Functional Programming and Evaluation – From Theory to Practice
1965 to 1997 -- Thirty-two years of professional practice at “Bridging the Gap”

Keynote Paper for the 1997 Conference of the Environmental Design Research Association
Françoise Szigeti and Gerald Davis, FASTM, AIA, CFM
International Centre for Facilities
440 Laurier Avenue West, Suite 200
Ottawa, ON Canada K1R 7X6
Phone: 1 613 727-1788 Fax: 1 613 723-9167 e-mail: icf@icf-cebe.com

ABSTRACT
This paper presents insights from 32 years of bridging the applicability gap from the knowledge of the EDRA community to professional practice and corporate management. A multi-discipline, multi-paradigm background, and a customer-oriented perspective about buildings, were important. Trends in the use of behavioral science techniques for facility management are reviewed, especially the use of occupant surveys to assess customer satisfaction, identify problems and recognize occupant requirements. The performance concept in building is summarized and its development since the 1940’s, and the history and development of building programming, are reviewed. The roles and contributions of many key researchers, practitioners and clients are identified. Differences between facility performance and facility serviceability are explained. Development and standardization of the Serviceability Tools and Methods (ST&M) is recounted. ST&M is explained with diagrams, and a list of topics is included. An extensive bibliography and suggested reading list is provided.

Keywords: facility management, functional programming, rating, performance, requirement, serviceability, usability, user

1. Introduction
Writing a keynote paper for EDRA at this juncture in our career is an honor and a challenge. How should we approach it? Not from an academic perspective! — For the last fifteen years, we have deliberately focused on bridging the applicability gap to practice and to management. We have concentrated our efforts on creating tools and methods for managers of facilities that would incorporate the knowledge of the EDRA community and make it actionable. We have not done project or academic research; instead we have pilot tested our work in the course of real projects.

Therefore, in this paper, we will try to share some insights from our work in practice. It is written, in part, in a more personal tone than is customary in a formal paper. Part 2 traces the strands of our own background which underlie our particular sets of experiences, part 3 reports on recent developments which are indicators of the current acceptance of behavioral tools and concepts in the business world, part 4 presents a brief history of the development of the new ASTM serviceability standards and part 5 introduces the Serviceability Tools & Methods (ST&M). We have also included a comprehensive bibliography of our work and other key reading material which is pertinent to our work.

The gaps between user and designer are just as real in the software design process as in the facilities design process. Because of the short product cycle time for software products, what does not work is discarded quickly. The opposite is true of buildings as “products”. The delivery of buildings takes years instead of months, and the life cycle of buildings spans decades. A lot can be learned from the experience of the software industry and from its focus on “user-friendly” interfaces. We wonder whether the gaps have been narrowing since 1976, when “GAPS” were the theme of EDRA-7. Are the E&B concepts more accepted to-day in the business world and the design professions? The emphasis on cost reduction and global competition makes it more important than ever to be able to show that any new approach “adds value”, such as by proving the impact of facilities on the productivity and effectiveness of the occupants. On the other hand, senior managers are more receptive generally than they used to be. Quality, team work, employee satisfaction, and impact on the core business are concepts that can be used today, and most managers will be willing to listen. A few years ago, they would have shown no interest, or would have reacted negatively.
2. Where we are coming from

Our background is multi-cultural, multi-lingual and multi-professional. We both speak more than one language. We have lived and studied in several countries. We have both had significant career shifts. Gerald Davis, in particular, has studied the so-called liberal arts, micro-biology, marine transportation, behavioral science and architecture, and taught in three disciplines. Why share with you this kind of information? Because our varied background probably explains why we are attracted to interconnections between different fields of knowledge, and why we feel so comfortable in exploring the “squishy middle”. Also, because we noticed that we have had a 100% failure rate when we hired staff who were unidisciplinary. On the other hand, we could almost predict whether people would fit in this new field by the nature of their career before they started working with us. We subscribe to a wide range of journals, and have acquired a substantial library in many related fields, which is why we started the EDRA Book Display in 1976 and organized it for close to ten years.

We both have had first hand experience with marketing, advertising and consumer research. Gerald jokes about the fact that he may be the only architect to have done focus depth interviews of heavy beer drinkers in taverns to understand the effects of the color of the physical setting on their beer consumption. If you view space and buildings as products that occupants “consume”, then the analogies between consumer research and environmental psychology might not seem so far fetched. Of course, thirty five years ago, we drew a blank when talking about user requirements to most business managers. They did not know what we were talking about. Likewise, the concept of “managing facilities” was not part of their vocabulary. The business world has changed quite drastically with the advent of facility management in the early 80s, the “The Age of the Customer” in the last two or three years, the notion of “user-friendly” products, and the emphasis on service.

3. “Customer satisfaction surveys” and other behavior-based tools

Customer satisfaction surveys are “in”. This may not last, but at the moment, even some “numbers oriented” senior managers have jumped on the band-wagon, in both the private and public sectors. Does it mean BETTER facilities for people? Not necessarily.

Several other significant trends are also coming into play: (a) cost reduction and outsourcing are pushing in the opposite direction, (b) globalization, downsizing, rightsizing, re-engineering, etc., are also pushing in the opposite direction, (c) the number of new buildings currently being built is low and the challenge is how to renovate and retrofit, (d) “green issues” and “sustainability” are gaining momentum, (e) the impact of alternate patterns of work is causing a reappraisal of the amount and kind of space needed by corporations and governments, and (f) the communications revolution has not yet been fully integrated by many industrial sectors, but it is continuing to drive major changes for the planning, design, management and use of facilities.

Facilities are still mostly considered as overhead and viewed as a cost center, rather than as an essential support to the mission of the business units. Facilities’ impact on the productivity and effectiveness of the core business is starting to be recognized, but is not yet widely accepted, and is still difficult to prove. However, the notion that the occupants are to be treated as valued customers by the providers of the facility they occupy is slowly but surely taking hold, whether the provider is inside the parent organization, or an arm’s-length outsourced contractor. Recent uses of “customer satisfaction surveys” illustrate this point.

In 1995 and 1996, the US Public Buildings Service (PBS) of the General Services Administration commissioned Gallup to conduct a customer satisfaction survey of the occupants of its buildings, using as a starting point the survey instrument prepared by the International Facility Management Association (IFMA). PBS has also been testing the effectiveness of the Serviceability Tools & Methods (ST&M), which will be described below, and the links between levels of Serviceability for their buildings and the scores from the customer satisfaction survey for a given building (Davis et al, 1996). The two instruments were created independently of each other. They are...
complementary, but, at the present time, they are not fully matched. Nonetheless, where they do match, each confirmed the findings from the other. ST&M provided the added information about the building that allowed the local staff to prepare an action plan backed by “objective”, comprehensive, defensible data. The results were a clearer set of priorities, the discovery of some lack of communication between PBS and the occupants which could easily be remedied, and decisions about what to do next. (See annotated set of ST&M scales nest page.)

A large portion of the 7,550 buildings in the PBS portfolio were covered by the customer satisfaction survey. The self-administered questionnaire was left on the desk of almost two thirds of all the occupants of the PBS buildings, and over 45% of the occupants responded, a total of approximately 250,000 respondents.\(^1\) PBS is using the results of these surveys to identify the aspects of their services, and of the facilities, which the occupants care about. The target of these initiatives is to improve the quality of the facilities where it counts and to understand how to deliver services and facilities in the most effective manner. In one building, the solution to improving the relationship between PBS and its tenant groups has been to locate a facility management officer in the building. That person is described as “the face of PBS” in that building. In another building where personal security was noticed as a problem, a single uniformed police officer now patrols the corridors and building lobby. Reports of petty theft in that building dropped by 75%. More or better hardware is not always the solution!!

A second interesting example comes from the new Ciba-Geigy laboratory in Tarrytown, N.Y. In this case, the design-build team for the project agreed to incentives for schedule, cost and satisfaction. Payment was subject to winning at least 75% of the vote from all the employees on a 15-question ballot regarding satisfaction, administered 90 days after move-in. The design-build team won 84% of the vote. The client is so pleased with the results that this team is being asked to do the next projects for Ciba-Geigy. We were not overly surprised, if you consider that the architect firm involved is HLW of New York. HLW is one of the few architectural firms who have had an excellent in-house facility programming team for close to twenty years.

In one of the largest multi-nationals, another study is currently underway to determine the functional requirements of one key group working on new products. The in-house team, responsible to supervise the move and the retrofit of the space they will be moving to, is using the ST&M approach with additional questions of particular interest to the senior management of that company. The impact of aspects of the facility on employee satisfaction, and on (external) customer satisfaction, are two of the topics included in the focus group survey instrument being used.

An example of environmental psychology going mainstream is the use by Steelcase of computerized instruments that have been created to capture “what people do” at work. These tools allow Steelcase to recommend furniture, and lay-outs, based on the requirements of the occupants on two main dimensions: their need for “interaction” and their need for “autonomy”. The fact that those instruments focus on only two main dimensions in terms of occupant requirements, is not the point. What is noteworthy is that E&B research, ergonomics and human factors have been recognized by the furniture industry leader, and integrated in their research, production and sales efforts. Listening to the presentations of their sales team, you would think that you were listening to an EDRA member!! Other major furniture manufacturers are using similar tools.

If the occupants at work do matter, and if they do in fact know a thing or two about what they need, then how can this knowledge be incorporated early on in the strategic decisions of the intending building owner or occupier? The new ASTM standards on Whole Building Functionality and Serviceability, now also American National Standards, and the Serviceability Tools & Methods (ST&M), enable that. In many papers, in the early EDRA proceedings and the early years of Environment and Behavior and Man-Environment Systems, researchers showed that architects, interior designers and other facility professionals, believed they knew best what building occupants need and should have, but that in reality these professionals were mistaken. In fact, many still do not understand occupant needs and priorities. They are often given the mandate to control what occupants get, and then proceed to allocate their building budgets inappropriately. Owners and occupants can use the new
serviceability tools to specify behavioral and functional requirements, using every-day language, and then assess whether a proposed design or retrofit will comply. ST&M enables them to enforce accountability in design, before construction. Some “early adopter” large organizations are already doing that.
The occupants use this left-hand column as though it were a multiple-choice question, to set their required level of serviceability on this topic. They decide which of these statements comes closest to describing their requirement.

There are seven topics in Aspect A.11. This is the sixth.

A.11 Image to Public and Occupants

This is the name of Aspect A.11

If the actual requirement is between level 5 and level 7, then the required level would be 6.

Occupant Requirement Scale

- **9** Operations require maximum "exposure" to the public. The address, building and signage must be very easy for pedestrians or motorists to find and recognize, even for those unfamiliar with the locality.
- **8** Operations require above average "exposure" to the public. The address, building and signage must be easy to find and recognize, for those familiar with the locality.
- **7** Operations require average "exposure" to the public. The address, building and signage must be easy to find and recognize, for those familiar with the locality.
- **6** Operations do not require much "exposure" to the public. Most visitors are "regulars". Corporate image is not a high priority.
- **5** Operations do not require much "exposure" to the public. Most visitors are "regulars". Corporate image is not a high priority.
- **4** Operations require average "exposure" to the public. The address, building and signage must be easy to find and recognize, for those unfamiliar with the locality.
- **3** Operations require average "exposure" to the public. The address, building and signage must be easy to find and recognize, for those unfamiliar with the locality.
- **2** Operations do not require much "exposure" to the public. Most visitors are "regulars". Corporate image is not a high priority.
- **1** Operations require that the office is obscure to the public, e.g. for security reasons.

Facility Rating Scale

- **9** Identity of building: The building is a well known landmark. The building and entry are clearly visible and recognizable.
- **8** Identity of building: The building and entry are clearly visible and recognizable.
- **7** Identity of building: The building and building entry are clearly visible to passing motorists and pedestrians, and recognizable.
- **6** Identity of building: The building and building entry are clearly visible to passing motorists and pedestrians, and recognizable.
- **5** Identity of building: The building and building entry are visible to passing motorists. The building is identifiable, and not easily confused with its neighbors.
- **4** Identity of building: The building and building entry are visible to passing motorists. The building is identifiable, and not easily confused with its neighbors.
- **3** Identity of building: The building is obscured by other buildings from some directions, and from people approaching along the street from one direction. The building is very similar and hardly distinguishable from adjacent buildings.
- **2** Identity of building: The building is obscured by other buildings from some directions, and from people approaching along the street from one direction. The building is very similar and hardly distinguishable from adjacent buildings.
- **1** Identity of building: The building is obscured by other buildings until viewed from directly in front, or, the building is not distinguishable from adjacent buildings, e.g. facades are almost the same.

To rate the serviceability of a facility, see which combination of features in the right-hand box best describes what is physically present in the facility.

For some topics there is a minimum level below which serviceability may not fall. This threshold level may be the same as or different from the required level, depending on other options and possible tradeoffs.

These three features, taken together (in combination) are indicators that the facility is capable of meeting the required level of the serviceability specified in the left column.
4. Serviceability Tools & Methods (ST&M) - a brief history

4.1 Looking back

The Serviceability Tools and Methods (ST&M), which incorporate the ASTM standards, offer a macro, broad brush methodology appropriate for strategic decision making in office facility procurement. They were developed by the International Centre for Facilities (ICF) as a way of dealing with the relationship between users and their facilities and to bridge the gap between the occupants’ “lay-persons’ language”, and the technical language of the professionals involved. Architecture and Design typically focus on each building project as a unique event and forget to capture the lessons learned from one project to the next. We were asked by our clients to create a systematic, consistent and comprehensive approach to deal with repetitive facility projects.

Some of us have noted that EDRA should pay more attention to the history of the concepts developed over the years by its members. It is frustrating to come to EDRA conferences and find the same issues discussed year after year with little evidence that the new discussions take past contributions into account. Papers at EDRA often ignore papers published in the EDRA Proceedings, or in Environment & Behavior, that are more than ten years old, even when the older material is of quality, and a comprehensive and in-depth treatment of the same topic. Therefore, we felt that a brief history of the concepts incorporated in our work, and a comprehensive bibliography, would be in order in this paper.

The Serviceability Tools & Methods (ST&M) have strong foundations. This work does not stand in isolation. It builds on and links with the work of many others. In the text below, we have focused on recording those prior events and concepts which have been most important in shaping ST&M, and on acknowledging those individuals and organizations whose work has had the most significant effect on the development of the serviceability concept as a complement to the performance concept in buildings.

4.2 The performance concept in building

ST&M has been founded in part on "the performance concept in building", which has roots before World War II in the United States, Canada, and overseas. In the United States in the 1950s and 1960s, the U.S. Public Building Service (a component of the U.S. General Services Administration) funded the U.S. National Institute of Standards and Technology (then known as the National Bureau of Standards), to develop a performance approach for the procurement of government offices, resulting in the "Peach Book" series of publications. An early marketplace application of the concept was the project of several California school districts (School Systems Development Corporation), which purchased component building systems for schools by specifying and testing performance. Similar applications to school construction occurred in Canada, in Ontario and Quebec.

Founded in 1946, Committee E06 on Performance of Buildings of ASTM (American Society of Testing and Materials) has developed standard performance test methods for building components. Starting in the early 1980s, the performance concept was applied to facilities for office work and other functions by ASTM Subcommittee E06.25 on Whole Buildings and Facilities.

In England, leadership for development of the performance concept has been provided by the government's Building Research Establishment (BRE). In Canada, the effort to develop norms for the physical setting of a productive workplace were led by: the former Building Use Section of the National Research Council; the Department of Public Works of British Columbia (succeeded by the British Columbia Buildings Corporation); the government of Alberta; and Public Works Canada (Public Works & Government Services Canada).

4.3 Performance and serviceability

By 1985, the importance of distinguishing between performance and serviceability had been recognized, and standard definitions for facility and facility serviceability were developed. Facility performance is defined by
ASTM as the “behavior in service of a facility for a specified use”, while facility serviceability is the "capability of a facility to perform the function(s) for which it is designed, used, or required to be used".

Serviceability is more suited than performance to specifying the functional requirements for a facility, because the focus of performance is on a single specified use or condition at a given time. Indeed, the ranges of performance specified constitute the capability of the building to respond and, thus, its serviceability.

4.4 Programming and briefing

The term program, meaning a statement of requirements for what should be built, was in common usage in the mid-nineteenth century by architects and students at the Ecole des Beaux Arts in Paris, and came into use in American universities as they adopted the French system for teaching architecture. In North America, the architect’s basic services include architectural programming, i.e. “confirming the requirements of the project to the owner”, but exclude setting functional requirements, which is the owner’s responsibility. In Britain and parts of Canada, the term briefing includes programming, but the distinction between functional, architectural and technical programming is not often made.

We have advocated that there should be an on-going dialog between “programmer” and “designer” on a given project, but the profession of “programmer” did not materialize quite in the form that we anticipated. The role that we envisaged for the programmer is now partially filled by the in-house facility manager, partially by the “strategic planner”, partially by the space planner. This is due to the fact that most projects are managed as a series of distinct phases, instead of being viewed as an iterative continuum. By the mid-twentieth century, some clients for large or complex projects paid extra to have their architects or management consultants prepare a functional program for their projects.

The first stand-alone, general practice in building programming in North America, not part of an architectural or management consulting practice, was TEAG - The Environmental Analysis Group, founded in 1965 by Gerald Davis. In the late 1960’s, building programming professionals, closely linked to architecture and interior design, were employed mainly to set requirements for individual projects, each project being treated by its architects as a unique, one-of-a-kind “event”. The programmers acted as translators between owner and designer, or as surrogate for the occupants. They documented requirements for rooms and spaces, for proximities and separations, and the like. Some programmers included careful analysis of social and behavioral requirements. John Archea, Aristide Esser, Gary Moore and Ray Studer were early leaders in launching the Design Methods Group (DMG), the Environmental Design Research Association (EDRA), and the journal Man-Environment Systems, all venues for the exchange of research findings and networking.

Among the early leaders in programming, building evaluation, organizational development and behavioral sciences, whose work has provided direct foundation for the Serviceability Tools & Methods (ST&M) are practitioners Pamela Cluff, Gerald Davis, Pleasantine Drake, Francis Duffy, Ezra Ehrenkrantz, Jay Farbstein, Min Kantrowitz, Walter Moleski, Willy Peña, Henry Sears, Geoff Shuttleworth, Don Sinclair, Fritz Steele, Carroll Thatcher, and John Zeisel, and university-based researchers and theoreticians Chris Alexander, Irwin Altman, Franklin Becker, Edward T. Hall, Volker Hartkopf, Kiyo Izumi, Peter Jockusch, Vivian Loftness, Wolfgang Preiser, Amos Rappoport, Henry Sanoff, Lynda Schneekloth, Robert Shibley, Bill Sims, Robert Sommer, Daniel Stokols, Phil Thiel and Rich Wener. We have been very fortunate that many of these leaders have collaborated with us, in one way or another at some point in our career.

4.5 Programming and evaluation for organizations with large portfolios of similar facilities

In 1976, Doug Shadbolt, then head of the School of Architecture at Carleton University in Ottawa, and Guy Desbarats, then Assistant Deputy Minister of Public Works Canada (PWC), teamed to launch a graduate degree program in the management of facilities for public and institutional organizations, funded by the tuition fees from mid-career civil servants in need of training and an added degree. They brought Gerald Davis and TEAG - The Environmental Group to Ottawa to lead the graduate program in facility planning and programming. The Carleton/ PWC project was aborted because of budget cuts, but PWC continued its
leadership, and in 1987, as discussed later, issued a contract to develop the standard methods and tools for programming and evaluation, which are now known as Serviceability Tools & Methods.

CERL, for a time while Robert Shibley was program manager for this activity, was also a focus of ideas and research with respect to the administration of a large portfolio of similar properties, in this case the US army. CERL was able to attract the like of Roger Brauer and Wolfgang Preiser.

In the early 1980’s, the group which later became the Centre for Building Performance Research (CBPR) at Victoria University of Wellington, under contract to the New Zealand Ministry of Works and Development, worked out ways of involving all the stakeholders in a building project, including the occupants, in an evaluation of the resultant facility, and learning and using lessons from it (Baird, et al., 1996). Duncan Joiner at the Ministry initiated and directed the work. The team included John Daish, John Gray, and David Kernohan. Helen Tippett was the Professor and Department Head in charge at the time. John Gray spent two sabbatical working with us at TEAG in Ottawa, in 1982 and again in 1988-89. The Building Quality Assessment (BQA) package prepared by CBPR in the early 1990’s for use in Australia, and later licensed for use in the UK and Europe, is based on an early draft of ST&M that was sent to John’s colleagues in Wellington in 1989 for their review and comments. To respond to the needs of the Australian insurance and investment organization who commissioned BQA, the CBPR team adapted ST&M to produce a single “bottom line score”. Intermediate scores are assigned by knowledgeable assessors and then weighted over the full range of categories and factors. BQA is a proprietary system, designed to be used only by licensed professionals. The weighting is known only to those licensed professionals.

In the UK, the Building Research Establishment (BRE) has for years supported innovative research linking E&B concepts to architecture and building research. With Francis Duffy in the lead at DEGW, John Worthington, Joanna Elley, and Alexi Marmott, on the one hand, and Peter Ellis, Sheena Wilson, Adrian Leehman at BUS on the other hand, have been at the center of much of this research. DEGW and Bernard Williams acquired the license to BQA for the UK and Europe. The BRE was involved in adapting BQA to the UK climate and building practice.

In The Netherlands, the Rijksgebouwendienst (RGD - the Dutch Government Building Agency) was led by Frans Evers, Director-General, until 1996. Under his leadership, RGD became one of the focal points of innovation in the management of real estate in the public sector. The RGD research group was headed by Hans de Jonge. In the late 1980s, Frank Becker spent part of his sabbatical in the UK at DEGW, and part of it in The Netherlands. At that time, he and Bill Sims at Cornell and we in Ottawa were continuing to work on the approach to building rating developed in the ORBIT-2 study (see below). Becker was a reviewer of the early drafts of ST&M and we sent him a copy of our work while he was in The Netherlands. As a result, another rating system was born in The Netherlands, which is now known as the REN (Real Estate Norm). Published with funding from RGD and from a group of private real estate advisors, it provides a quick assessment of buildings, primarily for use by real estate agents. It is based on a scale from 5 to 1 (high to low) and illustrated with nice architectural pictures, to make it easy for real estate agents to show their clients what they mean by the architectural item being rated.

It is remarkable that over the last twenty years, Canada, New Zealand, the UK, and the Netherlands have played a role in these developments quite disproportionate to their size. In each case, we can point to a combination of individuals with imagination and foresight who commissioned or led the work, and to an organizational context able to provide the necessary resources to do the work.

4.6 The ORBIT-2 Study, a precursor to ST&M

The ORBIT-2 study in North America (1984-85) was an important foundation for the Serviceability Tools & Methods (ST&M). It was proposed by Françoise Szigeti and Gerald Davis in 1982-83, and launched with the key support of the Xerox Real Estate Group, under the leadership of Michael Bell. The project was led by Gerald Davis (Project Director), with Franklin D. Becker, Francis C. Duffy, and Williams Sims as part of the core team.
and co-authors of the report. Fred Dubin and Françoise Szigeti were part of the team. A number of other colleagues were involved in some aspects of the project, including Jay Farbstein and Fritz Steele.

ORBIT-2 was sponsored by 18 organizations, including: Alberta Public Works, Supply and Services; Arthur Young; Birtcher; Building Owners & Managers Institute International; Donn Corporation; Exxon Corporation; Honeywell, Inc.; INNOVA; Interface Flooring Systems, Inc; Mead; Mobil Corporation; Public Works Canada; Steelcase, Inc; Sunar/Hauserman; Tate Architectural Products, Inc; TRW; The World Bank; Xerox Corporation.

The ORBIT-2 study pioneered the approach to the rating of office facilities by “levels”, as proposed by Bill Sims, Gerald Davis and Frank Becker. The rating approach was further developed by Davis and Szigeti, and a first standard practice for the rating of buildings and facilities (building-related) was approved by ASTM in 1987. The terms aspects, topics and combination of features were also adopted in the late 80’s. Francis Ventre was one of the participants in the work of ASTM Subcommittee E06.25. His experience went back to the “Peach Book”, and his collaboration was significant. Unfortunately, he had to retire prematurely due to illness. His store of knowledge and experience, and his creativity and contributions, have since been sorely missed. The work done during the ORBIT-2 study also took into account the work done by Xerox for its Office ’88 study under the leadership of Michael Bell, by The World Bank in its series of office technology and office planning studies guided by Rick Barry, by The Aetna group of companies (insurance) where Karen Odlum and others conducted analyses leading to the rehabilitation of its Home Office using a generic and modular footprint for workstation layouts, and by the government of Alberta in work commissioned from Donald Sinclair and others to assess the condition of buildings in its inventory.

4.7 Considering buildings and facilities as a whole

In the early 1980’s, a Task Group was first established within ASTM Committee E06 to consider standards which would deal with buildings and facilities as a whole and attempt to define their functionality and quality. By 1983, as stated above, this Task Group had become the ASTM Subcommittee E06.25 on Whole Buildings and Facilities. We wish to pay tribute here to the late Wayne P. Ellis because of his special role in getting ASTM Subcommittee E06.25 underway. Without his guidance, his dedication, his understanding of issues, his experience of ASTM processes and procedures, and above all his foresight, this subcommittee might not have been created. He recognized the need for a new kind of standards which deal more with broad concepts and processes than with narrowly defined and precise technical physical items.

The concept of functional requirements of occupants and serviceability features for buildings taken as a whole was a novel concept in the early 1980’s. Wayne Ellis recognized the need, had confidence in us, and gave us his unconditional support, his time, and his friendship. He also worked hard with us to make it all happen. By now, the world of standards has recognized the need for those kinds of standards. The world-wide acceptance and success of the ISO 9000 family of standards is a shining example of this.

4.8 Development of the Serviceability Tools & Methods (ST&M) and the role of Public Works Canada

One executive of Public Works Canada (PWC) who is now retired, J. M. (Derm) Dunphy, had a key role in the development of the Serviceability Tools & Methods (ST&M). In the early 1970s, he co-authored with Professor Doug Shadbolt a report for the Design and Construction Branch of PWC, which included recommendations for improved building programming and evaluation, and for a response to occupant requirements. In the mid-1980s, as the first Assistant Deputy Minister of the Accommodation Branch of PWC, he initiated a nation-wide competition to select a group to assist the Branch in becoming a “knowledgeable client” of its architectural, engineering and realty colleagues. The International Centre for Facilities (ICF) was selected. The ASTM Serviceability Standards for Whole Building Functionality and Serviceability are based in a large part on work performed by ICF under that contract.3
4.9 Functional Programming and Evaluation for large numbers of similar properties
Governments at all levels, certain types of organizations and institutions, and many large corporations have hundreds or thousands of street addresses, yet only a few functional categories of facility. They sign or renew many leases each month, and launch many similar construction projects. Fast, economical programming and evaluation should be part of their continuing, repetitive, facility management process. ST&M was developed to meet their typical need for capturing and using the institutional memory of what works best, and what does not work well, and for ensuring that their portfolio of property, leased and owned, best serves the functional needs of their core business groups.

5. The Serviceability Tools & Methods (ST&M): What they are.
The Serviceability Tools & Methods (ST&M)4 include: (1) a format for describing the occupant group, its mission and its organization, (2) a multiple choice questionnaire for identifying workplace requirements for functionality and quality on more than 100 dimensions, (3) a matching questionnaire for rating the capability of a building to meet those levels of need, and (4) a function-based method for estimating how much floor area an organization needs.5

ST&M meets the needs of users of buildings - the occupants and facility managers - to: (1) quickly, economically and objectively set occupant requirements, not just in terms of size, but also for functionality; (2) rate and compare offices, whether owned, leased, or offered for lease; and (3) help choose the best and most cost-effective fit between functional requirements and the serviceability of properties in a portfolio, or on offer. ST&M includes both the processes and the automated tools.

ST&M allows a corporate real estate executive, a facility manager, a real estate broker, a space planner, or any other interested party, to ask building occupants systematically about their present and future functional needs, and then to match those needs more closely when seeking or allocating space. The profiles of the serviceability of the buildings and facilities owned or leased by an organization can then be aggregated across a company, or an industry, and so on, thereby enabling an automated benchmarking system for functionality, quality and support for productivity.

ST&M uses matching scales to compare demand and supply (see sample annotated scale ahead). These scales are the core of the classifications which have been standardized by ASTM for the office facility category. The ST&M multiple-choice requirement questions are written in non-technical language. The answers to those questions create profiles of the functional and quality requirements of the occupants. Over 100 topics are considered. A matching set of scales, written in facility terms, is used to rate how well a building, or a proposed design, is capable of meeting occupant requirements. Over 340 features of the physical setting are considered “in combinations” to assess capability, and not separately, which has usually been the case until now (See list of topics below.) Facility Serviceability is about whether a building or facility is capable of performing as required. Facility Performance is about actual behavior in service at a given moment.6 The demand scales and the supply scales can each be used separately and independently of the other. Each can be used to add understanding and information about the other. For organizations with many facilities that house similar types of functions, ST&M speeds up the functional programming process and provides comprehensive facility ratings in a short time without being simplistic.

ST&M was designed to bridge between “functional program” elements written in user language on the one side, and “outline specifications and evaluations” written in performance language on the other. It is a standardized approach which can be easily adapted to the particular needs of a specific occupant organization. It can be used by building owners to rate the performance capabilities of their buildings and facilities. This allows them to assess their buildings’ strengths and weaknesses as part of an asset management plan or before marketing them for lease or sale. ST&M provides the tools and processes to get the facilities that best fit the purposes of the occupant groups and core business management.

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International Centre for Facilities, 440 Laurier Ave. W, #200, Ottawa, ON Canada K1R 7X6
Phone: 1 613 727-1788 Fax: 1 613 723-9167 e-mail: icf@icf-cebe.com
Thus, these scales provide a practical, consistent, comprehensive, systematic, and objective approach to match the overall performance of this complex product (a building), whether it already exists, or during its design and construction, against the functional requirements of its users. They help define and evaluate fitness for purpose. They provide a functional program at “general fit” on the one hand, and a “macro scan” of a facility on the other hand. The first edition of ST&M was developed around the needs of people who do office-type work. The diagrams on the following pages illustrate these concepts.
Find the *BestFit™* among several facilities

Find the *Best Fit™* among several requirement profiles

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ST&M: Matching people and the facilities they need

ST&M™ is used for a *macro* level scan, *not* for an in-depth investigation

ST&M: Typically one day on site. Identifies strengths and concerns, but does not investigate in depth. Covers over 100 topics, about 350 features.

Green Building assessment and rating, e.g. LEEDS

Building Condition Report and due diligence

In-Depth investigations:
- G&M: Operation and Maintenance
- Roof: Weather and drainage conditions
- Plumbing and piping systems
- Electrical and electronic systems
- Condition of equipment for Heating, Ventilating, and Air Conditioning
- Energy conservation, e.g. BIPAC, Canada; BREEAM, UK
- Electromagnetic radiation
- Indoor Air Quality
- Water and waste management
- Life cycle analysis
- Life cycle costing and value engineering
- Security: Threat and risk analysis
- Financial analysis and audit
- Real Estate market analysis
- PES - Post-Occupancy Evaluation
- And many other types of In-depth investigations...
### Topics of the Serviceability Scales

Each scale is a multiple-choice questionnaire. There are more than 100 scales, in two main groups. Scales in Group A, which cover the primary concerns of occupants and users, focus on requirements for group and individual effectiveness. Scales in Group B are about the property and its management. Some additional scales are being developed, to better cover green issues, plus topics which are special to facilities for manufacturing, retail, laboratories, education, etc. The titles of the existing scales are listed below.

#### OCCUPANTS’ GROUP AND INDIVIDUAL EFFECTIVENESS

**Support for Office Work**
- A.1.1 Photocopying
- A.1.2 Training rooms, general
- A.1.3 Training rooms for computer skills
- A.1.4 Interview rooms
- A.1.5 Storage and floor loading
- A.1.6 Shipping and receiving

**Meetings and Group Effectiveness**
- A.2.1 Meeting and conference rooms
- A.2.2 Informal meetings and interaction
- A.2.3 Group layout and territory
- A.2.4 Group workrooms

**Sound and Visual Environment**
- A.3.1 Privacy and speech intelligibility
- A.3.2 Distraction and disturbance
- A.3.3 Vibration
- A.3.4 Lighting and glare
- A.3.5 Adjustment of lighting by occupants
- A.3.6 Distant and outside views

**Thermal Environment and Indoor Air**
- A.4.1 Temperature and humidity
- A.4.2 Indoor air quality
- A.4.3 Ventilation air (supply)
- A.4.4 Local adjustment by occupants
- A.4.5 System capability and controls

**Typical Office Information Technology**
- A.5.1 Office computers and related equipment
- A.5.2 Power at workplace
- A.5.3 Building power
- A.5.4 Data and telephone systems
- A.5.5 Cable plant
- A.5.6 Cooling

**Change and Churn by Occupants**
- A.6.1 Disruption due to physical change
- A.6.2 Illumination, HVAC and sprinklers
- A.6.3 Minor changes to layout
- A.6.4 Partition wall relocations
- A.6.5 Lead time for facilities group

**Layout and Building Features**
- A.7.1 Influence of HVAC on layout
- A.7.2 Influence of sound and visual features on layout
- A.7.3 Influence of building loss features on space needs

**Protection of Occupant Assets**
- A.8.1 Control of access from building public zone to occupant reception zone
- A.8.2 Interior zones of security
- A.8.3 Vaults and secure rooms
- A.8.4 Security of cleaning service systems
- A.8.5 Security of maintenance service systems
- A.8.6 Security of renovations outside active hours
- A.8.7 Systems for secure garbage
- A.8.8 Security of key and card control systems

**Facility Protection**
- A.9.1 Protection around building
- A.9.2 Protection from unauthorized access to site and parking
- A.9.3 Protective surveillance of site
- A.9.4 Perimeter of building
- A.9.5 Public zone of building
- A.9.6 Facility protection services

**Work Outside Normal Hours or Conditions**
- A.10.1 Operation outside normal hours
- A.10.2 Support after-hours
- A.10.3 Temporary loss of external services
- A.10.4 Continuity of work (during breakdowns)

**Image to Public and Occupants**
- A.11.1 Exterior appearance
- A.11.2 Public lobby of building
- A.11.3 Public spaces within building
- A.11.4 Appearance and spaciousness of office spaces
- A.11.5 Finishes and materials in office spaces
- A.11.6 Identity outside building
- A.11.7 Neighbourhood and site
- A.11.8 Historic significance

**Amenities to Attract and Retain Staff**
- A.12.1 Food
- A.12.2 Shops
- A.12.3 Day care
- A.12.4 Exercise room
- A.12.5 Bicycle racks for staff
- A.12.6 Seating away from work areas

**Special Facilities and Technologies**
- A.13.1 Group or shared conference centre
- A.13.2 Video teleconference facilities
- A.13.3 Simultaneous translation
- A.13.4 Satellite and microwave links
- A.13.5 Mainframe computer centre
- A.13.6 Telecommunications centre

**Location, Access and Wayfinding**
- A.14.1 Public transportation (urban sites)
- A.14.2 Staff visits to other offices
- A.14.3 Vehicular entry and parking
- A.14.4 Wayfinding to building and lobby
- A.14.5 Capacity of internal movement systems
- A.14.6 Public circulation and wayfinding in building

**THE PROPERTY AND ITS MANAGEMENT**

**Structure, Envelope and Grounds**
- B.1.1 Typical office floors
- B.1.2 External walls and projections
- B.1.3 External windows and doors
- B.1.4 Roof
- B.1.5 Basement
- B.1.6 Grounds

**Manageability**
- B.2.1 Reliability of external supply
- B.2.2 Anticipated remaining service life
- B.2.3 Ease of operation
- B.2.4 Ease of maintenance
- B.2.5 Ease of cleaning
- B.2.6 Janitors’ facilities
- B.2.7 Energy consumption
- B.2.8 Energy management and controls

**Management of Operations and Maintenance**
- B.3.1 Strategy and program for operations and maintenance
- B.3.2 Competences of in-house staff
- B.3.3 Occupant satisfaction
- B.3.4 Information on unit costs and consumption

**Cleanliness**
- B.4.1 Exterior and public areas
- B.4.2 Office areas (interior)
- B.4.3 Toilets and washrooms
- B.4.4 Special cleaning
- B.4.5 Waste disposal for building
6. Concluding comments

6.1 Have we “bridged the gap(s)”?
Has any real progress been made since 1976, when the theme of EDRA-7 was “Bridging the Gap”? Has EDRA as a research and practice community, learned how to bridge the gaps between research and practice, between research and design, and between research and business? Have EDRA and IAPS had an impact on their targets, the design community and the management of facilities? We would like the answer to be yes. Some EDRA and IAPS members do participate in IFMA and other associations, and cross-fertilize the work of their primary professions or disciplines. But we wish there were more.

Furthermore, EDRA members, and in particular the academic community, do not use their own accumulated knowledge effectively. We see recent studies or papers that present concepts as if brand new, yet we know that a good look through the past EDRA Proceedings and other sources would show that some form of the concept has been presented before. Much could be learned from a thorough study of past papers, especially by students.

6.2 What can we learn from the software industry?
There is also a lot to be gained from other disciplines, by analogy. The similarities between the steps in the process of creating facilities and the steps in the process of creating a computerized system, or software (ASTM, 1987, p.4) are striking. It would be beneficial for EDRA members to take a serious look at the software industry, at the work done about User Interfaces and at the usability studies that are prevalent in that industry. The users of software can vote with their wallets and their feet. Few building occupants have a say in the procurement of the space they occupy. Therefore, the nature of the feedback loop between evaluation and needs analysis is almost instantaneous in the software industry, where the help desks, and the public beta tests function as an ongoing reporting mechanism for user input.

6.3 Other developments affecting the process of providing places, especially workplaces, for people
The software explosion has had a tremendous impact on the study of human factors. Terms such as “user”, “user-friendly”, “user needs analysis / assessment”, “satisfied or dissatisfied” and “customer focus” have not been driven by E&B research but by the market place and the computer revolution. What can EDR learn from this user focus in the software industry?

In the world at large, recent developments have focused the attention of senior management on “the customer” and the “user”, on quality, on productivity and effectiveness, on facilities — mainly to reduce space and costs—and on facility management — also mostly as a place to cut costs by out-sourcing to cut in-house head count and being able to change service- and product-provider more easily.

Current developments have been driven by the globalization of trade and the need to be more competitive. Much more research needs to be done about the impact of facilities on people, but the real world does not wait for us to do research before implementing new concepts. The trends toward “no address”, “space sharing” and “hoteling” are flying in the face of the work done on territoriality, appropriation of space, and personalization of space. New concepts are implemented when they respond to strong business needs. Teleworking and home-based businesses are driven by the economic forces that are buffeting both the corporate and public sectors.

New opportunities are emerging for the EDRA community to build links with facility managers and core business executives who would benefit from applying environment-and-behavior insights in their daily work. This will require giving priority to research and consulting that bridge into application. Such a focus may conflict with the “publish or perish” priority of EDRA’s academic-based members. It will require that EDRA reach out and collaborate with associations like IFMA, AIA, etc. In the past, EDRA has collectively not been willing to make it easy for those associations to collaborate. In the current era of academic downsizing and
grant cutbacks, paying attention to potential users of E&B research and making EDRA publications more “user-friendly” may be an easy choice.
7. Further reading

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End Notes

1 The PBS survey was managed by Booz, Allen and Hamilton, and conducted by Gallup. It is reported to be the largest, and most complex survey ever done by Gallup.


3 The authors appreciate the support, collaboration and information that has been provided by many staff members in Public Works and Government Services Canada (formerly Public Works Canada) both at Headquarters and in the Regions, who have been exceptionally generous in contributions of information, insight, expertise and hard work. The authors also express their appreciation for the opportunity to develop ST&M, and to use those products and methods in their teaching and public service work.

4 The Serviceability Tools and Methods (STM) were developed by a team from the International Centre for Facilities (ICF) led by Gerald Davis, and including Lynne Y. Blair, John Gray, Cynthia Manuel, Donald Sinclair, Françoise Szigeti, Carroll Thatcher and Guy Thatcher and several other Senior Advisors to ICF.

5 See Note 3 above.

6 See Note 2 above.