SPECIFY THE CALENDAR START E.G.
BASEDATE 1-JAN-79

UNITS - TO SPECIFY THE TIME UNITS E.G.
UNITS 4 PER DAY
UNITS 7 DAYS

REST - TO SPECIFY REST PERIODS E.G.
REST ON CALENDAR 1

HOLIDAYS - TO SPECIFY HOLIDAYS E.G.
HOLIDAYS ON CALENDAR 3

END - TO RETURN TO COMMAND LEVEL

- Typing "Switch Prompt On" will cause the system to feed the user with prompts from that point on for each command. (User input is in heavy type)

e.g. **SWITCH PROMPT ON**
SCHEDULE
TIME OR RESOURCE LIMITED: **RESOURCE**
SELECT IF: **RES IS CRANE**
GROUP: **RES/12**
ORDER: **ES TF**

Typing "Switch Prompt Off" has the obvious effect.

- Finally, the user can just type something on a trial and error basis. **ARTEMIS** will not sulk, cackle with laughter, disintegrate into a pile of chips or reply (unhelpfully) ERR - EOD12 but will respond with a helpful message. A few more tries will usually get it right!

Learning ARTEMIS

ARTEMIS relies upon the user "learning" a somewhat formalised subset of the English language. e.g. in learning to enter an enquiry by typing:-

```
DISPLAY IF RES IS PIPE AND ES
AFTER 1-AUG-80
```

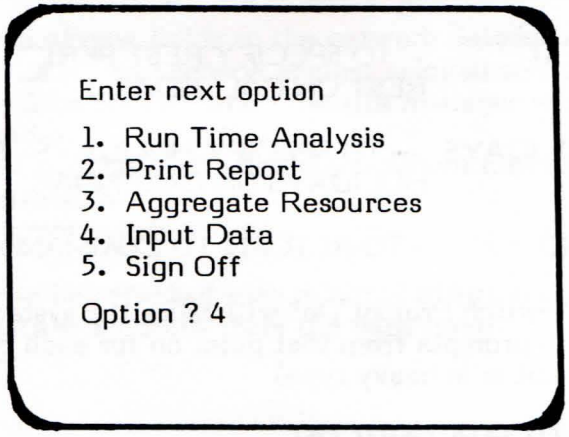
he has to remember a few field names, the command DISPLAY and a simple grammatical form.

The learning effort involved runs from a few hours for the most commonly used parts of the system (which is enough for the occasional user) to a few days for the complete system.

Notice that it's the user who is telling the system what to do.

Menu System

An alternative approach used in some other interactive systems is to use a "menu driven" system:-



Notice that it is the system which is in control rather than the user.

Question & Answer Systems

And another alternative is for the user to answer a series of questions put by the computer:-

```
Input, Update, Report or Calculate?  REPORT
Sort Sequence?                       TF
Any more?                            ES
Lines per page?                      60
etc.
```

Again, it is the system which dominates the dialogue with the user.

Easier?

Either of these two approaches might seem attractive, because at first sight they appear "easier" - being computer driven the user has only to exercise a set of options or answer a series of questions. Hence he does not have to "learn" the system.

ARTEMIS advantages

Extensive experience by the Metier design team over a 12 year period has shown however, that the **ARTEMIS** style of interaction is required for the kind of use experienced in project management, because:-

- It is far more powerful. For example, two **ARTEMIS** commands to change a report specification and then print it can equate with 30 answers in a menu or question and answer (Q.A.) system. Remarkably, there can easily be choices to exercise in printing a report, making a change, entering an enquiry, etc. **ARTEMIS** exercises such a choice in one or two commands whereas Menu or Q/A systems cannot practically handle that range of choice.

- It is user efficient. Typically Menu and Q/A systems will take 2 to 20 times as much typing by the user.

- Users like it because they are in control, not the machine. In contrast, the initially good user reaction to Menu or Q/A systems changes to one of boredom and irritation as they are driven repeatedly through the machine-led dialogue.

There's no denying that Menu and Q/A systems are the complete solution in some applications (e.g. airline seat reservation; bank teller terminals; order entry; etc.).

And they have a role to play in project management usage, e.g. entering a week no. when running a routine job. But they are inadequate for the greater part of user interaction in the project management context.

INTERACTIVE LANGUAGE DESIGN

Designing a language in which the cost/scheduling engineer can communicate easily and comfortably with the computer is a fairly subtle process. Over a period of 12 years or so we can fairly claim to have become reasonably expert at it, however. Doing it successfully is at the very heart of gaining the acceptance and enthusiastic support of the cost/scheduling profession.

English words - rather than using abstract symbols like
E */4 - 6/1024

familiar English words are used:-

DISPLAY IF PE = 1024

English syntax -The general grammatical form of the commands such as:-

CHANGE IN ---- IF ---- AND ---- OR ----

is familiar and immediately understandable.

Uniformity - the same commands are used in all applications

DISPLAY IN NETWORK IF DU >10 AND RES IS WELD

DISPLAY IN COSTS IF BUDGET >50000

DISPLAY IN DRGS IF DRGNO = 1248

Consistency - There is a consistent use of
- conditionals
- general grammatical form
- vocabulary

across all commands. For example

```
DISPLAY IF PE = 1234
CHANGE IN MATERIALS  DELY = 90
        IF TYPE = STEEL
SET IN COSTS
        EST = EST x 1.2 IF CODE = WELD AND
        START AFTER 1-SEP-80
```

The same consistent forms are used in report specifications, copying, network plotting, setting up command files and everywhere else.

Default strategy - If the user chooses not to exercise all the options open to him in a command the system will automatically set up the obvious default values and obey the command.

No "black holes" - There are no loopholes. If the user makes a mistake which the system can't understand it responds with an error message and doesn't go off into outer space somewhere. The user stays in control.

Tolerance - It tolerates some amount of mis-spelling and ignores spare spaces.

Free format - The commands are largely format-free rather than demanding a precise layout and sequence.

e.g.
DISPLAY IF DU 10 AND RES = WELD
achieves the same as
DISPLAY IN NETWORK IF RES IS WELD AND DU 10

Application level "programming" - The user sees his problem in application system terms and wants to "do" things at that level.

Thus for example he may see one problem as needing to calculate cost data from data about hours worked and the personnel rates per hour.

In **ARTEMIS** he can write:-

```
SET IN COSTS
USE HOURS, RATES
COST = COST + HRS * RATE IF TYPE IS CHARGEABLE
```

This is "programming" in the sense that he is telling the system what calculations to perform and on what data.

However it is not programming in the conventional way because the statements that he gives are unencumbered by the usual problem **how** the job is done - opening and closing files, subroutines, "goto's" and all the rest.

Artemis allows him to state what he wants **done** more or less at the application level at which he **thinks.**

SECTION 11 - SOME CPM TECHNIQUES

STANDARD NETWORKS

In some applications (e.g. tool and die manufacturing/repair in the automobile industry) it is appropriate to represent each job (e.g. the production of a tool) as a small network of about say 50 activities. Each activity is likely to have only 1 or 2 resources attached to it.

Scheduling can then be performed by combining the networks for all the current jobs (maybe 100 or more) and running a schedule on the whole.

To avoid having to draw a new network for each job it is possible to build a library of, say, 80 "standard" jobs. Entry of each new job then involves:-

- Choosing the nearest "standard" job
- Extracting it from the library
- Making various CHANGES to activities, durations and resources to fit it to this particular job.
- Possibly ading to it one or more further "standard" jobs to complete the whole tool.
- Adding a suffix to event numbers to make these unique when combined into the multi-project environment (with another CHANGE command).
- Copying the final network into the current multi-project file for later scheduling.

This provides a neatly automated way of handling this kind of semi-repetitive task.

NETWORK GENERATION

One category of application (e.g. high rise offices and apartments; large repetitive housing schemes) involves the repetition of a number of small networks. In some cases this may extend to "nested" repetitions e.g. 3 similar apartment blocks, each containing 16 repetitions of a floor which in turn contains 4 repetitions of an apartment.

ARTEMIS allows for the very rapid and easy generation of networks for this kind of problem:-

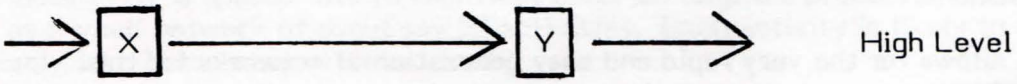
- A single small network for one apartment is created and put up on file.
- This is then read down four times, using CHANGE commands each time to add suffixes to event numbers (to make them unique) and also using CHANGE to add appropriate designators to the activity description (to indicate apartment#).
- The resultant network representing one floor is then COPYed to file and the process repeated to build a network for a building.
- At this stage of course additional activities must be tacked on to deal with foundations, roofing, etc.
- Next, the complete apartment network can be replicated three times
- Finally, a scheduling run is done on the whole scheme.

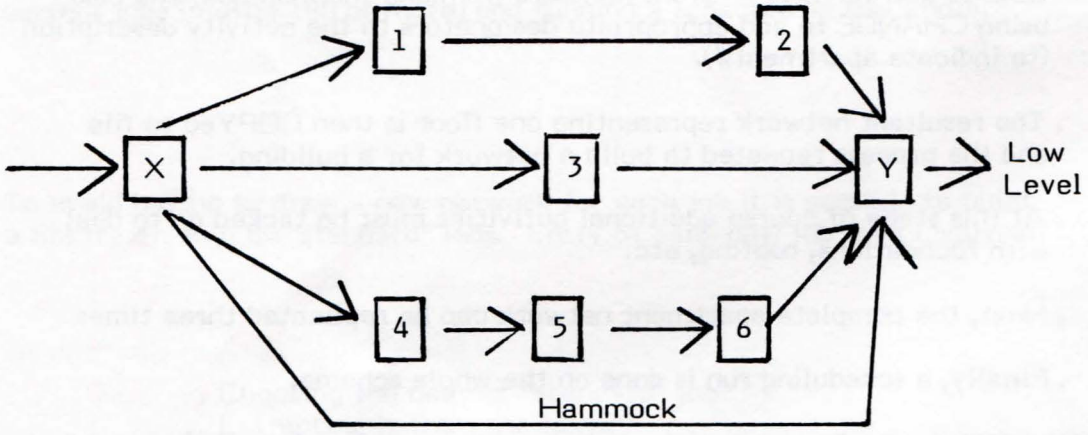
In some cases it may be appropriate at this point to reverse the whole process and "hammock" apartments on floors to build a management summary network for broad scheduling, cash flow planning and other control purposes.

A number of **ARTEMIS** users have built networks of effectively 25,000 or more activities in this way and completed the whole process of constructing the network, developing an appropriate schedule and analysing cash flows all within two or three days.

SUMMARY NETWORKS

Using **ARTEMIS** it is easy to summarise information from a lower level detailed network and pass it up to a high level summary network. It is equally easy to pass dates down in the form of target dates.





The usual method of doing this involves identifying nodes in the high level network with specific nodes in the lower level network by using the same node number (not absolutely essential, since they can be "translated" via an intermediate dataset if it's desired to use a different node labelling system in the two networks). In addition, each activity in the higher network is represented by a hammock in the lower one.

Two simple command files can be created, one to summarise and transfer data from the lower to the higher network and the other to transfer target dates from the higher to the lower network. Either command file can be run at any time.

RISK EVALUATION

Optional facilities within **ARTEMIS** provide the user with a set of tools for risk evaluation of projects using probabilistic techniques. Essentially, these allow the user:-

- To specify a range of duration for each activity. Each range is given in the form of three estimates and can be defined as
  - Normal curve distribution
  - Skewed distribution
  - "Square" distribution.

- To initiate a "Monte Carlo" network analysis run which performs a series of separate time analyses using randomly generated duration estimates for each activity (based on the probability envelope for each activity defined by the user). Typically 50 to 150 analyses might be called for.

- To print a variety of reports based upon the results showing distributions of expected completion dates, confidence curves, etc.

Samples of some typical reports are given overleaf.

These same techniques can be used to specify a range of the estimated costs of all work packages in a project.

- "Monte Carlo" runs can be initiated on the sum of the costs of all the work packages, to provide a distribution of the expected total project cost for purposes of risk evaluation.

PAN DEMONSTRATION 14-MAY-79

DISTRIBUTION OF EARLIEST FINISH DATES FOR EVENT 140

- RESULTS OF 100 RUNS OF NETWORK

EARLIEST	FINISH	REL. FREQ.	CUM. FREQ.	0 20 40 60 80
9-OCT-83 -	5-NOV-83	3	3	I$* I I I I I
6-NOV-83 -	3-DEC-83	1	4	I$* I I I I I
4-DEC-83 -	31-DEC-83	5	9	I$$$ * I I I I I
1-JAN-84 -	28-JAN-84	11	20	I$$$$$$ * I I I I
29-JAN-84 -	25-FEB-84	9	29	I$$$$$ I * I I I I
26-FEB-84 -	24-MAR-84	23	52	I$$$$$$$$$$$$ I * I I I
25-MAR-84 -	21-APR-84	11	63	I$$$$$$ I I I * I I
22-APR-84 -	19-MAY-84	8	71	I$$$$ I I I * I I
20-MAY-84 -	16-JUN-84	12	83	I$$$$$$ I I I I * I
17-JUN-84 -	14-JUL-84	8	91	I$$$$ I I I I * I
15-JUL-84 -	11-AUG-84	4	95	I$$ I I I I * I
12-AUG-84 -	8-SEP-84	4	99	I$$ I I I I *
9-SEP-84 -	6-OCT-84	1	100	I$ I I I I *

KEY: $$$$$$ REPRESENTS RELATIVE FREQUENCY
* REPRESENTS CUMULATIVE RELATIVE FREQUENCY

PAN DEMONSTRATION

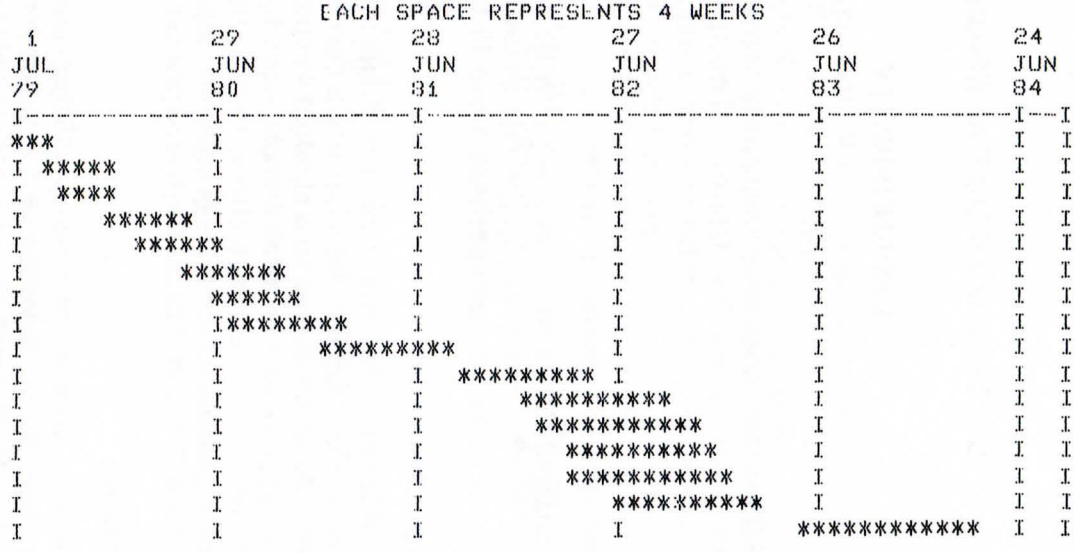
18-APR-79

RANGE OF EARLIEST FINISH DATES AND CRITICALITY OF ACTIVITIES

RESULTS OF 100 RUNS OF NETWORK

PREC. EVENT	SUCC. EVENT	CRIT. INDEX*	EARLIEST EARLY FINISH	LATEST EARLY FINISH
001	005	100	10.JUN.79	16.SEP.79
100	105	50	9.SEP.79	16.DEC.79
005	010	53	30.SEP.79	6.JAN.80
105	110	50	23.DEC.79	11.MAY.80
010	015	53	24.FEB.80	6.JUL.80
110	115	50	11.MAY.80	2.NOV.80
060	065	53	29.JUN.80	23.NOV.80
115	120	50	17.AUG.80	1.MAR.81
015	020	0	11.JAN.81	30.AUG.81
020	025	0	20.SEP.81	9.MAY.82
120	125	50	17.JAN.82	26.SEP.82
065	070	53	21.FEB.82	21.NOV.82
125	130	50	4.APR.82	26.DEC.82
070	075	53	11.APR.82	16.JAN.83
130	135	100	18.JUL.82	13.MAR.83
135	140	100	5.JUN.83	1.APR.84

EACH SPACE REPRESENTS 4 WEEKS



* % OF RUNS IN WHICH ACTIVITY LAY ON CRITICAL PATH

KEY: ***** REPRESENTS RANGE OF EARLY FINISH DATES

SECTION 12 - GENERAL FACILITIES

EXPANDABILITY

The basic **ARTEMIS** system consists, in hardware terms, of Central Processor, Printer, CRT with keyboard and Disc Drive. All equipment is standard Hewlett Packard. The capacity can be expanded in various ways:-

. Multiple Terminals

Additional CRT's with keyboard may be added up to a theoretical limit of 32. Depending on the mix of use, a more practical limit is likely to be between perhaps 5 and 15 terminals.

. Remote terminals

Some or all of the additional terminals may be situated remotely and access the system via tied or dial up telephone lines. As alternatives to a straight keyboard CRT, it may be more appropriate in these remote sites to use a keyboard CRT with printer and perhaps also with mag tape cassettes for local data capture. Alternatively again it may be more appropriate to use a 30cps or 120cps keyboard printer.

. Printers

The basic printer operates at 180char per second which for most purposes can be regarded as 1-2 pages per minute (or say 100 l.p.m.). Because of the interactive nature of **ARTEMIS**, the volume of print output required is lower than for conventional systems and only a small proportion of users have actually found they need higher speed.

A 400 lpm printer can be fitted either as an alternative, or as an additional printer.

Additional 180 char/sec printers (up to one per terminal) may be fitted.

Any printer can be assigned at any time as a "spool" printer to allow users at a number of terminals to place output into a queue for printing on that device.

. Discs

The single disc drive on the basic system supports one fixed and one exchangeable disc, each of 10M characters capacity. This allows typically 25,000 to 50,000 records (activities, cost items, material items, etc., or any combination of these) to be held on line at a time.

EXPANDABILITY (Cont'd)

The exchangeable disc carries all the records, so that a replacement disc carrying, say, another 35,000 records can be loaded in a couple of minutes. One **ARTEMIS** user, for example, handles over 50 projects totalling over 150,000 activities spread over some 10 or so exchangeable discs.

If a greater capacity is required on line, additional disc drives of either 20M character or 50M character capacity can be fitted up to a maximum of 8 drives. Addition of a single 20M character drive increases the on line capacity by 50,000 - 100,000 records and a 50M character drive increases it by typically 250,000 - 500,000 records.

. Management Graphics

An interactive graphics CRT and desk top, 4 pen plotter can be fitted to allow production of high quality curves, bar charts and histograms.

. Network Plotter

An on-line Calcomp 3 Pen 30" Plotter may be fitted for use in drawing networks.

. Other Hardware

Among the other items which have been fitted are:

- Magnetic Tape. For communication with users' mainframes.
- Card Reader. Used for occasional bulk data input.
- Paper Tape Reader. Similar use.

. Software Options

A number of software options can be exercised including:

- Support for CPM usage only
  (Artemis A)
- Support for extended CPM usage
  (Artemis B)
- Support for extended CPM and non CPM usage
  (Artemis C)
- Probabilities extension
- Management Graphics
- Network Plotting

. Operating System

ARTEMIS uses a somewhat modified version of the HP RTE operating system. The modifications provide improved user facilities while retaining HP's structure and interface conventions, allowing other HP software to be run by the user in the same environment if desired.

COMMUNICATION WITH A MAINFRAME

There are many reasons why the user may wish to pass information from an **ARTEMIS** system to his mainframe or vice versa.

- He may choose to run only CPM on **ARTEMIS,** running costs and materials management on the mainframe - but nonetheless wish to pass information to and fro.
- He may run costing on **ARTEMIS** and want to relate it to payroll and accounting applications on the mainframe.
- He may simply want to pass summary management information up from an **ARTEMIS** system on site to home office.

Magnetic Tape

Metier recognise these needs and provide facilities to meet them. Currently, this is done primarily through the media of magnetic tape. **ARTEMIS** can be equipped with a compatible tape drive and is provided with a set of special commands to allow easy translation of **ARTEMIS** data formats into an externally defined data format. A number of **ARTEMIS** installations are making use of these facilities.

2780 Emulator

To improve these facilities further a current development is in hand to allow an **ARTEMIS** system to emulate an IBM 2780. This development, which will be available last quarter 1979, will allow direct file to file communication between **ARTEMIS** and a mainframe providing appropriate bisync: communications support.

Metier will be pleased to discuss any other communication needs with prospective users.

GENERAL SYSTEM MANAGEMENT

Security

Of course, for highly classified projects **ARTEMIS** offers obvious advantages over remote use of a mainframe via telecommunication lines.

At the more mundane level, a system of user numbers, project numbers and passwords protecting users, projects and datasets ensures that access to any combination of these can be restricted to authorised individuals.

Usage Accounting

Reasonably complete facilities exist to allow the recording of system utilisation and an appropriate charging system for it to be developed.

System Management

One individual within the cost/scheduling group is normally designated as System Manager. He receives additional training and is provided with a System Managers Manual.

The System management tasks include:-

- Allocation of user numbers and passwords
- Usage accounting
- Daily procedures to start up and close system down, including the taking of archive copies of data for protection purposes. **ARTEMIS** incorporates very complete protection mechanisms to prevent accidental loss or corruption of data due to hardware/software failure or operator error.

Metier Management Systems

10175 Harwin Drive, Suite 100,
Houston, Texas 77036.
Telephone: (713) 988-9100

49-53 Harrow Road,
London W2, England.
Telephone: 01-402 5671