This work was done using the framework suggested by Ranganathan of, Personality, Matter, Energy, Space and Time. At the conceptual level this led to the following facets;

1. DESCRIPTION, 2. MATERIAL and PRODUCTS, 3. PRODUCTION RESOURCES, 4. LOCATIONS, 5. TIME RESOURCES.

Each facet is hierarchical in structure and consists of lists or tables of attributes giving greater detail as the hierarchical structure is followed.

In order to allow each group to access the data in such a way as to enable them to perform their functional tasks it is necessary to be able to extract information from several facets. The database would be structured to enable this to be done.

Of the many information sytems investigated it was found that CI/SfB was most closely allied to the principles of Ranganathan. To this end the CI/SfB system was modified as shown in Figure 3, a six facet structure being synthesised from the existing five facet structure.

It is hypothesised that the structure shown could form the basis of a database design and hence the development of a user friendly interface which would promote the exchange of information among the various functional groups in the design and construction processes.

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The Computer-aided Facility Management (CAD/FM) Program in the Government of Canada

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ABSTRACT

As a result of requests by a number of government departments for computer systems to address the facilities management process in buildings, in 1983 Public Works Canada (PWC) reviewed requirements, available systems, and potential benefits for a coordinated acquisition program.

The conclusion of the review was that no existing systems could address satisfactorily the wide range of needs, but that significant long term benefits could be obtained through the use of such systems, and that the basic capabilities for development existed in a number of Canadian firms.

Public Works Canada issued a request for proposal, which described features sought along with a proposed field trial approach, to some one hundred and twenty respondents to a letter of interest. The request suggested that the final product should be in a mid-price range and that field trials should take place in four government departments, starting with a basic drawing capability and evolving over the period of development to the final product. PWC reviewed sixteen proposals and conducted an extensive benchmark test for drawing production, manipulation, and storage on the final proposed start-up systems.

Public Works Canada selected two firms to produce products addressing computer-aided design for facility management (CAD/FM) through field trials with six departments. In all some thirty workstations are now in place and work is proceeding in a number of areas, starting with development of database structures and means of transferring files between the two selected products as well as to and from other systems.

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MOTS CLEFS

Conception assistée par ordinateur; gestion des installations; essais pratiques; bâtiments.

SOMMAIRE

En 1983, à la demande de plusieurs ministères Fédéraux qui désiraient voir automatiser la gestion des installations de bâtiments, Travaux publics Canada (T.P.C.) a examiné les exigences d'un tel projet, les systèmes existants et les avantages possible d'un programme coordonné d'acquisition.

L'examen a permis de conclure qu'aucun système existant ne pouvait satisfaire aux besoins très variés, mais que l'utilisation de systèmes spécialement conçus comportait des avantages importants à long terme et qu'un certain nombre de firmes canadiennes disposaient des capacités fondamentales nécessaires pour les élaborer.

Travaux publics Canada a donc diffusé une demande de propositions décrivant les caractéristiques souhaitées ainsi que les essais pratiques projetés aux quelque 120 firmes qui avaient répondu à une lettre préalable. La demande de propositions précisait que le prix du produit définitif devrait être moyen et que des essais pratiques devraient être faits dont quatre ministères fédéraux, depuis la capacité de dessin de base jusqu'au produit définitif, en passant par l'étape de l'élaboration. T.P.C. a examiné seize propositions, et mené un test de performance approfondi de la capacité de production, de manipulation et de stockage des dessins de la version définitive des systèmes de mise en route proposés.

Travaux publics Canada a ensuite choisi deux firmes pour réaliser, au moyen d'essais pratiques dans six ministères, des produits portant sur la conception assistée par ordinateur appliquée à la gestion des installations (CAO/GI). Quelque trente postes de travail sont maintenus en place, et les travaux se poursuivent dans de nombreux domaines, en commençant par l'élaboration de la structure des bases de données et de moyens d'échange de fichiers entre les deux produits choisis et avec d'autres systèmes.

About three years ago, as a result of some internal changes in the Government of Canada with respect to methods of property management and the growing awareness of the potential of CAD for building drawings, a few departments started looking seriously at purchasing computer systems for facility management. At the same time Public Works Canada, realty custodian for the majority of government office buildings and other property, had identified facility management rather than building design, most of which is done outside of the Department by private consultants, as an appropriate application for the CAD technology with which it had been experimenting in-house.

A cursory review of available commerical products at that time brought to light the following observations:
(i)some large CAD vendors were advertising products in this area but did not appear yet to understand the needs of facility managers; their offerings were really just repackaging of tools developed for other applications;
(ii) small vendors had some interesting products, but still had a long way to go to meet what were seen as necessary functional requirements;
(iii) issues such as organization for full facility management functionality, flexible database capability, and file exchange standards were not adequately addressed by anyone; and
(iv) although no Canadian products specifically addressed facility management, there existed considerable experience in CAD and in databases as well as an interest in developing products for this area by a number of firms.

An interdepartmental committee took on the task of identifying clearly the opportunity for use of CAD/FM in federal government departments and proposed a program for funding the development of tools and the introduction of computerized facility management in government departments. With total realty assets of over fifty billion dollars and annual expenditures to operate this property close to five billion dollars, the federal government had substantial interest in improving the effectiveness and efficiency of managing this inventory. Furthermore, since no suitable product was available on the market, additional benefits were seen by supporting development in local Canadian firms where eventual economic benefits to the CAD industry might be obtained. Finally, potential users were enthusiastic at the prospect of software development and eventual product support from local firms that would respond to their needs.

Public Works Canada issued a request for proposal, which described features sought along with a proposed field trial approach. It suggested that the final product should be in a mid-price range and that field trials should take place in a number of government departments, starting with a basic drawing capability and then evolving over the period of development to the final product. After a lengthy review of many proposals, involving an extensive benchmark test for drawing production, manipulation, and storage on a proposed start-up system, contracts were

awarded to two firms to develop enhanced computer tools. The software development process was to be one that would involve field trials in five government departments that would themselves purchase the necessary hardware from these same suppliers. In all, some thirty workstations have now been put in place. Each department started by learning how to use these CAD systems, doing small design projects and preparing files of building floor plans while software development proceeded.

At the time of this writing, software development is funded only for one year, a fact that has greatly inhibited the field-trial aspect of the program, however, even now substantial success of the Program has encouraged participating users and several additional departments have requested to join the Program. Proposals, requesting additional funding over at least an additional two years, are now under consideration.

Even though specifications for development software were comprehensively detailed in the light of anticipated user requirements before the Program commenced, many changes have been made to the specifications as further experience in the use of systems was gained. The substantial emphasis, though, on a sound database system and on file transfer requirements still stands. Table 1 lists a number of the modules from contracts with both firms, as originally conceived, as evolved through negotiation during development and as now proposed for future contract extensions. It is worth noting the way in which many original modules, that were conceived and described by users, had to be replaced as development proceeded with more general system capability modules which then in turn allowed the eventual creation of tools to address the stated requirements. Fortunately, flexibility built into the contracts and the good intentions of all involved has allowed these changes to be made. Frequent meetings between software developers and user groups assured that efforts were applied in the most productive direction.

One of the major benefits from this type of program has been the coordination and cohesiveness that has been provided to facility management activities across the government. An active Federal Interdepartmental Facility Management Association has been formed. Close ties have been made with the Canadian Standards Assocation with respect to standards for graphic symbols to be used on CAD systems and user groups have cooperated to agree on standard naming conventions for records and the use of drawing layers. This will increase the understanding of information passed between groups and to suppliers and has already simplified problems associated with moving files between CAD systems.

Although early productivity improvement in user activities was not be be expected while the development process was still under way, we have been encouraged by continual and unexpected successes. One of the major problems has been that early software development has had to concentrate on basic system capabilities such as graphics command functionality, the

database system, macro command development, and communication systems while specific application tools that rely on these capabilities have had to come later. Some final products are just being released now and, immediately upon coming into use, are suggesting to users many directions for further refinement.

User requirements are often best defined by working backwards from products with which they are familiar and expect from the CAD/FM system. For instance, if instructions by way of drawings and specifications are required for a move project, information is obtained from a database and file structure that must be configured to best accommodate this and other needs. It is difficult to structure the contents of this database before all user requirements are described and understood. In spite of these problems, we have been encouraged by the prototyping process of the field trials. User groups have discussed and argued issues such as that of appropriate standards and arrived at sufficient consensus to advance rapidly in their own implementations.

Systems selected for development, as well as a micro-based system already under development for area calculation and space control are all in the low to medium price range. Oddly enough, client departments with relatively unsophisticated facility management activities generally opted for the more expensive mini-based system where up to four workstations share a single processor. This has been primarily a result of this arrangement being more suitable for small cohesive working groups, typically ten or twelve persons, looking after all of the facility management activity in a given department. On the other hand, Public Works Canada activities are far more diversified, ranging in scope from gross realty planning in the government to management of large design and construction activities, and resources are scattered through six Regions and numerous District offices across the country. The result was that a decision for many stand-alone systems in different offices turned out to be more appropriate for getting started in computerized facility management. Nevertheless the Program, through the strong participation by user groups, has enabled standards to be set and files to be transferred directly between these significantly different systems.

Yet another advantage of these moderately-priced, stand-alone systems may be realized when it becomes realistic to place one in each building over a given size, such as fifty thousand square feet of floor area. Already significant computer and graphics power is being placed in many buildings as a result of implementation of direct digital control systems. As well as controlling building HVAC and other systems, these provide an easy ability to continually monitor conditions in the building. With this in mind, we see the potential to place a computerized management system in an "intelligent building" that will be capable of providing all of the following functions:

(i) automated control of all building systems, HVAC, electrical, security, and others:

(ii) continuous monitoring and recording of specified building conditions, such as occupancy, environmental changes and energy consumption;

(iii) a current model representation of the building and its use, so that "what if" models can be tested for evaluation of proposed changes;
(iv) historical data about construction details of facilities retained as a basis for renovation specifications; and
(v) inventory of space and contents for budgetary control.

In reviewing this list, one sees a close connection between data associated with or emanating from building control systems and that which is useful for facility management purposes. Integration then is obvious. Additionally, if we have learned one thing already in our experience with facilities data systems, it is that their usefulness is directly proportional to the reliability of the data in them. The best chance for facility data to be reliable and current is for it to be under the direct control and management of someone who has a strong vested interest in using it, particularly if he can change and update it quickly and easily as necessary. The best chance for this is on-site in the building by a responsible facility manager. Overall planning activities and detailed design changes can still be carried out by specialists at remote sites by extracting necessary data to similar workstations in their own offices.

In summary, even in the short one year time frame since the commencement of development activities, progress has been substantial and government officials are more than ever convinced of the value of CAD/FM systems as tools to increase productivity and effectiveness in the provision and use of facilities. Also the prototyping process of software development through field trials has been shown to work well, particularly when, as in this case, supplier firms are encouraged to prepare the same product for the general marketplace.

TABLE I. Modules for CAD/FM Development

Originally Contracted:	Changed To:	Future Development:
Start-up system enhancements	Graphics enhancements	Menu system enhancements
Building fabric graphics	Macro capability	Symbol creator and manipulator
Building services graphics	User-defined lines and fonts Symbol library	
Intelligent display	Pan, zoon, drag capabilities	Further display product enhancements
Digitize existing drawings	Edit macros	
Process flow graphics Scheduler	deferred	Scheduling program
Inventory management Non-graphics attributes	Database utility dev. Database query Report generator	Bar-code system Attribute management
Data converter	Data transfer standards Direct inter-system IGES transfer	
Drawing/field check	deferred	to be determined
Space and realty management	Area polygon and smart shade Area overlays Area attributes Report generator	
Communications NAPLPS pages	Local transfer Data in NAPLPS format	Long dist transfer
Cost calculations	Database query	
Planning tools Space design	deferred	Affinity relations Stacking, blocking diagrams
(Model making)	very limited	Three-dimensions Fly-through
(Software portability)		Portable to a range of hardware