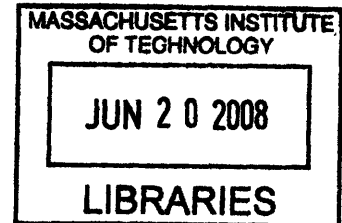Measuring The Value Of Workspace Architectural Design- Construction Of The Workspace Communication Suitability Index (WOCSIT)

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Measuring The Value Of Workspace Architectural Design- Construction Of The Workspace Communication Suitability Index (WOCSIT)

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Abstract

The aim of this dissertation is to measure the impact of workspace architectural design on the value it generates for tenant organizations in terms of, without loss of generality, strengthening organizational identity and communication – two critical productivity factors. The hypothesis, then, is that there is a measurable correlation between workspace architectural design and organizational identity and communication and, in turn, productivity (ICP). To elucidate this correlation, a set of architectural design variables that can measure ICP in a replicable manner is identified and structured. Observations, interviews and survey instruments are used to construct the "Workspace Communication Suitability Index" (WOCSIT).

In constructing the index, a set of diagnostic tools were designed to collect reliable field data while remaining mindful of confounding factors such as facility users' adaptable nature of behavior, culture, irrationality etc. Each index component, an architectural design variable, assumes a suitability rating as a result of subjective assessment of what range of values is acceptable for it to be "suitable" or relevant to ICP. Evaluation schemata, scoring devices derived from the index, can then be used to generate scores for different workspace artifacts and can either evaluate the design of existing composite artifacts – workspaces or guide the creation of new ones.

Wider adoption of the index in the professional world can influence all phases of the building design and management process, helping identify areas of possible intervention in the physical environment that improve performance in the design and planning of new and existing buildings. Thus, the predictive accuracy of the index can be the foundation for design guidelines that can be embedded in immediate interventions and, over time, in best practices used by workspace architects from the very early stages in the design process.

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1. Introduction

The unproven belief, often taken as a fact, that architectural design impacts human behavior and as such influences the added value these artifacts bring to tenant organizations is recurring. However, a formal approach that would identify and quantifiably measure the factors contributing to this link seems to be missing, in part due to the difficulty in conducting such multivariate analysis that would incorporate the effect of confounding factors. The need to successfully measure the value of workspace design to organizations is undoubtedly strong. First, because a vast amount of resources are channeled to this end – occupancy costs comprise a good part of any organization's budget, while renovation and restructuring costs are often a main capital expense. Second, a best practice design process for new and existing buildings does not exist – this invariably leads to unstructured relationships between workspace architects / designers and organizations. Third, the built environment reflects a social construct's values – a more channeled and controlled approach to design can also assist the introduction and adoption of new values, for example openness, collaboration or security.

Many industry, government and education leaders in the modern age have committed significant resources in shaping the built environment and the work environment in particular to fit their respective visions of progress.

Churchill said that "buildings shape the way we think". [Image 1- All Images Are Listed in Appendix 3]

Keynes insisted that his workspace have a particular configuration to optimize his productivity. [Image 2]

Hitler collaborated with Speer to translate his vision of ethno-socialism into a built environment. [Images 3,4]

Mahathir in Malaysia built the "government corridor" to modernize government administration. [Image 5]

Dubai's leaders invested heavily in the built environment including a unique hotel to spur and signal economic growth. [Image 6]

The Chinese TV organization seeked a facility emblematic of its public opinion power and build the CCTV tower. [Image 7]

A Swiss insurance company, Swiss Re, invested in the "Gherkin" tower and gained instant recognition. [Image 8]

What all these attempts have in common is the sponsors' underlying commitment to strengthening identity, communication and ultimately, productivity (ICP). The correlation between identity, communication and productivity, terms used interchangeably in this study, has been a topic of interest among different researchers. Sharing of knowledge, ideas, and information enhances the level of productivity and innovation as the existence of communication within an organization would in all likelihood enhance worker productivity. Also, employees who identify strongly with their organizations would be more likely to make decisions that are consistent with organizational objectives [Ashforth, Mael, 1989]. In light of the strong relationship between identity, communication and productivity, construction project sponsors seek to leverage architectural design in order to facilitate change and meet both basic as well as higher-level organizational needs.

This disposition is further supported by evidence that workplace reorganization induces a significant increase in labor productivity (Bertschek, U. Kaiser, 2001). The means of realization of these visions is the adoption of new modalities of behavior by space users, i.e. new ways of experiencing the working environment and new usage protocols. Thus, communication is directly related to expected incremental gains in the output of human work, i.e. productivity.

The modality of behavior exhibited in a working environment is the result of an ongoing bi-directional adaptation process. Inward adaptation takes place as space users over time adopt habits that gradually evolve into new personas with characteristics of evolving communication cultures. Outward adaptation occurs as space users express their subjective impressions and experience through interventions to the building.

Architects are central in the process of design and construction of workspaces conceived as communication tools. They use their, often limited,

knowledge to translate sponsor briefs into artifacts by studying the site, the program/functionality, the circulation and form. While these artifacts have an impact on behavior and identity formation, formal assessment methods have had difficulty in reliably tracing that impact and are complicated by (i) the fact that what impacts identity-formation is not only the physical artifact *but also* its modality of use as determined by a variety of confounding factors, e.g. organizational culture, business and facility management processes, work content etc. (ii) the fact that space users are humans who exhibit excellent adaptive qualities and can survive in many environments. Other species can survive only in specific physical environments and habitats. Humans can inhabit a much wider variety of environments and adapt their behavior to ensure survival.

The improvement of workspace architectural design research and evaluation methodologies is appealing because in modern service sector economies, progress is measured by the ability to improve productivity and economic output. Furthermore, the demand for quantification of impact measurement is higher. Such information cannot be disregarded because it is subjective and difficult to identify, measure and quantify in comparison to the management of occupational risks. More importantly, with a conception of design as constraint management, this input can be the source of inspirational creativity for the architect-designer.

2.A. Problem and Hypothesis

The problem is measuring the impact of workspace architectural design, on identity, organizational communication and productivity. In particular, measuring the value of workspaces, conceived as composite artifacts consisting of physical and human subsystems engaged in continuous bi-directional adaptation.

The hypothesis is that there is a measurable correlation between workspace architectural design and organizational identity and communication and, in turn, productivity (ICP). This correlation stands for value, in the sense of ICP, that can be measured in qualitative and quantitative terms by the application of a research methodology that seeks to identify relevant architectural design variables, inquire into their relationship and embed them in an evaluation schema, summarized in the form of a communication suitability index (WOCSIT).

2.B. Definition of Terms

The terms 'value' 'working environment,' 'composite artifact,' 'bi-directional adaptation, 'evaluation schemata' require definition.

Value refers to the determination of how much something is worth. The aspects of value that are explored depend on the chosen evaluation criteria and include economic, aesthetic, and social value. Economic value, for example, can be understood as the amount of money, goods, or services that is considered to be an equivalent for something else. For this study, the focus is on identity, communication and productivity value as determined by the suitability of the corresponding variables, identified as relevant.

Working environment or *workspace* refers to the physical and virtual environment where work takes place and includes but is not limited to office space. *Composite artifact* is an object that is shaped by human craft and viewed as the product of human conception or agency. An object is composite insofar as it consists of a physical and human subsystem. A physical subsystem includes the architectural form and building systems. A human subsystem is understood as an organization. Member in the organization is anyone who interacts with the physical/virtual artifact, regardless of the duration or frequency of the interaction. For example, a human being that crossed through the building's ground level just once is a member, as are one-time visitors to the department's website, or the students and faculty who work in the building. Between the physical and human subsystems there is also an interstitial subsystem, the information subsystem.

Bi-directional adaptation refers both to changes in the physical environment of a physical working environment and changes in the behavior of its occupants over time. An etymological analysis reveals that the term has meaning both in terms of goals and conditions: 'to undergo modification so as to fit new circumstances, to make fit for, or change to suit a new purpose; to adapt or conform to new or different conditions'.

Identity, Communication, Productivity (ICP): Identity, understood as organizational identity, is defined as the perceived amount of interests an individual and organization share and the extent to which an individual

perceives him/herself as belonging to the group and as being a typical member of it (Ashforth, Mael, 1989, Tajfel, 1982) Communication, at the organizational level, is defined as a processual activity that *constitutes* the organization and characterized by the exchange of messages that maintain interaction among people sharing the same interests (Tomkins, 1984). Productivity is defined as efficiency and effectiveness in realizing organizational objectives. (Burkhead, Henningan, 1978) These terms are used interchangeably throughout the study and are considered equivalent. This is insofar as it is conceivable that they are so. For example, one can argue that a face that is recognized is identifiable. The probability of communication with an identifiable face (a familiar person) is higher than that of communication with a non-identifiable face (a stranger). Communication is a necessary condition for productivity. Hence, identity, communication and productivity can be used interchangeably in an axiomatic sense.

Evaluation schemata are scoring devices / matrices that are used to evaluate artifacts subject to criteria, that is, judgments of value. If the criteria are met, the artifact is 'accepted' or considered 'suitable'. Evaluation schemata sum up a set of criteria; their content, structure, and inter-dependencies can be thought of as guidelines in the synthesis process as well. They are characterized as follows: they have variables (like a room has windows, doors, walls, etc.); they can embed one within the other; they represent knowledge at many levels of abstraction; they represent knowledge rather than definitions of many levels of abstraction; they are active processes; and they are recognition devices (Rumelhart, Norman, Ortony, 1975). In a psychological sense, schemata are unconscious mental structures, composed of past experience, and central features of human decision-making aparrata (Bartlett, 1932).

For example, a sample schema for a house can be set-up as follows:

Evaluation schema "House"								
		Sub-component	k	l	m	n	o	..
Design-component			glass	wood	tile	metal	plastic	..
windows	Y			1	0	1	0	
doors	Φ		1	0	0	0	0	
roof	X		0	0	1	0	0	
floor	Ψ		1	1	0	0	0	
furniture	Ω		0	1	0	1	1	
Subdesign "User 1"	Λ-1		$Y_1, \Phi_0, X_0, \Psi_1, \Omega_0$					

The example hereinabove is only meant as figurative. For a schema to be usable, the relationship between components and subcomponents would have to be exact and capable of directing the synthesis accurately.

3. Literature Review And Research Methodology

This section consists of the literature review and the proposed research methodology.

3.A. Literature Review

In order to define the problem and understand the conceptual landscape of research in workspace architectural design evaluation, a review of literature in the fields of environmental and cognitive psychology, ecology and social science as they relate to architecture was undertaken after positioning the concept of identity in architectural practice.

Identity in Architecture

End-users in certain organizations often ask architects to design their new workspaces in light of their need for consistency between their identity/brand and the building.

Architects then engage in design and product development processes that relate the concept of "Identity" to architecture. In this sense, an inquiry into the sub-field of design knowledge, i.e. how best practice of the design process unfolds, sheds light into the nature of these processes from the start-the composition of a brief to the program, all the way through schematic design, design development, and construction document production [Lawson, 2005].

Product development used in engineering is also relevant in the study of design processes, as it requires rigor and outlines the importance of identifying the design parameters that describe the product design and specifying those after rigorous assessment. (Eppinger, 2003) Managing creative projects-current best practice includes the project context, the system architecture and knowing the building type basics for office buildings. Throughout this process there are important inflection points that can influence the design of a working environment. For example, aligning design to corporate culture, ethos and strategy by means of proper client management, managing the transition into a new facility, facilitating communication and providing high-quality ambient conditions and positioning the facility into the urban context.

Swiss Re different architects were given the same set of guidelines and asked to design projects in different locations.

The company had set it as a priority to ensure that architecture would serve its purpose of making the company visible- specifically, *communicating its old and new core values of stability, strength, security, reliability, clarity, efficiency, directedness and openness in environments that could be described as "hives of creativity".*

Architects of six of its facilities were asked to respond to questions about the definition of corporate architecture, the benefits of architecture to the user, the relationship of architecture to brand/identity, the notion of architectural design having a "fit" to the company's values, the designer's management of tight constraints, the notion of architectural risk management and the difference of corporate architecture and corporate design. [Built Identity, 2007] These were their answers (edited for comprehension) to the questions pertinent to this study.

Question: "Corporate architecture allies architecture with a brand name. How well do they marry? Which company values does your project express?"
TT: "...ultimately, architects are only responsible for their own work, not for their clients; professional standards...am convinced that architecture has a positive and stimulating effect on staff performance...the company values precision...my work demonstrates openness, space, light, functionality- all with the perfection worthy of the company".

Dolf Schnebli: "...good architects do not play around with branding. They do not repeat themselves, but are ready to see and reinvent themselves for each and every project...they should of course retain their own intrinsic style but not let it dominate the project...the client recognizes that is employees are vitally important, have an open-mindedness to creativity and a liberal attitude towards behavior. So, I tried not to restrict openness, integrated the landscape into the building, position the windows so as to offer uninterrupted views and, overall, provide good working conditions for the staff."

Hadi Teherani: "...to be healthy, the marriage between architecture and branding should be balanced. Architecture should not dominate the brand, nor vice versa...companies cannot afford to ignore environmental factors in pursuit of a monomaniac corporate architecture agenda: ...the design ideas of an introverted three-dimensional park was influenced by the geometry of the site and the external spatial characteristics of the client's former headquarters. Other drivers included the wish to create a building that would facilitate work and communication-accommodate exhibitions and events, communicate with internal and external stakeholders and the wish to look after employees with a program that includes everything a modern-day office worker needs, i.e. a gymnasium, recreation rooms, a sick bay, library, gardens etc.".

Norman Foster: "...the client said they'd like a building that everyone would recognize- you could hail a taxi anywhere in London, ask to be taken to Swiss Re, and everyone would know where it was - we delivered just that! ...The company was evidently committed to high-quality design and I warmed up to the ethical thread of its thinking-its support for low-energy, environmentally friendly technology was especially encouraging.

Question: "How did you handle client's strict Corporate Architecture/Corporate Identity requirements?"

TT: "...the foundations/guidelines of the company's corporate architecture may seem daunting but merely provide a broad framework by defining colors and combinations of colors, materials, signage and fonts-the basics of a buildings' appearance. These guidelines do not necessarily affect the architect's design as they do not say how to do things, but why they should be done- else, architects would not design such different buildings for the company."

HT: "...many artists cannot cope with companies' internal rules and regulations, but I find them a blessing. The more specifications you have, the more precisely you can respond to them, the more precise the corporate identity, the more accurately the architect can tailor his work. When it came to signage, however, we managed to persuade the board to override its existing CI rules."

NF: "...In the field of workplace design, genuine innovation is pioneered by owner-occupiers. Fundamental changes, which are seen to stand the test of time, then filter down to be adopted by the marketplace, are recreated by those who develop speculatively."

Environmental and Cognitive Psychology in Architecture

The field of environment-behavior or environmental psychology inquires into the problem of measuring the impact of the environment on behavior, which its proponents describe as follows:

"Environment refers to the physical, administrative, and social attributes of settings in which people live, work, and play. Behavior refers to things people do, including thinking, feeling, and seeing as well as talking with others and moving around...E-B research centers on finding out how people behave in reaction to their environments." (Zeisel, 1984).

"Environmental psychology is the study of transactions between individuals and their physical settings. In these transactions, individuals change the environment and their behavior and experiences are changed by the environment. Environmental psychology includes research and practice aimed at making buildings more humane and improving our relationship with the natural environment." (Gifford, 1997).

The field of cognitive psychology and cognitive development and in particular the issues of attention and memory. Luria (1976) promotes the idea that the foundations of human development are socio-cultural, while Vygotsky (1978) suggests that mediating devices such as language and other symbols or tools are central in the development of mind and thought. These ideas, at the intersection of activity theory and human-computer interfaces, are important in the design of *virtual*, or digital, working environments and strongly support and guide the embedding of technology design in cultural and social contexts that form dynamic activity systems characterized by by ambiguity, change, and tensions or breakdowns (Gay/Hembrook, 2004).

Ecology in Architecture

The field of ecology and in particular the methodology for deriving an index used by the US Military to determine habitat suitability for different species are relevant to workspace evaluation in architecture The US Fish and Wildlife Service developed the habitat evaluation procedures (HEP), and widely used them in the United States to determine the impact of major construction projects on fish and wildlife habitats. HEP relies heavily on habitat suitability (HSI) models that use measurements of important habitat characteristics to rate habitat quality for a species on a scale of 0 (unsuitable) to 1.0 (optimal). [REFERENCE?]The conception of a workspace as a habitat and of its users as "species"–terms borrowed from the field of ecology-can be useful in assessing the relation of ICP to architecture.

"Green" architecture, an ecological term, which has found its way in the field of architecture has been characterized by efforts to measure it. Performance measurement and in particular certification systems like the LEED, is relevant insofar as it introduces into the process of building design the concept of "accountability" and constraints that go beyond the usual ones relating to engineering, e.g. statics.

Social Science in Architecture

Workplace researchers have long tried to understand the causal relationships and competing interpretations of evidence that help understand how workplace design impacts human behavior after a design has been completed.

Erez (1987) studied the relationship between _communication and productivity_, specifically between interpersonal communication systems in organisations and their relationships to cultural values, productivity and innovation. He found that _on the motivational level, sharing of common values makes for better consensus and commitment to those values while on the cognitive level, sharing of knowledge, ideas, and information enhances the level of productivity and innovation._

S. Hellweg, S.Phillips (1982) examined issues connected to the variables "communication" and "productivity" in the context of human relation theorists' work who, like Elton Mayo, have considered as almost axiomatic that the existence of communication within an organization would in all likelihood enhance worker productivity.

Ale Smidts, Ad Th. H. Pruyn, Cees B. M. van Riel (2001) studied the relationship between _communication and identity_, speficically tested the hypothesis that adequate information about an organization strengthens identification and demonstrated that communication content and climate affect organizational identification.

Ashforth, Mael, (1989) studied the relationship between _identity and productivity_ and found that employees who identify strongly with their organizations are more likely to show a supportive attitude toward them and Simon (1996) notes that these employees would be more likely to make decisions that are consistent with organizational objectives.

Mayo (1949) carried out experimental studies at the Hawthorne Plant of the Western Electrical Company between 1927 and 1932 that found manipulation of physical environment variables led to improved worker production. Brill and Sundstrom have also inquired into causal relationships. Joroff and Bell pointed out the importance of studying the physical environment in conjunction with the nature of work and strategic managerial issues.

Hinks (1999) discussed the gap between senior and facility managers of what each believes are appropriate measures for performance measurement. (Effectiveness and functionality are important key performance indicators for facility managers, while growth and revenue/profit are important for senior managers. Customer satisfaction is for both.)

The table below indicates these gaps as well as what a possible rating from an architect would be for each issue.

Performance Measurement Gaps Between Senior and Facility Managers

Performance Indicator	Management	Protocol	Architectural design (author note)
	Facilities management priority	Business priority	Designer priority
Cost effectiveness	93	29	25
Customer satisfaction	82	110	75
Functionality	66	12	50
Revenue/profit	39	97	0
Service quality	36	3	25
Staff satisfaction	27	22	75
Space management	26	11	50
Business growth	21	51	0
Safety	17	8	100
Flexibility	17	6	75
Total effectiveness	11	8	75
Service response time	11	8	25
Synergy with company's strategic plan	11	21	75
Efficiency	9	3	50
Risk Management/Technology	8	4	50
Change	8	6	50
Efficient workforce	4	6	25
Benchmarking	4	1	50
Research	3	5	50
Quality environment	3	20	75
Communication	1	2	50
No harm to environment	6	6	75

[Column Architectural design indicates possible designer priorities for each issue]

Amaratunga and Baldry {2001} discussed performance measurement of support services in an organization with the use of the Balanced Scorecard method which "translates an organization's mission and strategy into a comprehensive set of performance measures" derived from financial and non-financial criteria". The process for developing a balanced scorecard incorporates customer, internal processes, financial and learning/growth perspectives into a set of critical success factors and measures that constitute the basis for an implementation plan aimed at upgrading facility performance.

Hedges (1982) - mentioned that "numerous problems affecting employees' work were found such as lack of privacy, high levels of distraction and disturbance... for a majority of employees performing managerial and technical tasks, *there appears to be an inverse relationship between their satisfaction with work and their satisfaction with office conditions*. Staff with the most complex, demanding and satisfying jobs also tends to be the most sensitive to their work environment.

Carlopio and Gardner (1992) observed that perceptions of work environment might be more strongly related to satisfaction for managers, professional and supervisors than for clerical workers.

Leaman stated that the link between resource input and output is not necessarily a direct relationship nor completely manifest. He also stresses the importance of context: "hundreds of variables are involved, many of them correlated with each other, so it is usually difficult to know which to choose-some concerned directly with the building, its people and occupying organizations, others with the social and technical background which is always subtly volatile, *so it can be a challenge to know which variables will be significant in any situation*". He also adds that "businesses are often unclear about what they are trying to achieve, taking refuge behind "flexibility" without understanding what they are asking for, so often they get things that they didn't know they want".

Preiser & Vischer (2004) introduced the building performance evaluation approach (BPE). It incorporates the expert knowledge accumulated over the years from post-occupancy evaluations of different buildings and introduces a framework that applies that feedback and evaluation at every phase of building delivery, ranging from strategic planning to occupancy, throughout the building's lifecycle. The BPE approach is related to post-occupancy evaluation defined as "a phase in the building process that follows the sequence of planning, programming, design, construction, and occupancy of the building," or as "an appraisal of the degree to which a designed setting satisfies and supports explicit and implicit human needs and values of those for whom a building is designed" (Preiser, 1988). Marans, Speckelmeyer (1981) shifted the focus to include all user groups, as well as important building elements. A social science approach emerges that relates objective, measurable environmental, and organizational setting attributes to subjective user perceptions, proposing a more comprehensive perspective that accounted for both users *and* building elements. This model of inquiry, which proposed studying how the physical environment and organizational setting of a workplace influences the satisfaction of workers, has been an important reference in the literature and is relevant to the author's perspective too.

As part of the social science literature relating identity to architecture, one could also take note of workplace related work at MIT:

Duffy ran workshops on innovation in workplace design and corporate real estate.

Allen in collaboration with Henn explored the theme of how spatial planning can support communication networks.

Porter and Joroff inquired into the relationship between buildings structure and the changing nature of work.

Frenchman inquired into the implications of changing work patterns for the design & management of cities.

Geltner has inquired into the implications of lease vs. own decision on design quality. There is also thematic research:

Turner/Myerson (1998) discussed the theme of *change*. Change is powerful, and most human beings relate to it over time. The philosopher, Heraclitus, pointed to a law of change as the underlying force in the doctrine of *flux* he espoused. Applied to the social order of work, change is reflected in shifting of user requirements or existing work patterns, and gives rise to a new set of work values—*a new work culture*. The 'new' work values, focused on human comfort, mobility, communication and collaboration, can be realized by use of specific layout templates that highlight different aspects of activity in an organization. Roadmaps with tactics help overcome intra-organizational barriers to any change initiative.

Brill (1984) focused on *employee satisfaction*. Comprehensive studies done in organizations employing tens of thousands of people have generated a list of characteristics in a working environment that are most closely related to employee satisfaction. They include daylight and air freshness. Allen (1977) centered on studying the *flow of communications* in science and engineering organizations and showing how human, organizational and physical systems could be restructured to bring about improved productivity and better person-to-person contact.

Harrigan (1987) approach focused on *human activity*. Working environments shall be designed on the basis of their ability to accommodate, facilitate, and support a variety of human activities in a physical setting. An early manifestation was found in human-factors engineering, and the resolution of problems like aircraft cockpit design, with lessons learned then applied to architecture and interior design.

Despite the variety of thought relating evaluation to the design of working environments, defensible and robust theories predicting the costs and benefits of specific innovations are elusive.

3.B.Proposed Research Methodology

Selection of Research Methods

The proposed research methodology for this study used five case studies as "conceptual containers" to incorporate three different research approaches: qualitative research (observation and surveys), correlational research and logical argumentation research.

First, case studies/artifacts to be used in field research were chosen based on similarities in population type, facility size and permission for access. Then, through observation and interviews a set of relevant variables were identified as index components of WOCSIT v.1; these were narrowed down to forty (40) by way of reorganization to make up WOCSIT v.2A. For these variables, suitability charts were drafted, initially entirely subjectively, then with input from facility users. Finally, in two comparable case studies (Stata, ITU), a survey was administered and variables could gain statistical relevance and, after factor analysis, get further organized in a hierarchy of relevance to ICP[1]. On the basis of WOCSIT, evaluation schemata could be formed.

Qualitative research, a well-established method in the social sciences focusing on naturally occurring patterns, was first used relying on <u>observation and interviews</u> to gather field data and specify the "suitable" design variables that would be measured.

To clarify the relationship among the complex set of real-world variables, correlational research was used. Unlike experimental research, correlational research did not depend on the researcher's active intervention. The instrument for carrying out this form of research was the survey. Finally, to situate the issue of workspace architectural design in a systemic framework that could have explanatory or utilitarian power over that issue, logical argumentation research was undertaken. The systemic theory developed is about identity and communication of the artifact (workspace) that is defined

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[1] A second survey is planned that is expected to have stronger statistical relevance and further elucidate factor relevance

by the hierarchy of component parts of the Communication Suitability Index.2

3.B.I Correlational Research

The general hypothesis that workspace architectural design and identity, communication and productivity are correlated is challenging to test. Hence, the methodology introduced in order to support the class of hypotheses the author seeks to demonstrate, relies heavily on empirical evidence that requires the support of senior decision-makers in the host organization support the study (workshop conducted by Duffy and Tsakonas in 2004).

Accordingly, the following requests were made of and accepted in full or in part by the directors of each participant organization:

- Access to public intra-departmental email archives

- An office/desk in the field of research (i.e., the facility itself)

- Permission to interview occupants starting immediately after their relocation

- Access to server space for the purpose of storing and disseminating project-related information

- Permission to administer a survey to the whole user population

The timing of the administration and format of the tools varied. In the corporation, archival research was limited for confidentiality reasons, interviews were fewer due to time scarcity and scheduling delays, while surveys were prepared well in advance and introduced to only part of the population due to senior management reservations. In academic environments, the conditions were different: most records were widely available and opportunities to interview people were ample. Surveys, on the other hand, were a challenge to administer due to the non-hierarchical nature of the organization; a director's recommendation to fill out a survey provided no guarantee of a higher response rate.

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2 Similarly, shape grammar research, is about a certain systematic way that formal composition can be understood by the dictates of formal logic

Looking at each technique more specifically:

- Archival review included analysis of newspapers, magazines, web releases, video materials and books published about the facilities. In addition, maintenance records and email correspondence in online public intra-department forum for community members were reviewed and analyzed to identify building-related issues and create a thesaurus of terms, locations, and arguments.

- A total of about ten (10) interviews took place with all user types in each facility and included students, faculty, senior and junior staff and directors; they were informal and open-ended in nature with a standard length of about 30 minutes. The interview content was transcribed and questions that seemed to elicit interesting responses were repeated in other interviews while excerpts from responses were compiled into a draft survey for validation. Questions that were invariably asked included finding out about interviewees' nature of work, their perception of the ambient environment, and consonant and dissonant experiences.

- Observation logs were kept from the fixed location of the researcher's desk within the facility, when that desk was available. Different students sat at the desk and for varying degrees of time recorded activities in the area. Logs were also kept in high-traffic areas like the cafeteria or near elevators with the intent of classifying visitors, and understanding their direction of movement and the socialization patterns.

- Surveys of select sub-populations were administered with the intent of finding out more information about specific conditions in all the facilities. For example, one survey focused on the experience of ten ephemeral visitors attending a weekend conference; another, on a group of fifteen scientists inquiring into their sense of perception, orientation and possible illusion in spaces with specific conditions; yet another on design features affecting employee satisfaction. This unreported data was helpful in the process of formulating the large-scale 35-question survey that was administered to the whole

population in two of the case studies (Spring 2006)

Technique	Focus
Archive review	Impressions, complaints, praise
Interviews	Impressions, relocation, privacy etc
Observation–desk	Neighborhood activity, territoriality, flexibility
Observation–general	Interstitial spaces, transience, utility
Survey–visitors, ephemeral visitors	Iconic value, management
Survey–special room	Space perception, disorientation and dizziness
Survey–productivity	Adjacency and productivity

3.B.II Illustration of Logical Argumentation Research

An effective way to illustrate the application of logical argumentation research is by demonstrating its use in determining the suitability of a habitat for a simpler form of life. The example used is that of the water turtle.

For a habitat to be suitable or the survival and growth of a water turtle, certain conditions need to be present both for its water and land habitats. For the water habitat, at least three factors/variables are considered critical: water velocity, water depth and water temperature. For the land habitat, two factors are critical: grass coverage and shaded areas. Each factor/variable can have a range of values, a subset of which are considered suitable for life.

		Unit of Measurement	Range of Values	Suitable	Example 1 Observed Values	Suitability	Example 2 Observed Values	Suitability
	velocity	cm/sec	0-100	5-30	3	0	10	1
	depth	meters	0-10	0-3	5	0	2	1
	temperature	celcius	0-50	10-30	70	0	..30	1
Water								
Land								
	grass	%coverage/m2	0-100	25-100	10	0	50	1
	shade	%coverage/m2	0-100	10-50	70	0	30	1
Suit-ability						0		1

(Left vertical label: Habitat Suitability)

This information can also be demonstrated in the form of charts for each variable. On the x-axis is the range of values for each variable and the subset of suitable variables, while on the y-axis is the suitability of each x-axis value. The suitability is determined by an expert ecologist.
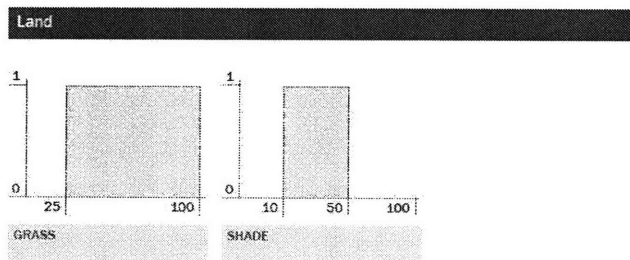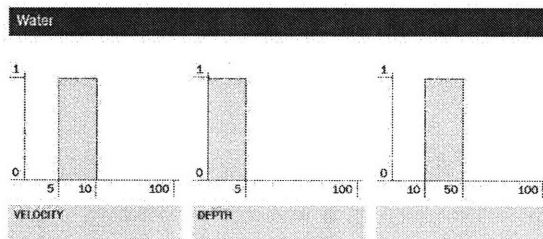
An evaluation schema for the water turtle would be as follows: In qualitative terms:

The "happy" water turtle lives in a habitat consisting of both water and land. Water is running (but not too fast), is relatively deep and relatively warm. Land has grass but is also shaded somewhat."

The "sad" (soon dead) water turtle lives in a habitat with stagnant, sweet and very deep water and land that has no grass or shade whatsoever."

Evaluation Schema "Turtle Habitat"							
			v	d	t	g	s
			velocity	depth	temperature	grass	shade
	ω	water	v	v	v		
habitat suitability							
	φ	land				v	v

subdesign "turtle1"	λ-1		v-1	d-1	t-1	g-1	s-1

In quantitative terms, the derivation of an evaluation schema would require that **each of the subjective terms used becomes measurable** with the use of operational variables and the corresponding metrics.

So for the "happy" water turtle, the range of suitable values could be

"Water is running (but not too fast"→ v= [20-80 cm/sec]

"Water is not too deep"→ d=[0.5-3m]

" Water is relatively warm"→ t= [10-30c]

" Land has some grass"→ g=[0.25-1/m2]

" Land is shaded somewhat"→ s=[0.25- 0.75 shade coverage/m2]

Evaluation Schema

			a	b	c	d	e
			connectivity	visual access	sense of belonging	recognition	recall
	ω	awareness	v	v	v	v	v
Identity& communication suitability							
	φ	memory				v	v
subdesign "user1"	λ-1		v-1	d-1	t-1	g-1	s-1
subdesign "user2"	λ-2		v-2	d-2	t-2	g-2	s-2

To demonstrate the evaluation framework, all variable values have been simplified. An equation, indicating the relative weight and relationship of each variable to the other determines the overall suitability of a habitat. To derive the equation, it is necessary to have field data from a range of habitats and correlate it with the water turtle's survival. Then, an equation can be derived that can help predict for each set of field values the suitability of a habitat for water turtle survival. A reasonable equation can be based on the concept of *limiting factors*: any one of the identified factors that assumes an unsuitable value will make the *whole* habitat unsuitable for the water-turtle.

Thus,

HSI= min. (Water, Land)

where Water= min. (Velocity, Depth, Temperature) and Land=min(Grass, Shade)

While simple, the framework set forth triggers questions that need clarification:

a. "What is the range of suitable values a factor can have?" For a wildlife species, suitable values are derived from repeat field observations that reveal the threshold values for survival- they are often captured as "expertise" specialists have accumulated after years of experience.

Experiments, where variables can be controlled, may also be possible but harder to set-up.

b. "What is the relative impact of each factor on the other and on water-turtle survival?"

Multivariate factor analysis would reveal the relative impact of each factor as well as its influence on the others. For example, for the factor "grass" common sense may dictate that there is an inverse relationship between "grass" and "shading" values- the more shade an area has, the less light is available for grass to grow, so the factors may partially cancel out each other.

In normal conditions, as seen from the real suitability charts of the slider turtle (in the literature review herein below), cut-off values for each variable are not discreet but continuous and interdependent.

The proposed methodology to evaluate the architectural design of workspaces is **analogous** to the methodology used to assess water-turtle habitats.

Using the tools developed to collect data, variables deemed relevant to identity-formation and communication are noted and data is collected for each. These variables are organized in a schema. The instantiation of a schema determines if a workspace is "suitable" or unsuitable" for identity-formation and communication when field values for each variable are compared to the suitability charts for each variable. These charts are formed by expert opinion or some other more objective method and indicate what range of values for each variable is considered "suitable".

Evaluation Schema

			a	b	c	d	e
			connectivity	visual access	sense of belonging	recognition	recall
	ω	awareness	v	v	v	v	v
identity& communication suitability							
	φ	memory				v	v

| subdesign "user1"	λ-1		v-1	d-1	t-1	g-1	s-1
subdesign "user2"	λ-2		v-2	d-2	t-2	g-2	s-2

3.B.III Other Data Collection Techniques

While most of the techniques described herein below were developed to a point of being usable, no data from them are reported in the study as the techniques were difficult to administer and produced few verifiable results. In-depth methods were modifications of existing techniques used in other studies, or new experimental techniques whose efficacy has not yet been proven.

- Cognitive mapping: select interviewees were asked to sketch with a pencil on paper, their new and old proximal working environment and describe their path to the nearest exits, the cafeteria, bathroom, conference room, and the colleagues they worked with most often. This information related to the assessment of one key client committee assumption—that members of research groups were better off working next to each other.

- Photographic sessions: every three months, a set of more than five hundred pictures of various areas were produced and archived. Over time, it was expected that the cataloging of these visual resources could be enhanced with metadata and provide a valuable visual record of how the building has changed over time. Scenarios of alternative interventions in response to a set of needs were explored.

- Fire exit way finding: after systematic disorientation was recorded among users, short exercises were administered in Stata to find out about occupants' ability to locate fire exits.

- Video games: the design and construction of an online game assisted players in learning about the building and each other. More importantly, it allowed the researcher the opportunity to collect accurate data about the behavior and movement paths of players that were then analyzed to draw conclusions about workspace pattern of usage.

- Review of the design process: key stakeholders in the production of a facility were interviewed and asked to fill in boxes on a timeline with what they considered key 'inflection or dramatic points' in the planning and design process. These points helped understand and recreate the decision space each agent faced and their role in the design process.

- <u>Design charrettes/games:</u> as a precursor to one possible path to intervention, a charrette had   important short-term effects, as it created goodwill with the occupants and provided a glimpse of occupants' reactions and perceptions of space in a group situation.

Technique	Focus
Cognitive mapping	Space perception, adjacencies
Photographic sessions	Change of physical conditions
Fire exit way finding	Orientation, way finding
Design process	Client group
Design charrette	Concept of "tweaking"

- <u>Stage Performance Art:</u> the premise of using the building as a prop in art performances served an important goal insofar as it rose to the realm of the possible activities that would normally be considered likely to happen. For some spaces, the more activities that can be layered on a space, the more valuable that space is. The effort by a group of students led by an MIT arts professor to invent new ways of using Stata through stage performance was monitored.

- <u>Design rationale:</u> architects' drawings were studied in an effort to extract those aspects of the design rationale that could be preserved as evaluation criteria in future interventions.

- <u>Reconstructed geometry/virtual reality:</u> the reconstruction of the geometry of a meeting room, its embedding and testing in a virtual reality environment, improved the ability of computer models to predict human behavior in architectural spaces.

Virtual Reality Source:Author
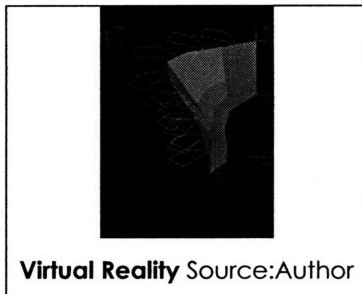
- <u>Seat sensor:</u> to verify respondent statements regarding the amount of time they believe they spend at their desk, a seat-sensor was designed and placed on the work chair. Every time a respondent would leave the chair, the seat-sensor would get the value O while when they were sitting, the value would be 1. Thus, along with the Pulse Tracker and Survey methods, it was possible to track movement in and out of the chair rather accurately.

- <u>Web-tool:</u> a website served as a communication and research tool with the community, that is, the faculty, students, and staff that work in a facility every day. Different modules included: Oral history. A web-based discussion thread that allowed end-users to record the oral history of their early days moving in the facility. "Elisa-interviewer": An online interviewer helped the researcher conduct repeat interviews with subjects over time. The respondents voiced their views to a computer, thus saving the researcher time and allowing scalability of the method. As open-ended interviews often become a monologue with the interviewer interjecting support remarks ("I understand", " yes", "tell me more"), the promise of this application being useful is high.

- <u>Pulse-tracker:</u> in an experiment, participants filled out a brief survey with questions about their location and movements and were then given a cell phone that tracked their location and movement patterns within the building. Their records were uploaded on the project server that they could review at their leisure. Following exit-interviews, they were asked to narrate their activities while reviewing their data history. It was expected that gaps would exist between *what they thought they did, what they said they did and what they actually did.* This supported the contention that human beings live in perceptual reality believing in 'psychological truths.'

- <u>Arrows:</u> an online applet allowed occupants to place arrows on images depicting plans of each floor, to upload images of their own, and to enter commentary. A map was generated with hundreds of entries of 'problem areas' or 'areas of interest' in the facility.

Arrows (Screenshot)   Source: Author
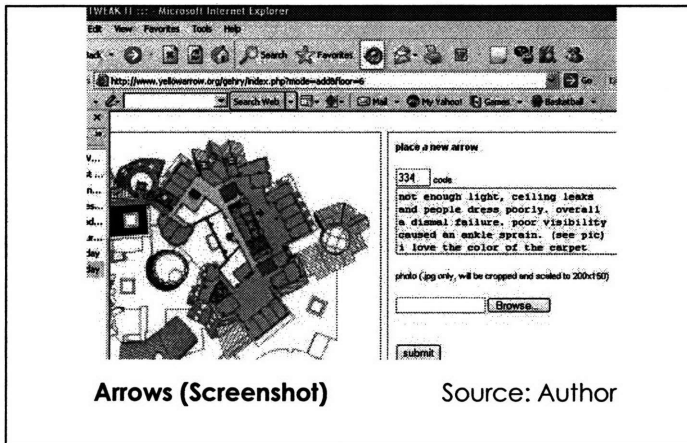
- <u>Privacy assessor:</u> select spaces in the facility were rated for their performance on the privacy modality scale (information gathered from a workshop conducted by Cho and Tsakonas in 2002) that inquired into the ability of a space to support four different modalities of privacy. Those that could support all modalities were rated highest.

Technique	Focus
Performance art	Activity layering
Virtual Reality	Space perception&orientation
Web tool-	
-→oral history/ elisa-interviewer	open-ended interviews
-→"pulse-tracker"	Location and movement
-→"Statarrows"	Identify problem areas
→Privacy assessor	
→ Design rationale	Evaluation criteria
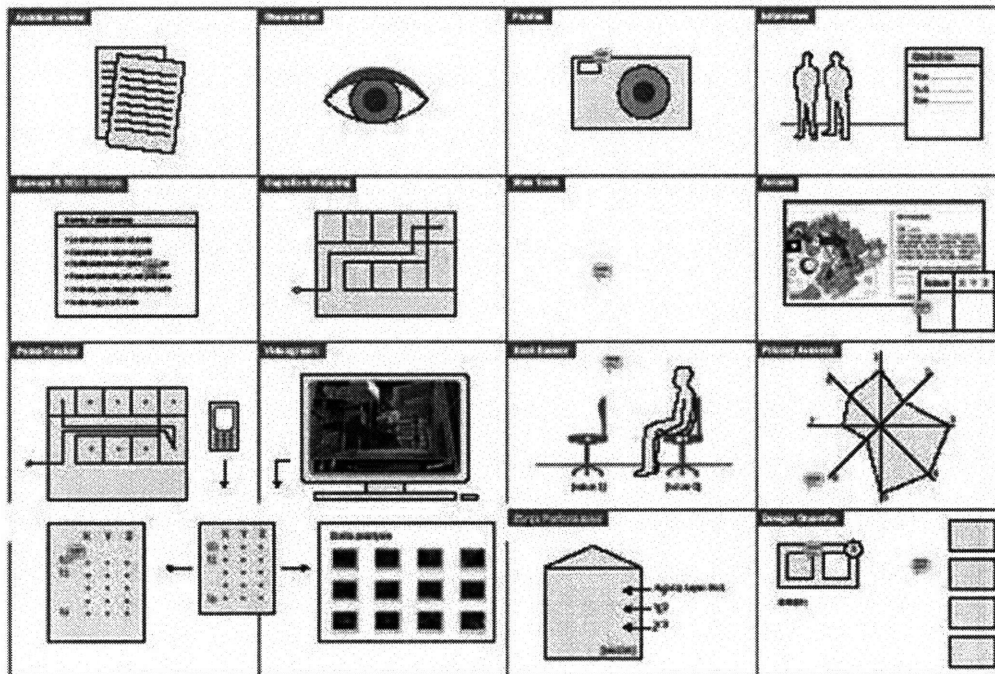
Graphic representation of selective data collection tools

4. Application Of Research Methodology: Comparative Case Studies

Introduction

Project stakeholders in each of the five cases described herein below (MIT Media Lab, Genzyme, Telco, Stata Center CSAIL and ITU) seek evaluation methodologies that measure and account for both financial and non-financial value generated by their investments in architectural design. To this end, comparative case studies and correlational research can help clarify the relationships of a complex set of variables characteristic of the workspace to organizational identity, communication and productivity. As stated earlier, the effort to identify variables and gather data that help assess the performance of the facilities is best summarized with the construction of an index, the WOCSIT index, which can act as a guide for needed interventions that ensure the workspace and the occupant organization work effectively.

Evidence gathered in the process of conducting each case study can lead over time to the creation of a *predictive* equation that describes what environment is suitable for communication, depending on the values and weight each variable has in that equation.

The proposed method is analogous to that of determining a habitat's suitability for a species' survival (see HSI index). However, it is more complex for workspaces as the human species exhibits a wide variety of behaviour. Defining "suitability" for other species may be closely related to their biological limitations while doing so for humans can often be highly subjective while sampling reliable data can be a challenge.

Overview

The MIT Media Lab, founded in 1960, is an organized space where "future-obsessed product designers, nanotechnologists, data-visualization experts, industry researchers, and pioneers of computer interfaces work side by side to tirelessly invent–and reinvent–how humans experience, and can be aided by, technology." The MediaLab approach to the academic enterprise is signified by the original design of its building, a structure designed by IM Pei.

Lack of workspace led to the relocation of research groups in a commercial office facility (1CC) a few hundred feet away and eventually triggered the decision to start a second building immediately adjacent to the original. Comparing communication quality among groups in the two facilities allowed some insight into the impact of physical design characteristics on communication. It seemed that those who worked away from the main facility also had a weaker sense of belonging to the organization, looser lines of communication and less influence on the group's research agenda.

Genzyme is a start-up biotechnology company that has grown consistently, primarily through acquisitions of other companies, to a size of 9,500 employees in 70 locations in over 30 countries worldwide, including 17 manufacturing facilities and 9 genetic testing laboratories. The need to maintain cohesion in the workforce led to the decision to design a new headquarters building, the Genzyme Center. Comparing the performance of the new facility to that of the old facility in terms of impact on identity and quality of communication would help measure financial and non-financial returns on the investment of USD140M+.

Telco is a ten-year old company experiencing rapid growth, currently employing more than one thousand people and generating revenues in excess of one billion euros per annum. They are dispersed in three nearby buildings plus two other, centrally located ones and are considering consolidation in one facility. Comparing the current situation to the future situation will provide insight into the incremental contribution of good workplace design to identity, communication and productivity.

The Stata Center, designed by F.Gehry, is home to the Computer Science& Artificial Intelligence Laboratory (CSAIL), which has more than eight hundred members including investigators, administrative staff and students. It is housed in the same facility with the Laboratory for Information and Decision Systems (LIDS), and the department of Linguistics and Philosophy and across the street from the Cognitive Science department and was created in the context of the institution's aim to be positioned on three pillars, teaching, research and community for MIT (Vest, 2004).

ITU, the "Information Technology University" is a relatively new educational institution financed by the Danish Government. It has a staff of approximately one hundred and fifty and serves a population of approximately two thousand people with a focus on teaching, research and enterprise (Tofte, 2004/2006).

For each of the five composite artifacts the following were undertaken:

1. The composite artifacts used in the comparative case studies were described from the physical/technological and human/organizational vantage points.

2. Variables identified after field research relying on observations and interviews were listed and summarized. For each variable, a range of values and suitability were defined and a preliminary communication suitability rating for each facility was derived (WOCSIT v.1).

3. Based on qualitative research and categorization process, a second version of the WOCSIT index was derived (WOCSIT v.2A.). Based on quantitative correlational research, a survey was conducted and the relevant statistical analysis undertaken to update the index once again.(WOCSIT v.2B.).

MIT MEDIA LAB

The building of the MIT Media Lab, designed by I.M. Pei, opened in 1985. The Lab focuses on "human adaptability"–work ranging from initiatives to treat conditions such as Alzheimer's disease and depression, to sociable robots that can monitor the health of children or the elderly, to the development of smart prostheses that can mimic–or even exceed–the capabilities of our biological limbs."

The case study took place in the context of a seminar on how physical space, communication and innovation are interrelated and was based on T. Allen's work who stated in his book "Managing the Flow of Technology" that "80% of all innovative thinking is derived from face-to-face communication". The study objectives included mapping current communication pathways in five select research groups, identifying communication gravity centers and suggesting improvements.

Artifact Description

The MIT Media Lab is a composite artifact consisting of a physical and human subsystem. At their intersection, an information subsystem is formed that constitutes the working environment.

I. Physical subsystem

Selected features of the MIT Media Lab architectural design are described from the end-user perspective.

The exterior of the main building is glass-clad. The building is surrounded by land, part of which is set aside for an expansion project and a plaza.
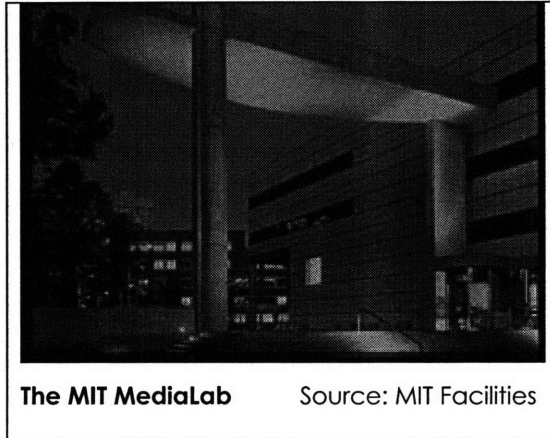
The MIT MediaLab Source: MIT Facilities

The interior features that characterize the building include a two-level (ground and basement) public area. Off this public area on the ground floor are a research lab and an exhibition space while at the basement an auditorium, and research areas.

The interior of the building has a standard indoor air quality management plan, no operable windows, lighting controls or permanent temperature and humidity monitors connected. The building management system is dated. Natural light is scarce while the atrium permits little light to the atrium.

A typical floor features a corridor that surrounds the atrium, or goes through the research group areas. Off to the periphery or on the sides of the circulation corridor are the research common areas, which are visible, as the partitions are made of glass. Therein, one can find food stations, conference rooms, lounges, couches, exhibition areas as well as desks for master's level students. Private offices, for faculty or Phd students, are on the periphery of the building, non-visible and in spaces blocked off with doors.

Individuals have a lot of flexibility to modify privacy and communication modalities in their environment, i.e. to choose the height-adjustable chair,

tables and desks, file cabinets, and other components for their reconfigurable offices or cubicles. For example, two or more workstations can be joined together to form a creative team. Most employees have wall switches that allow manual over-rides of lighting and temperature controls of the building. The operable windows allow employees to control indoor air intake and vary the exterior building in design, color, material, and proportion. Overall personal space design allows people the opportunity to adapt it to their own needs while allowing an overall standard of quality to be maintained. This flexibility also allows the opportunity to.

Regarding the 'look and feel' of the facility, color is used selectively, yet the facility overall is dark with insufficient natural and artificial light.

From the technological standpoint, the facility has a large network of computers, ranging from fine-grained, embedded processors to mesh networks. The rapid prototyping resources include 3-D printing, injection moulding, and PC board fabrication. There are studios for audio and video, and laboratories for DNA labelling, new sensors, micro-encapsulation, quantum computing, and perceptual studies.

II. Human subsystem

About two hundred and fifty people work in the MIT Media Lab.

The faculty, senior research staff, and visiting scientists working in the Laboratory number more than 40, and more than 70 other staff members support the Laboratory's research, facilities, and administration. Graduate enrolment totals approximately 135, with approximately 70 masters and 65 doctoral students.

Group	Faculty	Students	Staff	Total
Media Lab	40	135	70	245

MIT Media Lab Working Population Breakdown   Source: MIT Media Lab

At MIT Media Lab, there are approximately twenty-seven research areas and principal investigators, two to five per floor. Some research groups require space for equipment and machines, while others like theory or networks and systems require office space only. Senior faculty members have their own office, while Ph.D. students share offices.

GENZYME

Genzyme was founded in 1981 and now focuses on lysomal storage disorders, renal disease, orthopedics, transplant/immune diseases, oncology and genetics/diagnostics. The company has a staff of 9,500 located in 70 locations worldwide. Genzyme Center, part of a development project, had Stefan Beihnish as architect.

To measure improvements in workplace performance and user satisfaction, a pre-occupancy survey was conducted in June 2001 with 181 respondents and a post-occupancy survey in April 2004 with 213 respondents.

Artifact Description

The Genzyme Center is a composite artifact consisting of a physical and human subsystem. At their intersection, an information subsystem is formed, the Genzyme working environment.

I. Physical subsystem

Selected features of the Genzyme Center's architectural design are described from the end-user perspective.

The exterior of the building is characterized by a glass cladding that maximizes daylight exposure. The building is near the subway and the MIT campus and part of a development scheme by a local company

The interior features that characterize the building include a sunlit atrium of very large volume.

The ground level 'urban street' which lies under the atrium is designed to be open to the public and accommodate commercial shops.

A set of wide stairs leads to the check-in counter and onwards to transparent elevator banks.

The Genzyme Center Interior   Source: Genzyme Co.
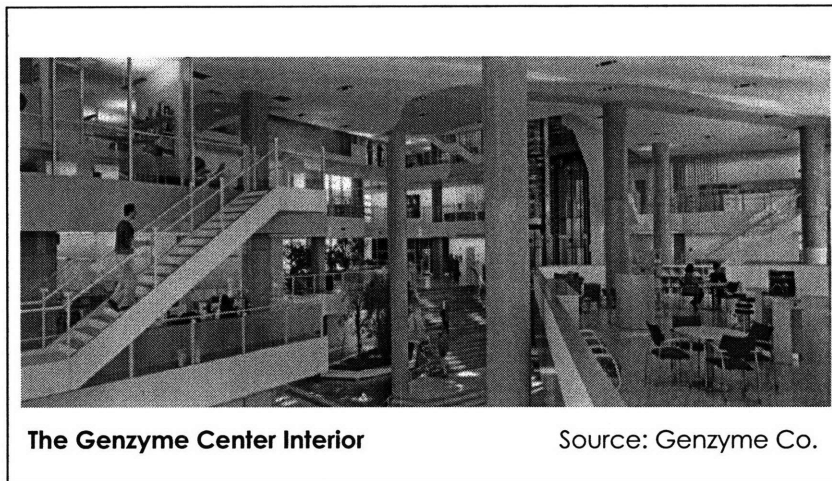
An indoor air quality management plan carbon dioxide monitors and separate ventilation for chemical storage areas. It has operable windows and lighting controls for perimeter workspaces as well as permanent temperature and humidity monitors connected to the building management system. The light enhancement system provides sufficient natural light for at least 75% of workspaces. Workspace layout, the use of a 12-story central atrium and extensive use of glass on both interior and exterior walls permit views to the outside from all of the regularly occupied spaces while eighteen indoor gardens and accessible outdoor patios further enhance occupants' connection with the natural environment.

The upper floors are characterized by extensive common areas populated with different types of workspaces, conference rooms, and small coffee tables. A typical floor features a common area/lounge off the elevators, open areas, offices with lockable doors, conference rooms, kitchenette, controlled access, and staircases that led to the floor below.

The Genzyme Floor Plan   Source: Genzyme
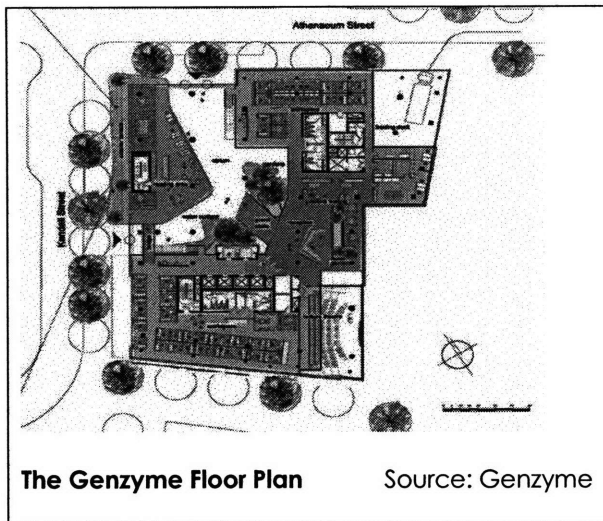
Individuals are given the freedom to modify privacy and communication modalities in their environment, i.e. to choose the height-adjustable chairs, tables and desks, file cabinets, and other components for their reconfigurable offices or cubicles. For example, two or more workstations can be joined together to form a creative team. Most employees have wall switches that allow manual over-rides of lighting and temperature controls of the building. The operable windows allow employees to control indoor air intake and vary the exterior building in design, color, material, and proportion.

Overall personal space design allows people the opportunity to adapt it to their own needs while allowing an overall standard of quality to be maintained.

Regarding the 'look and feel' of the facility, a lot of color is used, as well as 'natural' materials like wood. Natural light certainly is the main determinant of an overall impression characterized by a user-friendly, open working environment.

II. Human subsystem

A few hundred people work in the Genzyme Center.

Group	Senior Staff	Jr Staff	Admin	Total
Genzyme	45	126	102	837
Total				890

Genzyme Center Working Population Breakdown (App.)   Source: Author

In Genzyme Center, some workgroups require space for equipment and machines, while others require office space only. Senior directors have their own office, while junior staff either share an office or sit out in open areas marked by partitions.

STATA CENTER (CSAIL)

The conception of the Stata Center as a composite artifact is central to the approach of the research study, as it emphasizes the interdependence of architectural design and the organization of human social life.

In the period of 2004-2006, case study research was undertaken in the research lab with 800+ members working.

Artifact description

The Stata Center, and CSAIL in particular, is a composite artifact consisting of a physical and human subsystem. At their intersection, an information subsystem is formed, the working environment.

I. Physical subsystem

Detailed descriptions of select features of the Stata Center's architectural design are described from the end-user perspective.

The exterior of the building is characterized by irregular or 'broken' surfaces, a variety of materials (primarily brick and steel), the presence of an amphitheatre and two towers, which—represent the AI and computer science paradigms. The large-sized building is broken down in scale, in part, due to the podium structure that links the towers to the alumni gym.

The Stata Center   Source: MIT/P.Greenspun

The interior features that characterize the building include a conference room with tilted panels (the 'Kiva' room), two large seminar rooms and the R&D pub on the fourth floor.

- The ground level 'urban street' which lies under the podium and runs the length of the building. It connects the gym to the two towers and houses the cafeteria, underground parking lot, child center and auditoria/classrooms

- A set of neighborhoods, semi-contained research areas connected through internal staircases and common areas

From the technological standpoint, a set of building systems which support requirements like secure access control, energy efficiency, security, and building signage. These building systems are 'interoperable', introducing a new interface between building systems and the rest of the enterprise information infrastructure. As the buildings'' physical systems are linked, as any other piece of software, to other parts of an enterprise information system, they also inherit challenges similar to those of enterprise information systems.

A typical floor features a common area/lounge off the elevators, open areas for students, offices with lockable doors, two conference rooms, a kitchenette, controlled access, and a spiral stair-case that led to the floor below.

Stata Center Typical Floor (partial)   Source: MIT CSAIL
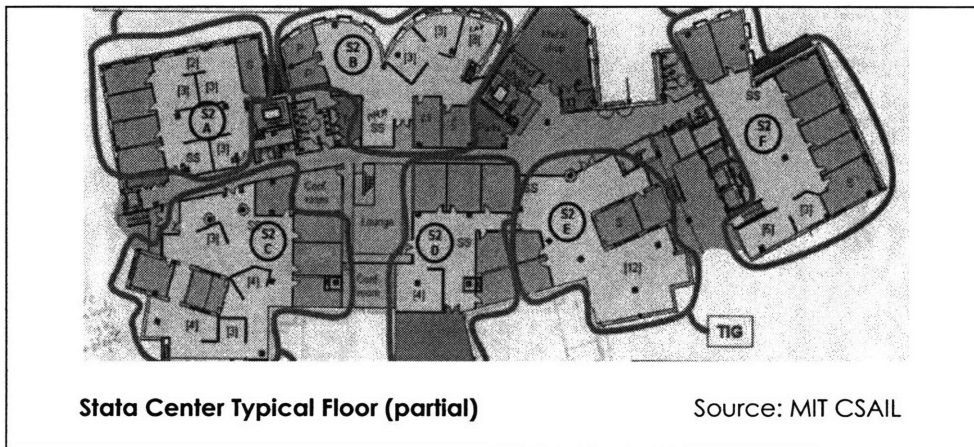
Regarding the 'look and feel' of the facility, a lot of color is used, as well as 'industrial' materials and configurations that were reminiscent of the WW II-era Building 20 [IMAGE}, a building named the 'magic incubator' as it was the physical space where a lot of important scientific innovations were created.

II. Human subsystem

More than one thousand people work in the Stata Center. Of the three main tenants, the Computer Science and Artificial Intelligence Laboratory is by far the largest, occupying all of nine floors of the Gates tower and two additional floors in the Dreyfoos tower. The Laboratory for Information and Decision Systems (LIDS) occupies two floors and another two are assigned to the Department of Philosophy and Linguistics.

Group	Faculty	Students	Staff	Visitors	Total
CSAIL	145	526	102	64	837
(LIDS)	22	72	11	10	(115)
(P&L)	42	74	12	10	(138)
Total					1090

Stata Center Working Population Breakdown   Source: MIT CSAIL

In CSAIL, there are approximately thirteen research areas covered in the department of computer science and artificial intelligence including computational biology, computer vision and graphics, robotics, networks and systems, theory, and the worldwide web. Ninety principal investigators, faculty or senior research scientists are responsible for about thirty research groups or so-called 'neighborhoods,' two to five per floor. Some research groups like robotics or computational biology require space for equipment and machines, while others like theory or networks and systems require office space only. Senior faculty members have their own office, while Ph.D. students either share an office or sit out in open areas marked by partitions.

LIDS, on the other hand occupies only two floors of space on the east side of the complex, in Dreyfoos tower, and is engaged with research in Communications, Systems, Detection, Estimation and Optimization, and

Control. Finally, the department of Linguistics and Philosophy occupies the top two floors of the Dreyfoos tower in a well-lit and spacious environment.

There are many other ways to describe the human system in the Stata Center, based on its demographics, e.g. who the occupants are and in terms of their activities and social networks. The unit of analysis can be the research group and its field but also the type of affiliation (faculty, student), their career stage, age, gender, individual and group activities. For example, a basic analysis of activity in various spaces of Stata reveals that it is not only work that people are involved with when at Stata. Eating, sleeping, and socializing in Stata are all activities that take as much if not more time.

ITU

The IT University was founded by the government of Denmark with the intent of creating an international educational institution that could link education, research and enterprise in the information technology industry. The ITU is a composite artifact consisting of a physical and human subsystem. At their intersection, an information subsystem is formed.

Artifact description

I. Physical subsystem

Selected features of the ITU architectural design are described from the end-user perspective.

The exterior of the building is characterized by a longitudinal H shape and is clad in dark blue glass. Next to it are four buildings: a circular dormitory made of wood, the humanities university, a residential building and the new headquarters of the Danish TV (designed by French architect Jean Nouvel).

The ITU Site   Source: ITU Facilities
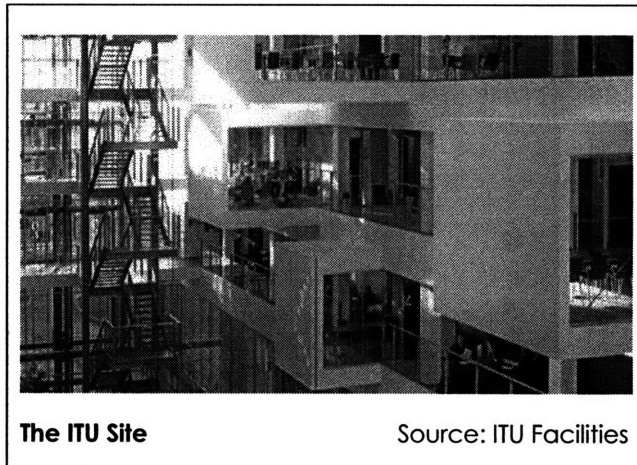
The interior features that characterize the building include:

- Conference rooms that are dispensed in the atrium and two transparent banks of double elevators.

- The ground level 'urban street' runs the length of the building with the Humanities University on one side and the TV building on the other side. On its sides, one can find a space leased-out to a tech company, the

bookstore, the facilities department, teaching areas (computer rooms, auditoria), a pub and a restaurant. There is no gym or kindergarten, the underground parking is for bicycles only (cars are parked on the adjacent empty lot)

- A set of research groups located in "wings", four in each of the four floors ITU occupies in the facility (the fifth floor is leased by an incubator company).

A typical floor features a common area with conference rooms extruding into the atrium and populated by desks, some with computers, surrounding the atrium. Auditoria and classrooms are off the common area in the periphery of the building, while the research groups are located in the "wings" which are subject to controlled access through a single door with no emergency exit. Bathrooms, copy rooms and snack machines are in the common areas.
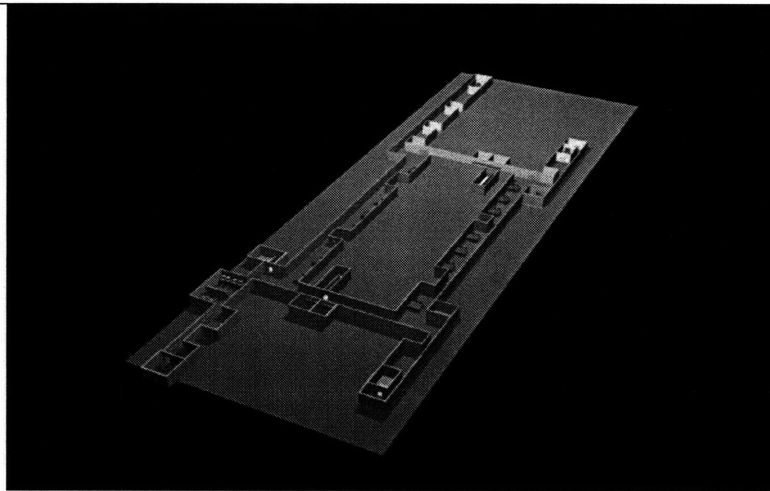
ITU Typical Floor Plan (axonometric)   Source: Author

Within the wings, a kitchenette and common area desk exist. All other spaces are individual offices with doors housing faculty and PhD students. No more than two people are located in any one room.

Regarding the 'look and feel' of the facility, little color is used. 'Industrial' and "cold" materials are used throughout. For example, floors are covered with exposed concrete.

From the technological standpoint, the building systems support requirements like secure access control, energy efficiency and security. These building systems are 'interoperable', introducing a new interface between building systems and the rest of the enterprise information infrastructure.

II. Human subsystem

More than one thousand people work in ITU. It is, however, a smaller facility than the Stata Center. Of the two main tenants, ITU is by far the largest, occupying four out of five floors. An Incubator Company occupies the fifth floor while a start up company occupies space on the first floor.

Group	Faculty	Students	Staff	Visitors	Total
ITU	75	50	(45)	(1500)	1670
Incubator	-	-	(115)	-	115
Total					1785

ITU Working Population Breakdown   Source: ITU Facilities

In ITU, there are approximately thirteen research areas covered in the department of computer science and artificial intelligence including. Senior faculty members have their own office, while Ph.D. students share an office.[3]

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[3] There are many other ways to describe the human system in ITU, based on its demographics, e.g. who the occupants are and in terms of their activities and social networks. The unit of analysis can be the research group and its field but also the type of affiliation (faculty, student), their career stage, age, gender, individual and group activities. For example, a basic analysis of activity in various spaces of ITU reveals that it is not only work that people are involved with when at ITU.

TELCO

Telco was founded in 1981 by its parent company, a former telecommunications monopoly in Europe and now focuses on the provision of mobile telecommunications services in Southeastern Europe.

The company has a staff of 1,700 located in five locations in the city.

To measure the contribution of workplace design to identity, communication and productivity, a pre-relocation study was undertaken during the fall of 2006 and spring/summer of 2007.

Artifact description

In 2006 and 2007, case study research was undertaken in a company with one thousand two hundred employees working in the headquarters in Athens Greece.

The Telco is a composite artifact consisting of a physical and human subsystem. At their intersection, an information subsystem is formed, the working environment.

I. Physical subsystem

Selected architectural features of the Telco buildings are described from the end-user perspective.

The headquarters consists of three buildings. Two five story buildings are part of a three-building compound while the third, a four story building originally designed to be an eight story building, is at a busy intersection.

The Telco Facility   Source: Site Owner

The interior features that characterize the building include a small lobby and long circulation corridors on each floor.

- There is no ground level or 'urban street'.

- The upper floors have few extensive common areas. A typical floor features a common area/lounge off the elevators with no open areas. There are conference rooms, a kitchen with a closing door, and controlled access outside the elevators. There are some offices with single occupants, yet most offices house anywhere from four to ten people.

Typical Telco Floor   Source: Telco
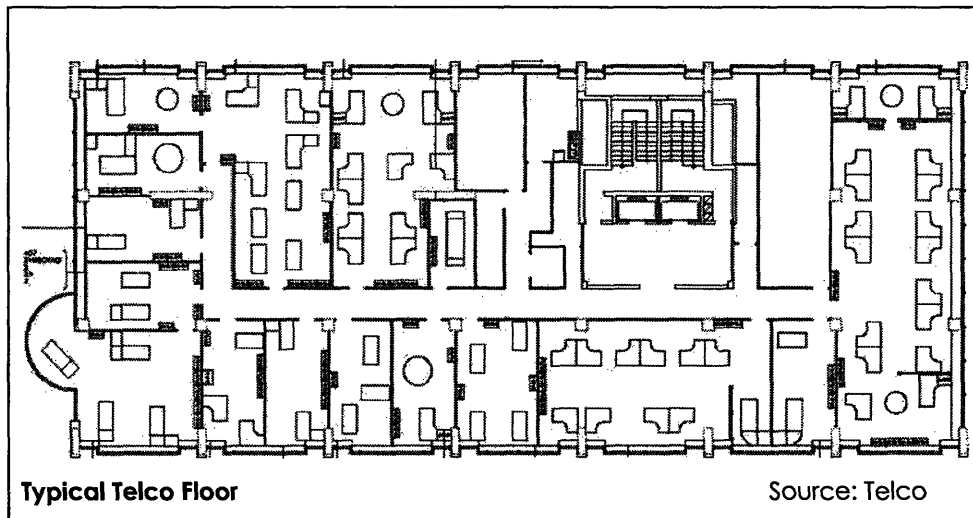
Regarding the 'look and feel' of the facility, little/no color is used, while materials are inconsistent, varying from place to place. For example, in one floor half of it is out of wood while the other half out of tile!

II. Human subsystem

More than one thousand people work in the facility.

Group	Senior Staff	Staff	Admin	Total
Telco	100	526	640	1150

Telco Working Population Breakdown   Source: Telco

In Telco, there are 19 directorates, each with a minimum of a director and sub-director managing several workgroups. Some workgroups require space

for equipment and machines, while others require office space only. Senior directors have their own office, while junior staff either share an office or sit out in open areas marked by partitions.

5. RESULTS

As a first step in measuring the impact of architectural design on value, observation and interviews yielded a set of 77 general design variables that were thought of as having some degree of impact on ICP. These variables constituted the first version of the index (WOSCIT v.1). These variables were then filtered and structured via qualitative (interview) and quantitative techniques (survey) to construct the second and the third version of the index (WOSCIT v. 2A WOSCIT v. 2B respectively). The results of the variable identification and index construction processes are presented below:

Identification of WOSCIT Variables

WOCSIT variables were identified through observation and interviews.

Observations

To avoid getting overwhelmed by the complexity of the situation in each working environment studied and risk collecting random and non-representative data, it was important to undertake observation in a systematic fashion learning to know what to look for and which activities or facts to specify, code and measure through identified variables. At the same time, **the effort to identify the appropriate variables that relate to identity, communication and productivity was necessarily exploratory.** With few exceptions (e.g. the role of natural light in meeting basic human needs at the workspace), it is a challenge to establish either correlation or causality of the variables identified.

The following steps were taken to control the risk of randomness and non-representation:

- All sites chosen had comparable characteristics in terms of size, population make-up

- Access to the sites was secured and few restrictions applied

- Researcher presence at the sites was at all times discreet However, in some sites (Stata, Telco) there was opportunity to both live-in, and undertake selective repeat "spot" observation (e.g. Stata/ITU circulation)

Interviews

Interviews proved to be invaluable research tools, especially because of their informal nature that gently directed the interviewee to comment on issues of interest. At the expense of brevity, allowing the discussion to flow freely permitted interesting facts and perceptions to emerge. In the period of study, some aspects of the working environment that were overlooked during observation sessions proved important. For example, the subjective and emotive conditions some users were able to verbalize, e.g. getting dizzy when working in tilted walls, or, feeling isolated within the organization could only be identified through interviews.

The particular circumstances pertaining to an end-user's activity could provide insight useful in determining how project goals were being met: learning more about ephemeral users and their ties with occupants could relate to the notion of connectivity-an essential aspect of identity; the study of an odd architectural form could be a strong identity-differentiation factor; the study of movement patterns could help study physical cross-pollination underway among end –users.

Construction of Workspace Suitability Indices (WOCSIT)

a. Rationale for Index construction

Field research based on observation may help identify architectural design variables related to identity and communication. An index can organize the information and systematize assessment. And the simplicity of the approach used by ecologists to assess habitat suitability for different species, e.g. the water turtle, by narrowing down the set of factors that most influence water-turtle survival, may be captivating and useful in workspace evaluation. There are different ways to develop an index, both qualitative and quantitative and both are demonstrated herein below.

b. Selection process of index components

The selection of Index components is a multi-step process that relies on the application of one or more data collection techniques to come up with different versions of WOCSIT:

i. WOSCIT v.1 summarizes the appropriate variables that were identified through field observation and interviews.

ii. WOCSIT v.2A   involves the selection of a subset of variables based on qualitative assessment of available data, categorization and elaboration of existing and new data.

iii.WOCSIT v.2B involves the selection of a sub-set of variables that are thought of as capable of explaining most of the variance in communication suitability of each workspace based on the use of quantitative data collection methods, i.e. surveys.

The steps are discreet yet interdependent as the collection of data and the design of an appropriate index are in continuous feedback. While the challenge involves the identification and selection of variables, data fidelity is also very important. Ideally, the use of technology can ensure data triangulation and higher accuracy and efficacy for the index. For example, along observation and interviews, the 'pulse-tracker' method using mobile phones can be used to track the variable 'mobility' in yet another way. Or, along self-reporting and video camera recording, seat sensors can track the variable 'desk hours'.

c. Derivation of WOSCIT v.I

As illustrated in the case studies above, the first version of the workspace communication suitability index is an attempt to summarize identified variables. After field observation and interviews, 77 index functions were created, each with a value of either 1=suitable or 0= not suitable. Every index function corresponded to a variable that measured an aspect of architectural design impacting identity, communication and productivity (ICP). Altogether, by addition, these index functions created the 'Workplace Suitability Index v.1 (WOCSIT).

Derivation of WOSCIT v.1: Case Studies Observation And Interviews
MEDIALAB

Overview

The visitor to the Media Lab workspace is immediately struck by the darkness and the "techie" look of the interior public space which is in stark contrast to the commercial interior of the building where overflow workgroups are located.

In one of the groups, the presence of a large screen provides a real-time weblink to other media labs in Ireland and India. The screen is an integral part of the environment as is the workshop and the conference room one has to go through before reaching the next research group. There, the activity of the group is immediately clear: robot research. A robot is placed in a central location along with explanatory information of the group and its research focus. The bathrooms are very near the workdesks and only steps away and on the differing approaches to privacy of each lead faculty. One faculty may have closed door and shutters, while the other open door but closed shutters. Group work seems to cluster around the wall screen and workbench, while private spaces are tucked away in the periphery.

During a tour of the facility one is informed that related groups sit near each other. Depending on the sponsor visit (the MediaLab is highly dependent on outside sponsorship for ongoing research), different artifacts are placed prominently near the research group areas while general introductory material is placed outside, in the corridor. Not all research groups, however, have evidence of their work exhibited as they present their work within more confined individual offices. The common areas have designated space allocated for a couch, a TV and a water fountain while there are two shops in the middle of the main workspace. Master students work in the common areas while Ph.d. students and faculty have their own or share private offices with doors. While collaboration and communication is close with immediately adjacent groups as well as remote groups in different time zones, it is non-existent with all other groups.

Highlights from observation

The following architectural design and workplace variables were identified as potentially having an impact on identity, communication and productivity (ICP), presented below in random order:

1. Partitions: physical separation exists due to partitions that create individual offices.

2. Leader location: head faculty office strategically located allowing visual access to everyone entering the office.

3. Prop signalling: the presence of props, e.g. teapots, makes the space warm and liveable while many posters and maps signal what activities are underway in the workspace. In other spaces, it is 'unclear' what occupants are working on.

4. Space use: some spaces are dedicated to one use while others allow multiple layering of activities. Conference rooms are used only for meetings. Lounges and workbenches, on the other hand, are used for individual study, social and work related meetings.

5. Inter-floor interaction: there seems to be little interaction with other floors, especially in the commercial building. When present, coffee pots seem to mitigate this phenomenon.

6. Live prop: weblink to other laboratories and other computer screens are an integral and visible part of the environment.

7. Meeting room circulation: in some meeting rooms, people could circulate therein creating distraction, but also necessitating interaction.

8. Bathroom location: bathrooms in some workgroups are completely inside the workspace, only steps away from the desks. In the main building, however, they are by the core of the building.

9. Privacy mode: different faculty deal differently with privacy, e.g. one may have closed door and shutters while the other open door/closed shutters. The mode also depends on the nature of the work underway at any given period of time.

10. Layout flexibility: since moving in, few changes to the space layout seem to have taken place.

11. Resource Sharing: two co-located groups share a large plasma screen, workbenches, conference rooms, bathrooms indicating high degree of inter-dependency, possibly because of common interest of social friends.

12. Tour Capability: while touring the facility was easy, esp. the main building, spaces seemed 'disconnected'.

13. Adjacency/Proximity: related groups seem to be sitting nearby each other, yet there is also collaboration among groups in different buildings.

14. Common Area Location: common areas are in most workspaces immediately reachable and near circulation paths.

15. Cluttering: most space seem cluttered with things-and are empty of people.

16. Remote Collaboration Management: physical evidence (large plasma screen) signals that remote collaboration is under way with other labs.

No interviews were arranged at the Media Lab due to lack of prior consent and time constraints.

Each of the 16 variables identified hereinabove was then given a value of 0 or 1, depending on its 'suitability"' to ICP enhancement (see Tables 1A, 1B below). The values for all variables were then added up to give the total WOSCIT value for MIT Media Lab:

MIT Media Lab WOCSIT (n=1..16) = 13/16

R-Table 1A: Assignment of "Suitability" Values to MIT Media Lab WOSCIT v.1 Variables

aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value
1	Partition	Exists-Does not exist	Depends	Exists	1
2	Leader location	Visible- Not Visible	Visible	Not Visible	0
3	Prop signalling	Exist- Not Exist	Exist	Exist	1
4	Space use	Dedicated- Layered	Depends	Mix	1
5	Inter-floor interaction	Exists- Does Not Exist	Depends	Mix	1
6	Live prop	Exists-Does not Exist	Exists	Exists	1
7	Interfering circulation	Distracting- Not distracting	Depends	Not distracting	1
8	Bathroom location	Social- Out-of-the-way	Social	Social	1

R-Table 1B: Assignment of "Suitability" Values to MIT Media Lab WOSCIT v.1 Variables

Aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value
9.	Privacy mode	Private-Non-private	Depends	Mixed	1
10.	Layout flexibility	Flexible-Not Flexible	Flexible	Flexible	1
11.	Resource Sharing	Shared- Not Shared	Shared	Not Shared	0
12	Tour Capability	Capable – Not Capable	Capable	Capable	1
13.	Adjacency/Proximity	Near-Far	Near	Far	0
14.	Common Work Area Location	Strategic- Not Strategic	Strategic	Strategic	1
15.	Cluttering	Cluttered- Not Cluttered	Depends	Mixed	1
16.	Remote Collaboration Management:	Exists- Does not exist	Exists	Exists	1

GENZYME

Overview

The visitor to the Genzyme workspace is immediately struck by the lightness and expansiveness of the interior public space, which is in stark contrast to the commercial exterior of the commercial building.

In a typical floor, the presence of see-through elevators and two-story staircases provides a sense of linkage to all other floors. The activity of the organization is not immediately clear, i.e. that it is a pharmaceutical company. However, what is clear is that it is a corporate environment with an "easygoing" disposition. Offices of managers are very small, yet well connected to the rest of the workspaces of each group where people sit in low-partitioned cubicles. A manager may have closed door and shutters, while another may keep the door open but closed shutters. Concentration seems to be well maintained, in part because staff is conditioned to behave according to certain protocols. Group work seems to cluster around the atrium, while private spaces are tucked away in the periphery.

During a tour of the facility, one is informed that related groups sit near each other. Depending on the visitor Genzyme has multiple locations worldwide and thus on-going face-to-face communication with different staff, vendors etc), different conference areas are used. The common areas have no designated space use. Small tables with chairs can be used for meetings, for eating or just resting.

Highlights from observation

The study of Genzyme extended the set of 16 WOSCIT variables that were defined in the MIT Media Lab case to 28. The 12 additional variables are presented below, again in random order.

17. Visual Exposure/Circulation: people might say 'hello' once in the early part of the day in the corridor yet, during the day, consider acceptable social behavior whereby multiple crossings are met with ignorance! Corridor interceptions seem uncommon and unappreciated.
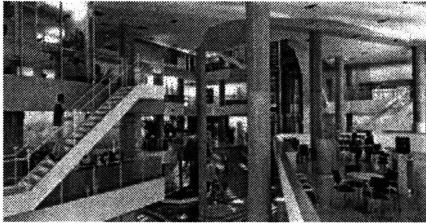
18. Basic needs-temperature: (air/ natural light/ artificial light) the abundance of natural light and presence of fresh air provides visual and thermal comfort in spite of some problems with air-circulation due to the atrium design.

19. Manager office size: manager offices are very small, including storage, area and desk space.

20. Scheduled Meetings: timely availability of conference rooms seems like a challenge—one has to schedule and book rooms in advance.

21. Large Group Meetings: there seems to be trouble in finding space for bigger meetings.

22. Spontaneous Meetings: spontaneous meetings, including chance encounters and run-ins, are well accommodated. People can meet in breakout spaces, in offices, in corridors or by the elevator for shorter meetings.

23. Personal workspace concentration: despite visual transparency, the workspace seems to be quiet and the work culture discreet allowing, thus, for concentration levels to remain high.

24. Food, drinks & snacks: easy access is possible to various food resources including coffee pots, and the top-floor restaurant.

25. Personal workspace controls: the presence of temperature and furniture personal controls gives employees an increased sense of ownership and a sense of belonging.

26. Personal workspace meetings: due to the personal workspace sizes, the ability to host meetings is more limited.

27. Interaction frequency: visual and verbal interactions are facilitated by transparency.

28. Sense of belonging: visual access to most of the building builds a sense of familiarity.

Each of the additional 11 variables identified hereinabove was added to the existing 16 variables in the Workspace Communication Suitability Index and was again subjectively given a 0 or 1 'suitability' value (see Table 2 below) . Again, the values for all variables were then added up with equal weighing to give the **incremental** WOSCIT value for Genzyme (total value is not presented here, for simplicity):

GENZYME WOCSIT (n=17..28) = 11/12

There was no permission or consent for interviews with staff at Genzyme.

Table 2: Assignment of "Suitability" Values to Genzyme WOSCIT v.1 Variables

Aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value
17	Visual Exposure/transparency	Exposed-Not Exposed	Exposed	Exposed	1
18.	Basic needs-temperature/air/ natural light/ artificial light	Met-Not Met	Met	Met	1
19.	Manager office size	Small-Large	depends	Small	1
20.	Scheduled Meetings	Available-Not Available	Available	Available	1
21.	Large Group Meetings	Accommodated-Not Accommodated	Accommo dated	Not Accommo dated	0
22.	Spontaneous Meetings	Accommodated-Not Accommodated	Accommo dated	Accommo dated	1
23.	Personal workspace concentration	Exists-Does not exist	Exists	Exists	1
24.	Food, drinks & snacks	Accessible-Not accessible	Accessible	Accessible	1
25.	Personal workspace controls	Exist-Do not exist	Exist	Exist	1
26.	Personal workspace meetings	Possible-Not possible	Depends	Possible	1
27.	Interaction frequency	Frequent-Not frequent	Depends	Frequent	1
28.	Sense of belonging---	Exists-Does not exist	Exists	Exists	1

STATA

Overview

The visitor to the MIT Stata Center is immediately struck by the unusual exterior form and the expansiveness of the interior public space.

In the ground floor, the presence of a restaurant, auditoria, a gym, a kindergarten, permanent and ephemeral art exhibitions and plenty of sitting spaces makes the space constantly busy. The activities of the tenant organizations become clear, however, once one reaches the upper floors via elevator or the meandering staircases. Within workgroup spaces (which are marked), faculty offices are of reasonable size and at the periphery of ill-defined common spaces. Like elsewhere, one faculty may have a closed door and shutters, while another may keep a door open but shutters closed. Concentration seems to be a problem, in part because of excessive visual access to workspaces by passer-by and in part due to high levels of background noise. There is, at the same time, plenty of natural light and color creating an energetic atmosphere.

Group work seems to take place in common spaces, while private spaces are tucked away in the periphery. Related groups sit near each other. Way finding is a major problem, mostly for visitors. The common areas have no designated space use and what furniture is there can be used for meetings, for eating or just resting.

Highlights from observation

Again, using the same approach, the Stata case study produced another incremental set of WOSCIT v.1 variables that were deemed to impact ICP.

29. Myth management: early evidence of the user group's attitudes, expectations and knowledge about the future home is humorously captured in a short movie prepared by graduate students for the so-called 'AI Olympics', a week long series of events with more than a hundred students participating. In that movie, a description exists that captures what was communicated to the population during the design process and while they were watching the building go up across the street from their old location in Technology Square. Roughly, the message was that the new facility would be "equivalent to masterpieces from antiquity like the Parthenon in Athens and the Pantheon in Rome" and that "it would integrate the positive elements of legendary buildings like Building 20 into a futuristic design" This is an example of myth-management, a way of building up the identity of a facility through conscious highlighting of selective aspects.

30. Building operation manual: a review of the public record email exchange reveals a lot about the collective state of mind of the CSAIL population prior to the move. Technically, this method of collecting data is considered archival research, yet an email record can also be understood as a "summary of other people's observations and comments on what they experience". Some workspace users in e-mail exchange the idea that people can make the best use of the facility provided they receive some instruction and help with its use. This idea is related to the idea promoted by the author, that the management protocol of the facility is just as important as the physical dimension of it in determining user experience.

31. Software design protocol: comparing building design to software design suggests that there exist similarities in how these artifacts are or should be designed. For example, there are similarities in the need to keep the end user in mind, while the notion of 'open source,' the recombination of freely

available modules/components, now popular in software design could also apply to building design with some modifications.

32.'Loose'/Flexible design: the architect stated that architectural design should not lead to 'turn-key' projects but configurations that are malleable, flexible, open to change and fundamentally 'unfinished" at the time of project delivery. Some users referred to this approach as "incomplete" design.

33. Neighborhood access: access to research areas (neighborhoods) is restricted and this impacts the nature of socialization in the facility. The protocol has main entrance and lab entrance doors shut after working hours to all except lab members carrying access cards.

34. Fire evacuation: the interior design of the facility poses threats to safety due to the difficulty in finding fire exits. Cambridge fire fighters who were interviewed, mentioned that they have the same problem and undergo extensive and repetitive special training on how to evacuate the particular facility

35. Orientation and circulation: people have difficulty finding their way around due to poor signage and convoluted circulation. "This navigational space is very complex. Six months later and I can still not find my way around!" commented a user.

36. Under utilized space: large parts of the building, esp. the open areas, remain empty or under utilized, possibly to keep flexibility high. 24-stata-before-a24-fterDSC_0395.JPG

37. Work practice culture: a major expectation, central to this study, is that relocation will provide an opportunity for the department's organizational 'modernization.'

38. Tradition culture: the department's "modernization" also means the death of traditions that emerged since its inception. For example, there is no 'video room' in the program of the new facility. At the same time, there is a small exhibition on the ground floor of artifacts related to "Building 20" as the facility on the grounds was named.

39. Napping: the right of students and others to take naps in the facility is challenged by some faculty concerned that having potential sponsors see students sleeping during tours of the transparent facility would turn them away. This is reflective of the evolving nature of the educational enterprise: as it seeks funding from corporations, it is also becoming more accountable and reflective of their culture.

40. Naming and reference: the process of naming the facility created friction. It is customary to name buildings after their donors, yet the overrun costs (which forced MIT to cover the balance) and the identity of the donors, irked some members who feared that such naming decisions would influence the development of the new department culture.

41. Signage: way finding problems upgrade the importance of signage. Maps help, yet a strong mental model of the space is also necessary.

42. First impression: The ill-planned relocation negatively affected the initial perception of the facility. For example, the perceived chaos in the Stata Center during the initial relocation days led to this statement: "Before we had continuous space. Now we have disjointed space." Had it been smoother,

some of the early strong reactions concerning, for example, the abundance of open space would have been more muted.

43. Organizational change: the relocation provided a good timing opportunity to initiate the merger of the Artificial Intelligence and Computer Science. This was reflected in the adjacency of groups that were formerly apart, e.g. Graphics &Vision groups. The relocation provides a window of opportunity for the introduction of significant change that highlights the relationship between the timing of relocation and the effectiveness of organizational change. Comments a member of the client committee: "Doing space planning for the building in 2003, it became increasingly obvious that the distinction between the Laboratory of Computer Science (LCS) and Artificial Intelligence (AI) was quite arbitrary".

44. Durability: fears were expressed that the building will be in major disrepair in 10-20 years.

45. Connectivity: what people seemed to like about Stata is that it is connected to the campus- acting as a node, an exchange.

46. Whiteboards: to facilitate brainstorming, many whiteboards are dispersed in the facility and people are seen spending time by these props.

47. Ambient environment /Energy feel: numerous comments by people focus on the "energy" of the facility, how the presence of natural light, color, and abundance of space augments excitement about being in the facility.

48. Habituation: early complaints about the building subsided over time as people became used to it and habituated in a modality of use that was suitable for productive work. For example, earlier complaints of those working in open, transparent spaces about being distracted by passers by, subsided over time as they learnt to ignore such stimuli and be more discreet.

49. Bustling streetscape: the ground floor is bustling with activity, the cafeteria is very busy, classrooms are always booked, and the auditorium is the most sought-after space on campus for conferences and related activities. In addition, many people pass through the area on their way elsewhere on campus and the street itself is a frequently chosen location for events.

50. Vistas: use of glass and the interior form of the building provide multiple opportunities for interesting vistas that surprise and remain in memory.

51. Iconic value: the odd external shape of the building has made it into an instant icon of the MIT campus, figuring often in all kinds of publications and forming a memory trace to most members of the MIT community.

52. Scale: for a facility as large as the Stata Center, the treatment of scale is exceptional. The building 'breaks down' into visually manageable external forms that are pleasing to the eye and easy to comprehend. Nonetheless, people comment that they do not feel so connected anymore with events due to the large scale.

53. Rich program: the presence on the ground and fourth floors for different uses, such as cafeteria, childcare century, gym, classrooms, pub, etc., has introduced a diverse and exciting environment to most people.

54. Operational and maintenance cost: by far this is the most expensive facility to maintain on campus. A special operating plan has been devised and MIT facilities have a dedicated staff for the Center. As mentioned hereinabove, the Cambridge Fire department hold special training sessions to ensure fast evacuation in case of trouble. This added cost has to be compensated, some people think, with evidence of concrete benefits from this design, including improvements in communication.

55. Employee satisfaction: overall levels of employee satisfaction are mixed many months later. Enough occupants have 'given up' trying to fix their working environment and settle for less.

56. Relocation process: the relocation process to the new facility was problematic as budgetary pressure cut earmarked resources available to plan it properly. The result was that people had to pack and unpack their belongings by themselves resulting in significant productive time loss.

57. Space assignments: starting with the fact that their new work locations were vaguely assigned, many occupants spent weeks and in some cases months adjusting to their environment. Hundreds of man-hours were diverted by faculty and students in an effort to mould their working environment to their needs in a non-expert manner. The problem is especially acute for students who have much higher attrition. The results in the opinion of most were mixed. Remembers an interviewee working in one of the laboratories:

"[T]he day before we moved in we found out this new faculty member was sharing the space with us. The night before we were supposed to move I stayed up all night packing our entire lab the movers had no idea where things were supposed to go... we moved in March and I was at my desk until June until I was told I am in the wrong room."

58. Design completeness: the idea of leaving a design "incomplete" and letting users finish it up as they saw fit did not gain much support. Commented a user "I think most of us are still in the role of being handed something that didn't quite make it".

59. Containment/Isolation: Stata breeds a new type of containment: there is more intra-group and less inter-group communication. Numerous occupants have expressed their concern that the layout of the building is not conducive to inter-group communications while inter-group communications has increased.

60. Marketing fit: The building form and function reflect the organizations values. "Stata is the new face of MIT. And CSAIL is the face of Stata".

61. Workarounds/Adaptive Acts/Interventions/"Tweakability": facing problems in the use of their workspace, users can undertake interventions,

either physical or in terms of usage protocol. One user comments that "one can always manage to live in a dysfunctional environment and find work-arounds". Instead of waiting for a period of up to a year before intervening in the building, one research group to spend more than $100,000 on a renovation within two days of moving in. Unlike such large-scale interventions, tweaking the facility is related to flexibility, except is suggestive of "quick, easy, informal and low-cost" physical change. "It is very hard to 'tweak' the space! Not only is it inflexible, but it is also cumbersome to undertake any change as they are costly and time consuming".

62. Mental model: way finding is related to the memorability of the workspace, the so-called mental model of the space. "It took me a couple of weeks to develop an internal map of the layout", comments a user.

63. Communal space: the size and number of common areas is larger than anywhere else on campus. Coupled with high ceilings that offer transparency and visibility, the public or semi-public areas of the facility are bound to affect the culture of the occupants and experience of visitors. "The main thing we have in Stata that we did not have before is communal space".

Each of the additional 35 variables identified hereinabove was added to the existing 28 variables in WOSCIT v.1, was subjectively given a 0 or 1 "suitability" value (see Tables 3A, 3B, 3C below) . The values for all variables were then added up with equal weighing to give the **incremental** WOSCIT value for Stata (again, total value is not presented here, for simplicity):

Stata WOCSIT (n= 29...65)= 18/35

It was possible to arrange interviews in Stata and some of the points raised by participants therein are reflected above.

Table 3A: Assignment of "Suitability" Values to Stata WOSCIT v.1 Incremental Variables

Aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value
29	Myth management	Exists-Does not exist	Depends	Exists	0
30	Building operation manual	Exists-Does not exist	Exists	Does not exist	0
31	Design process (Software protocol)	Exists- Does not exist	Exists	Does not exist	0
32	'Loose'/Flexible design:	Exists-Does not exist	Exists	Does not exist	0
33	Neighborhood access	Exists- Does not exist	Depends	Exists	0
34	Fire evacuation	Quick-Slow	Quick	Slow	0
35	Orientation and circulation	Easy-difficult	Easy	Difficult	0
36	Underutilized space	Exists-Does not exist	Depends	Exists	1
37	Work practice culture	Formal-Informal	Depends	Informal	1
38	Tradition culture	Maintained-Not maintained	Depends	Maintained	1
39	Napping	Permitted-Not permitted	Depends	Permitted	1
40	Naming and reference	Exists-Does not exist	Exists	Exists	1
41	Signage	Adequate-Not adequate	Adequate	Inadequate	0

Table 3B: Assignment of "Suitability" Values to Stata Lab WOSCIT v.1 Variables

aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value
42.	First impression	Positive-Negative	Positive	Positive	1
43.	Organizational change	Exists-Does not exist	Depends	Exist	1
44.	Durability	Durable- Not durable	Durable	Not durable	0
45.	Connectivity	Connected-Not connected	Connected	Connected	1
46.	Whiteboards	Exist- Do not exist	Exist	Exist	1
47.	Ambient Environment/Energy feel	Exist- Do not exist	Exist	Exist	1
48.	Habituation	Exist- Do not exist	Exist	Exist	1
49.	Bustling streetscape	Exists- Does not exist	Exists	Exists	1
50.	Vistas	Exist- Do not exist	Exist	Exist	1

Table 3C: Assignment of "Suitability" Values to Stata Lab WOSCIT v.1 Variables

Aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value
51	Iconic value	Exists-Does not exist	Exists	Exist	1
52	Scale	In scale- Out of scale	In scale	In scale	1
53.	Rich program	Basic – Rich	Depends	Rich	1
54.	Operational and maintained cost	High- Not high	Not high	High	0
55.	Employee satisfaction	High- Not high	High	Mixed	0
56.	Relocation process	Effective- Not effective	Effective	Not effective	0
57.	Space assignments	Explicit-Not explicit	Explicit	Not explicit	0
58.	Design completeness	Complete- Not complete	Depends	Not complete	0
59.	Containment/isolation	Exist- Do not exist	Do not exist	Exist	0

Table 3D: Assignment of "Suitability" Values to Stata Lab WOSCIT v.1 Variables

aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value
60.	Marketing fit	Exists- Does not exist	Exists	Exists	1
61.	Workarounds/Interventions/Tweakab ility	Exist- Do not exist	Depends	Exist	0
62.	Mental model	Strong- Not strong	Strong	Not strong	0
63.	Communal space	Exists- Does not exist	Exists	Exists	0

ITU (IT University, Copenhagen, Denmark)

Overview

The visitor to ITU is not immediately struck by the exterior form, but is awed by the massive atrium with the extruding conference rooms. This is the defining characteristic of the facility that gives it a strong and memorable identity. In the ground floor, a large concrete floor spans the atrium. A restaurant, a bar, auditoria, a bookstore are off to the side of the atrium while the conference rooms hang above. Exhibitions, a ping—pong table and through-traffic keep the ground floor constantly busy.

Transparent elevators help visitors reach the upper five floors. Open bay areas populated with desks and computers surround the atrium on each floor. The activities of the tenant research groups, however, are not immediately visible. On each floor, four wings exist separated by the main area by a small grey door. It is very hard to understand that behind a grey door a large group resides. Within workgroup spaces, faculty offices are of reasonable size and at the periphery of a single well-defined common space where a conference table is located. Like elsewhere, one office user may have a closed door and shutters, while another may keep a door open but shutters closed. Concentration does not seem to be a problem, largely due to the layout and separation of workgroups from the main facility. There is, at the same time, a sense of isolation within the group spaces that is further accentuated by the lack of sufficient natural light.

Group work seems to take place in common spaces and outside in the bay areas as well as within the conference rooms, the ground floor, and in the designated computer rooms. Related groups sit near each other. Way finding is easy, yet the similarity of floors sometimes confuses even the residents. The common areas have no designated space use.

Highlights from observation

In this case, six more incremental WOSCIT v.1 variables were identified:

64. Materiality: facility users complained about the use of concrete on the floors. In Denmark, apparently, the use of wood is abundant and concrete uncommon. The "industrial" look alienated users.

65. Public props: the use of ping-pong on the ground floor of the atrium attracted attention, generated noise and "marked" the space for this particular use.
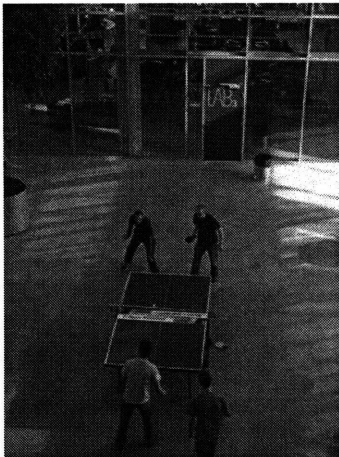
66. Outdoors: during sunny days, outdoor areas were used extensively for relaxation, breaks and sometimes lessons

67. Transparent meetings: conference room users could be seen from afar as walls were made of glass.

68. Events: events were organized throughout the facility at all times. Those held in the atrium ground floor were visible by all. Every Friday, there is a gathering at the bar where all are invited.

69. Urban context: immediately near the facility are the Danish TV headquarters and the Humanities university- the use of restaurants allows traffic between these facilities.

As in all previous cases, these variables were subjectively given values of 0 or 1 (see Table 4 below) and then added up with equal weighing to give the **incremental** WOSCIT value for ITU (again, total value is not presented here, for simplicity):

Each of the 6 additional variables identified hereinabove is added to the existing 63 variables in the Workspace Communication Suitability Index.

A subjective rating of the Index with equal weighing among variables allows us to rate ITU as follows:

ITU WOCSIT (n=64-69): 5/6

It was possible to arrange interviews in ITU and some of the points raised by participants therein are reflected above. A sample interview is included as Appendix II.

Table 4: Assignment of "Suitability" Values to ITU WOSCIT v.1 Incremental Variables

aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value
64.	Materiality	Industrial-Not industrial	Depends	Industrial	0
65.	Public props	Exist- Do not exist	Depends	Exist	1
66.	Outdoors Life	Exists- Does not exist	Exists	Exists	1
67.	Transparent meetings	Exist- Do not exist	Depends	Exist	1
68.	Events	Exist – Do not exist	Exist	Exist	1
69.	Urban context	Exists- Does not exist	Depends	Exists	1

Telco

Overview

The visitor to the Telco facilities reaches a three-building complex whose exterior is made of glass and public plaza of granite. Parking is scarce. Within, ceilings are low, lobbies small, furniture shoddy, elevators slow. An underground parking lot allows those with cars to reach their offices directly, by-passing the lobby. There is no real defining characteristic of the facility that can give it a strong and memorable identity, except its sheer size. One can enter each floor through a set of wooden or glass doors with access control. Once in, a circulation corridor dissects the floor plate leaving large or not-so-large office spaces on each side. Kitchenettes and bathrooms are near the core of the building. Within the office spaces, employees sit in groups ranging from one person (for directors) to more than ten. There are also visiting consultant work areas. Floor materials range from wood, to carpet to stone. Within workgroup spaces, director offices are of reasonable large while there seems to be a shortage of meeting rooms. Privacy and concentration is maintained with the use of doors and shutters. However, for those working in open space, concentration is hard. Common tables are used for meetings, external associates but also to eat and store materials. Rarely, are employees alone at their desks.

A sense of disconnectedness exists between groups working in different facilities. The second facility is more modern and has better quality of light and a large underground parking lot. Space constraints, however, have forced the organization to use ground floor as open-plan office space. This creates noise while the glare from the sun reduces thermal and visual comfort.

Way finding is easy, yet the similarity of floors sometimes confuses even the residents. There are few, if any, common areas as their need is covered by the corridor circulation system, the conference rooms, kitchenettes and open areas within offices, some of which have meeting tables.

Highlights from observation

This case yielded a final additional set of 8 more variables:

70. Smoking: a dedicated smoking room in one building was often seen mostly empty; people used staircases and exits to smoke or did so at their desks after gaining supervisor permission.

71. Exercise: while no one seemed particularly overweight, few seemed fit.

72. Desktime: most workers spend the largest part of the day at their desks.

73. Technology-assisted interactions: email and telephone seems like the main means of technology-assisted interactions.

74. Short trips: most short trips seem to be to the WC, Kitchen and offices of a supervisor or colleague.

75. Knowledge span: most people seemed to have a strong social network
76. Pop-ups: the ground floor shop, the building entrance, a waterfall and one's own office were most often cited as memorable features of the facility.
77. Atrium: the open space between the three buildings could be an atrium-if it was covered and there was access to it from multiple points. The absence of the atrium was noticeable as it left the space empty and void of life.

Insights from interviews undertaken in Telco are reflected hereinabove. Each of the additional 8 variables identified hereinabove was added to the existing 69 variables in the Workspace Communication Suitability Index which, has the following additional components:

A subjective rating of the Index (see Table 5 below) with equal weighing among variables allows us to rate the Telco as follows:

Telco WOCSIT (n= 70...77)= 5/7

Table 5: Assignment of "Suitability" Values to Telco WOSCIT v.1 Incremental Variables

aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value
70.	Smoking	Exists- Does not exist	Does not exist	Exists	0
71.	Exercise	Exists-Does not exist	Exists	Does not exist	0
72.	Desktime	Full-time-Not full-time	Depends	Full-time	1
73.	Technology-assisted interactions	Exist- Do not exist	Exist	Exist	1
74.	Short trips	Many- Few	Depends	Many	1
75.	Knowledge span	Expansive-Not expansive	Expansive	Expansive	1
76.	Pop-ups	Exist-Do not exist	Exist	Exist	1
77.	Atrium	Exists-Does not exist	Exists	Does not exist	0

Once variables have been incrementally identified they can be applied to all case studies to generate a cumulative score for each based on the suitability defined for each variable.

##	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value	MIT MediaLab		Genzyme		Stata		FTU		Tokyo	
						W	SV	W	SV	W	SV	W	SV	W	SV
1	Partition	Exists-Does not exist	Depends	Exists	1	1	1	1	0	1	0	1	1		
2	Leader location	Visible-Not Visible	Visible	Not Visible	0	1	1	0	0	0	0	0	0		
3	Prop signaling	Exist-Not Exist	Exist	Exist	1	1	1	1	1	1	0	0	1		
4	Space use	Layered-Dedicated	Depends	Mix	1	1	1	1	1	0	0	0	0		
5	Inter-floor interaction	Exists-Does Not Exist	Depends	Mix	1	1	1	1	1	1	0	0	0		
6	Live prop	Exists-Does not Exist	Exists	Exists	1	0	1	0	0	0	0	0	0		
7	Interfering circulation	Distracting-Not distracting	Depends	Not distracting	1	1	1	1	0	1	1	0	1		
8	Bathroom location	Near-Far	Social	Social	1	1	0	1	0	1	0	1	1		
					7		8		4		2		4		
				M:T:M:L		G		S		I		T			
9.	Privacy mode	Private-Non-private	Depends	Mixed	1	0	1	0	0	1	0	1	0		
10.	Layout flexibility	Flexible-Not Flexible	Flexible	Flexible	1	1	1	0	1	0	0	0	1		
11.	Resource Sharing	Shared-Not Shared	Shared	Not Shared	0	1	1	1	1	1	1	1	1		
12	Tour Capability	Capable-Not Capable	Capable	Capable	1	1	1	1	1	1	1	0	1		
13.	Adjacency	Near-Far	Near	Far	0	1	1	1	1	1	1	1	1		
14.	Common Work Area Location	Strategic-Not Strategic	Strategic	Strategic	1	1	1	1	1	1	1	0	0		
15.	Cluttering	Cluttered-Not Cluttered	Depends	Mixed	1	0	1	1	0	0	0	1	0	0	
16.	Remote Collaboration Management	Exists-Does not exist	Exists	Exists	1	1	1	1	1	1	1	1	1		
				M:T:M:L		G		S		I		T			

No.	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value								
17	Visual Exposure/transparency	Exposed-Not Exposed	Exposed	Exposed	1	1	1	1	1	0	0	0	1
18.	Basic needs-temperature/air/light/noise	Met-Not Met	Met	Met	1	1	1	0	0	0	1	1	1
19.	Manager office size	Small-Large	depends	Small	1	1	1	1	1	1	1	1	1
20.	Scheduled Meetings	Available-Not Available	Available	Available	1	1	1	1	1	0	1	0	1
21.	Large Group Meetings	Accommodated-Not Accommodated	Accommodated	Not Accommodated	0	0	0	1	1	1	1	0	1
22.	Spontaneous Meetings	Accommodated-Not Accommodated	Accommodated	Accommodated	1	1	1	1	1	1	1	1	1
23.	Personal workspace concentration	Exists-Does not exist	Exists	Exists	1	1	1	0	0	1	1	0	0
24.	Food, drinks & snacks	Accessible-Not accessible	Accessible	Accessible	1	1	1	1	1	1	1	0	1
25.	Personal workspace controls	Exist-Do not exist	Exist	Exist	1	1	1	0	0	1	1	0	0
26.	Personal workspace meetings	Possible-Not possible	Depends	Possible	1	1	1	1	1	1	1	0	1
27.	Interaction frequency	Frequent-Not frequent	Depends	Frequent	1	1	1	1	0	1	1	1	1
28.	Sense of belonging--	Exists-Does not exist	Exists	Exists	1	1	1	1	1	1	0	0	
					11		11		9		11		9
				MTML		G		S		I		T	
No.	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value								
29.	Myth management	Exists-Does not exist	Depends	Exists	0	1	1	1	1	1	1	0	0
30.	Building operation manual	Exists-Does not exist	Exists	Does not exist	0	0	0	1	0	1	1	1	1
31.	Software design protocol	Exists-Does not exist	Exists	Does not exist	0	0	0	0	0	0	0	0	0
32.	Loose/flexible design	Exists-Does not exist	Exists	Does not exist	0	0	0	1	0	0	0	1	0

	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value								
33.	Neighbor-hood access	Exists-Does not exist	Depends	Exists	0	1	1	0	0	0	0	1	1
34.	Fire evacuation	Quick-Slow	Quick	Slow	0	1	1	0	0	0	0	1	1
35.	Orientation and circulation	Easy-difficult	Easy	Difficult	0	1	1	0	0	1	1	1	1
36.	Underutilized space	Exists-Does not exist	Depends	Exists	1	0	1	1	0	1	1	0	1
37.	Work prac-tice culture	Formal-Informal	Depends	Informal	1	0	1	0	1	0	1	0	1
38.	Tradition culture	Main-tained-Not main-tained	Depends	Main-tained	1	1	1	1	1	0	0	1	1
39.	Napping	Permitted-Not per-mitted	Depends	Permit-ted	1	0	1	1	1	0	0	0	1
40.	Naming and reference	Exists-Does not exist	Exists	Exists	1	1	1	1	1	0	0	0	0
41.	Signage	Adequate-Not ad-equate	Adequate	Inad-equate	0	1	1	0	1	1	1	0	1
aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value								
42.	First impression	Exists-Does not exist	Exists	Exists	1	1	1	1	1	1	1	0	0
43.	Organi-zational change	Exists-Does not exist	Depends	Exist	1	1	1	1	1	1	1	1	1
44.	Durability	Durable-Not du-rable	Durable	Not du-rable	0	1	1	0	0	1	1	0	0
45.	Connectivity	Connect-ed-Not connected	Con-nected	Con-nected	1	1	1	1	1	1	1	0	0
46.	Whiteboards	Exist- Do not exist	Exist	Exist	1	1	1	1	1	1	1	0	1
47.	Ambient Environment / Energy feel	Exist- Do not exist	Exist	Exist	1	1	1	1	1	1	1	0	0
48.	Habituation	Exist- Do not exist	Exist	Exist	1	1	1	1	0	1	1	1	0
49.	Bustling streetscape	Exists-Does not exist	Exists	Exists	1	1	1	1	1	1	1	0	0
50.	Vistas	Exist- Do not exist	Exist	Exist	1	1	1	1	1	1	1	1	1
aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value								
51.	Vistas	Exist-Do not exist	Exist	Exist	1	1	1	1	1	1	1	1	1

No.	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value								
52.	Iconic value	Exists-Does not exist	Exists	Exist	1	1	1	1	1	1	1	0	0
53.	Scale	In scale-Out of scale	In scale	In scale	1	1	1	1	1	1	1	0	0
54.	Rich program	Basic-Rich	Depends	Rich	1	1	1	1	1	1	1	0	0
55.	Operational and maintained cost	High-Not high	Not high	High	0	0	0	0	0	1	1	1	1
56.	Employee satisfaction	High-Not high	High	Mixed	0	1	1	1	1	1	1	0	0
57.	Relocation process	Effective-Not effective	Effective	Not effective	0	1	1	0	0	1	1	0	0
58.	Space assignments	Explicit-Not explicit	Explicit	Not explicit	0	1	1	0	0	1	1	0	0
59.	Design completeness	Complete-Not complete	Depends	Not complete	0	1	1	0	0	1	1	0	0
60.	Containment/isolation	Exist-Do not exist	Do not exist	Exist	0	0	1	1	0	0	0	1	1
Aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value								
61.	Marketing fit	Exists-Does not exist	Exists	Exists	1	1	1	1	1	1	1	0	0
62.	Work arounds/Interventions/Tweakability	Exist-Do not exist	Depends	Exist	0	0	1	1	1	0	0	0	1
63.	Mental model	Strong-Not strong	Strong	Not strong	0	1	1	0	0	1	1	1	1
64.	Communal space	Exists-Does not exist	Exists	Exists	0	1	1	1	1	1	1	0	0
				MTML		G		S		I		T	
Aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value								
65.	Materiality	Industrial-Not industrial	Depends	Industrial	0	1	1	1	1	0	0	0	0
66.	Public props	Exist-Do not exist	Depends	Exist	1	0	1	1	1	1	1	0	0
67.	Outdoors Life	Exists-Does not exist	Exists	Exists	1	0	0	1	1	1	1	0	0
68.	Transparent meetings	Exist-Do not exist	Depends	Exist	1	1	1	1	1	1	1	0	0
69.	Events	Exist – Do not exist	Exist	Exist	1	1	1	1	1	1	1	0	0
70.	Urban context	Exists-Does not exist	Depends	Exits	1	1	1	1	1	1	1	0	0

aa	Observation Variable	Variable Range	Suitability Range	Variable Value	Suitability Value								
71.	Smoking	Exists- Does not exist	Does not exist	Exists	0	0	1	0	1	0	1	1	0
72.	Exercise	Exists- Does not exist	Exists	Does not exist	0	0	0	1	1	0	0	0	0
73.	Desktime	Full-time- Not full-time	Depends	Full-time	1	1	1	1	1	1	1	1	1
74.	Technology-assisted interactions	Exist- Do not exist	Exist	Exist	1	1	1	1	1	1	1	1	1
75.	Short trips	Many- Few	Depends	Many	1	1	1	1	1	1	1	1	1
76.	Knowledge span	Expan-sive- Not expansive	Expan-sive	Expan-sive	1	1	1	1	1	1	1	1	1
77.	Pop-ups	Exist-Do not exist	Exist	Exist	1	1	1	1	1	1	1	0	1
78	Atrium	Exists- Does not exist	Exists	Exists	1		1		1		1		0
					53		64		55		58		41

d. Derivation of WOSCIT v.2A and v.2B

This first approximation of an evaluation methodology has some advantages, notably simplicity and comprehensiveness. However, there is a strong rationale for developing the index further that is driven by the fact that WOCSIT v.1 is *too large* and difficult to administer in any population size (i) and *void of statistical properties* (ii). Any absolute value "X" the index generates could be meaningless Applying the methodology in a similar fashion to any number of identical buildings with identical populations could still generate different index values. The field values could be consistent but the suitability values for each variable that are subjectively derived could differ.

The second and third versions of the workspace communication suitability index are an attempt to filter and structure observation variables. One version of the index (2A) was derived in a qualitative manner, and the other version (2B) in a quantitative manner with the use of a survey, addressing the need for a probability distribution for the index and each of its components- an advantage provided *by use of a statistical methodology.*
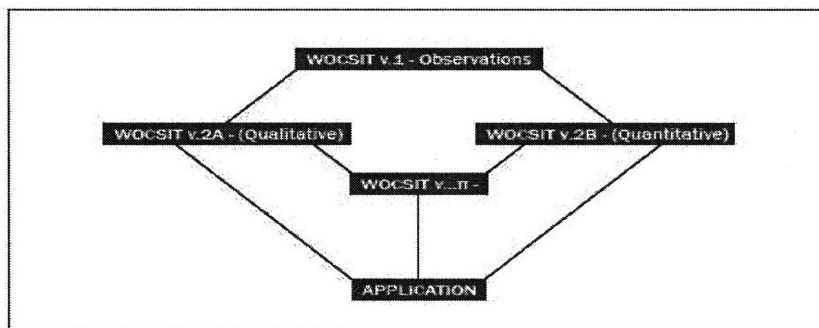
WOCSIT v.2A was the result of EX-ANTE qualitative evaluation of all available data and was tested with a pilot group in Telco

WOCSIT v.2B was the result of EX-POST quantitative analysis of survey data from Stata and ITU facilities.

WOCSIT v.2A:

WOCSIT v.2A was used in the evaluation of workspace architectural design undertaken in a pilot study in the Telco facility. Twenty employees representing the whole population (senior, middle-level and junior staff) responded to a structured survey in one-to-one interview sessions.

WOCSIT			
Part I	**Part II**	**Part III**	**Part IV**
1. **Worklocation**	13. *Knowledge span*	21. **Warm Public Space**	30. **Identity**
2. *Workhours*	14. *Mobility – span*	22. **Defensible Space**	31. **Marketing Fit**
3. Deskhours	15. **Visual Acoustic**	23. **Flexibility**	32. *Emotive Fit*
4. *Breaktimes*	**Physical Psychological**	24. **Basic Needs**	33. **Color**
5. Position	**Access** (VAPP)	25. Immersion	34. **EntryPoint**
6. *Work FTF Interactions*	16. *Time distribution*	26. *Activity Layering*	35. **vonRestoff**
7. *Social FTF Interactions*	17. Recall - **Popups**	27. Proximity	36. **Symmetry**
8. *Technology Interactions*	18. Spots	28. **Redundance**	37. Mental Image
9. *Walkarounds*	19. Adaptation	29. **Wayfinding**	38. Storytelling
10. *Solo/Team Work*	20. Distractability		39. Prototype
11. *Mgt Protocol*			40. **Exposure**
12. *Work Culture*			

In total, there are 40 components in the WOCSIT v.2A. in four parts.

The first part captures information about the *users' profile and modality of use.*

The second captures different aspects of users' *workspace*

The third captures information about *workspace functionality.*

The fourth captures information about *workspace memory.*

In **bold** are the components under the direct influence of the architect/designer.

In *italics*, are the components that express the effects of design decisions.

Underlined, are the components for which another method except the survey is used to collect data.

WOCSIT v.2A "Reference" Suitability Charts

It is necessary to also create a reference set of value ranges considered suitable for each index component. Each component is depicted on the x-axis of an x-y-cartesian coordinate system with a value range that depends on the component. For example, "workhours" has a value range of 0 to 12. On the y-axis, values range from 0- unsuitable to 1- suitable. These suitability charts can then potentially be used to derive an appropriate equation that describes what range of values is suitable for each variable and how much that variable can be weighed in the index. Here is a sample suitability chart for index components, derived subjectively:

Sample Suitability Charts - WOCSIT v.2A

WORK LOCATION (visual access)	WORK HOURS (hours)	DESK HOURS (hours)	BREAKTIMES (daily frequency)
POSITION (fit %)	WORK SOCIAL INTERACTIONS (daily number)	TECHNOLOGY INTERACTIONS (daily number)	WALKABOUT (frequency)
SOLO/TEAM WORK (ratio %)	MGT PROTOCOL (intervention degree)	KNOWLEDGE SPAN (# of people)	MOBILITY SPAN (# of trips)
VAPP (percentage)	TIME DISTRIBUTION (variance)	POPUPS (# of recalls)	HOT SPOTS (# of spots)
ADAPTATION (degree)	DISTRACTABILITY (degree)	PUBLIC SPACE (ratio)	DEFENSIBLE SPACE (ratio)

Sample Suitability Charts - WOCSIT v.2A

FLEXIBILITY
(degree)

BASIC NEEDS
(degree)

IMMERSION
(degree)

ACTIVITY LAYERING
(no. of layers)

PROXIMITY
(degree)

REDUNDANCY
(degree)

WAYFINDING
(degree)

IDENTITY STRENGTH
(degree)

MARKETING FIT
(degree)

EMOTIVE FIT
(degree)

COLOR
(degree)

ENTRY POINT SALIENCE
(degree)

RESTOFF EFFECT
(degree)

SYMMETRY
(degree)

MENTAL IMAGE
STRENGTH (degree)

STORYTELLING POTEN-
TIAL (degree)

PROTOTYPE
(degree)

EXPOSURE
(degree)

WOCSIT v.2A "Before-After" Suitability Charts

Pilot study participants were asked to state the current vs. desired values for select index components and corresponding suitability ratings:

In comparison with the first set of suitability charts, the ones depicted herein below differ insofar as they:

i. have information about both **current** and **desired** pairs of values/suitability for the variables under consideration

ii. reflect not the researcher's but the user's input.

Due to time constraints imposed by the Telco senior management, it was necessary to present for consideration only those variables for which a high variance between current and desired pairs of values/suitability was expected. As can be seen, this variance was found in all pairs with the exception of the variable "management protocol".

The before-after suitability charts help identify the variables that require the most attention by architects. By asking people to state their assessment of the value and suitability of a variable in their current workspace and, then, asking them to state their assessment of the value and suitability of a variable in their future workspace, one can identify the distance from the two pairs of points (x-axis: value, y-axis: suitability) and identify the degree and direction of needed change. For example, the current condition of a workspace might be that it has very little natural light, a condition thought of as unsuitable for productive work and having values (2,2). The future condition of workspace would have ample natural light (x-value; 8) that would be considered suitable for productive work (y-value: 8). Thus, the difference between the two points indicates that the magnitude and direction of change needed.
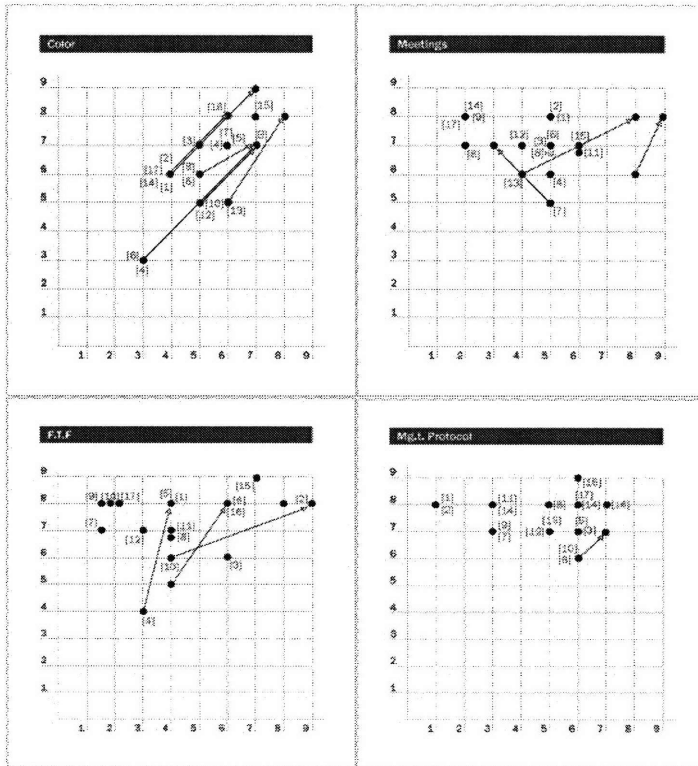
"Before-After" Suitability Charts

Variables: Color, Meeting, FTF (Face-to-Face), Mgt.Protocol
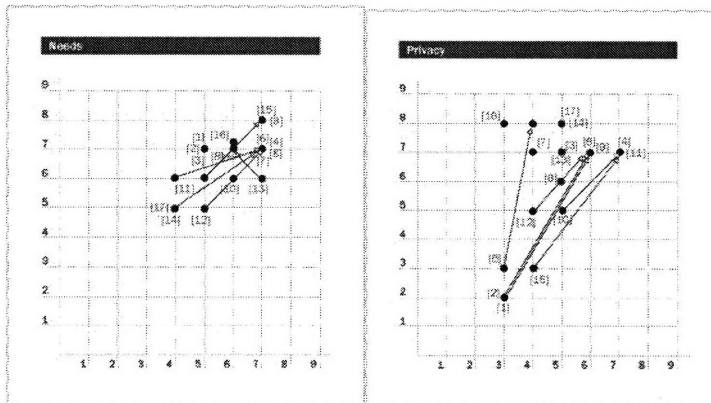
"Before-After" Suitability Charts

Variables: Basic Needs, Privacy

The survey the twenty participants in the Telco pilot group filled out provided the following insights:

1. Regarding the nature of work:

    a. There is more team than solitary work

    b. Significant percentage of work time is spent at employee desk chair.

    c. Trainings and trainees are few and department size changes infrequent.

    d. Much time is spent communicating with the support of technology (15x/day phone, 10x/day email).

    e. Many small, short meetings take place throughout the day (they are 3x more than all other meetings).

    f. Majority of users are non-smokers, yet there is significant and visible minority that smokes.

    g. Few exercise, most use car for transportation.

    h. Sales, internal audit and logistics departments have most contact with third parties, yet procurement and IT departments have most face-to-face contact.

    i. Work culture is seen as friendly, open, innovative, effective, teamwork and service-oriented, successful. Existence of "kingdoms" seen in company, due to the working content/conditions and physical differences in each floor/building.

2. Interactivity: work-related interactions are highest in office and other common spaces (conference rooms), while social-related interactions are highest in corridor and floor kitchen.

3. Time distribution: very little time is spent in social, common spaces! 300 minutes on personal desk, 30 minutes on common utility spaces, 90 minutes on common workspaces (incl. conference rooms), 15 minutes in common social spaces, 30 minutes in colleague workspaces, 15 minutes outside the company, total: 480 minutes, 8 hours total.

4. Knowledge Span: for four out of thirteen floors, most respondents know more than ten persons in each floor.

5. Visual Acoustic Physical and Psychological access: certain floors are most visually accessible, others most acoustically, physically and psychologically accessible.

6. Perception: human resources department is perceived as the most recognized and accessible, Commercial department as the most progressive while treasury as the least known. Thus, perception is correlated with nature of work of each group and their location should be dictated in part by perception needs.

7. Distractibility:

   a. Technology (emails, telephone) is most frequent cause of distraction, while multiple other factors (e.g. environmental) distract but are not perceptible due to culturally induced habituation.

   b. Absolute concentration is needed for only half the solitary work time.

8. Sense of Public: all respondents think their personal workspace is very public, while fewer consider the open areas in their floor as public. It also became evident that the sense of personal space is an important characteristic of company work culture.

9. Mobility: interestingly, those that indicated they were highly mobile did not necessarily have a high knowledge span! (A2, A3, A4 have most mobility, 2-4 times a week)

10. Common area activities: work-related activities with colleagues take place very often, informal social clustering with colleagues less often, while informal social clustering with visitors rarely.

11. Pop-ups: mental workspace is defined by personal workspace primarily, anchored in select aspects of larger work environment, i.e. exterior, shop.

12. Short-trips: kitchen, WC and conference rooms are heavily utilized.

13. Desired Areas: Kitchen areas, close parking areas, atrium, childcare, vestry and rest areas are desirable to differing degrees (5,4,3,2,1 respectively).

14. Exposure: people feel exposed, 60% of respondents feel their personal space is very public!

15. Adaptation acts: there is ample personalization of workspace and a sense that quality of communication is improved.

16. a. Most people agree that "warm/inviting and comfortable public spaces are important but absent".

b. Many people agree that "the availability of public space in the facility has strengthened communication".

c. Some people agree that "A lot of exciting new ideas emerge in the facility"

d. Few people agree that "The facility architectural design sends the message were are ready to take risks"

e. Very few people agree that "each person needs their own private workspace with a closing door"

In light of the field data of the pilot study (suitability charts and survey/interviews), WOCSIT v.2A can have suitability values. In CAPITALS are index components for which the pilot group provided their assessment. In **bold** are index components for which significant data could be gathered from the pilot group.

WOCSIT

Part I	Part II	Part III	Part IV
1. *Worklocation (1)	13. *Knowledge span (1)	20. Warm Public Space (0)	29. *Identity (0)
2. *Workhours (1)	14. *Mobility –span (1)	21. *DEFENSIBLE SPACE (0)	30. *Marketing Fit (0)
3. *Deskhours (1)	15. *Visual Acoustic Physical Psychological Access (VAPP) (0)	22. *Flexibility (1)	31. Emotive Fit (0)
4. *Breaktimes (1)		23. *BASIC NEEDS (0)	32. *COLOR (0)
5. *Position (1)	16. *TIME DISTRIBUTION (1)	24. *Immersion (0)	33. EntryPoint (0)
6. *WORK FTF INTERACTIONS (1)	17. *RECALL - POPUPS (0)	25. *Activity Layering (1)	34. vonRestoff (0)
7. SOCIAL FTF INTERACTIONS (1)	18. *Spots (1)	26. *Proximity (1)	35. Symmetry (1)
8. *Technology Interactions (1)	19. ADAPTATION(0)	27. Redundancy (0)	36. *Mental Image (0)
9. *Walkarounds (1)		28. *Wayfinding (1)	37. *Storytelling (0)
10. SOLO/TEAMWORK (0)			38. *Prototype (0)
11. MGT PROTOCOL (1)			39. *Exposure (1)
12. Work Culture			TOTAL: 20/40

Index Efficacy and Derivation of an Equation for the Updated Index

The benefit of having component values ranging from 0 to 1 is clear for purposes of computation and standardization. Some detail may be lost, yet the gain in simplicity facilitates evaluation.

For workspace design, deriving an appropriate equation that describes what range of values is suitable for each variable and how much that variable can be weighed in the index is a challenging process. Suitability charts were introduced to derive communication suitability values for each comparative case study. The suitability values were decided by the author and were subjective, based on his experience with each organization. In the case of the Telco study, respondents filled out their current and desired range of values for each parameter. Specifically, for each department in the organization, they were asked to mark the current vs. desired values for each variable as well as the perceived suitability. Thus, acceptable ranges for each variable could be defined. Still, the components of the index were decided by the author.

With WOCSIT v.2A, the following have been accomplished:
- Variables have been reduced from 77 to 40, by means of qualitative assessment, categorization and in light of new data.
- Suitability ranges were expanded from binary 0-to-1 scale to a broader scale of 1-10 (still, the 0-1 scale is used as it is more practical)
- Suitability ranges for select variables were made less subjective as they were determined not by the researcher, but by pilot group participants.
- For most index components, it was possible to gather insightful field data.

Despite this progress, it was not possible to either come up with more objective selections of variables or gain insight into their relative degree of importance with respect to identity, communication and productivity.

To accomplish the goal of coming up with more objective selections of variables, WOCSIT v.2.B was developed. Unlike WOCSIT v.2A, which was developed on an ex-ante basis, WOCSIT v.2B was developed on an ex-post basis. That is, the index presented herein below was the outcome of the statistical analysis of a dataset generated by the administration of a survey (see Appendix I).

Below is an illustration of WOSCIT v.2B and its components:

In bold are the components under the direct influence of the architect/designer.

In italics are the components that express the effects of design decisions.
Underlined are the components for which another method except the survey can be used to collect data.

In CAPITALS are the components that are also present in WOCSIT v.2A.

WOCSIT v. 2B						
Factor 1 ambient activity	Factor 2 knowledge span	Factor 3 hotspots	Factor 4 memorability	Factor 5 open-space activities	Factor 6 short trips	Factor 7 exposure
1. Familiar People	8. K-span floor no.1	10. Transit Points - Elevator lounges	16. Meeting rooms 1..n	20. Book reading	24. Short Trip- kitchen	29. Meeting room
2. SENSE OF BELONGING	...n	11. Outdoors	17. MAIN ENTRANCE	21. Exterior	25. DESKHOURS	30. Unusual architecture
3. PUBLIC SPACE AVAILABILITY	9. Circulation Paths- Passageway	12. Conference rooms	18. Main staircase	22. Open spaces	26. Short trips- WC	31. On display
4. Isolation		13. Ground floor	19. Awareness (K-span)	23. Laptop work	27. Short trips- Printer	32. Connected & Aware
5. Personal Workarea - Own research area		14. INFORMAL INTERACTIONS- CHIT-CHAT			28. Visible workspaces	
6. Short breaks		15. Work lunch				
7. Time away						

WOCSIT v. 2B						
Factor 1 ambient activity	Factor 2 knowledge span	Factor 3 hotspots	Factor 4 memora-bility	Factor 5 open-space activities	Factor 6 short trips	Factor 7 exposure
1. *Familiar People* 2. **SENSE OF BELONGING** 3. **PUBLIC SPACE AVAILABILITY** 4. *Isolation* 5. *Personal Workarea - Own research area* 6. *Short breaks* 7. *Time away*	8. *K-span- floor no.1 ...n* 9. **Circulation Paths- Passageway**	10. Transit Points - Elevator lounges 11. **Outdoors** 12. **Conference rooms** 13. **Ground floor** 14. *INFORMAL INTERACTIONS- CHIT-CHAT* 15. *Work lunch*	16. Meeting rooms 1..n 17. MAIN ENTRANCE 18. Main staircase 19. Awareness (K-span)	20. *Book reading* 21. **Exterior** 22. **Open spaces** 23. *Laptop work*	24. *Short Trip- kitchen* 25. DESKHOURS 26. *Short trips- WC* 27. *Short trips- Printer* 28. **Visible workspaces**	29.**Meeting room** 30.**Unusual architecture** 31. **On display** 32. **Connected & Aware**

Like with WOCSIT v.2A, it is necessary to also create a reference set of value ranges considered suitable for each index component. Each component is depicted on the x-axis of an x-y-cartesian coordinate system with a value range that depends on the component. For example, 'workhours' has a value range of 0 to 12. On the y-axis, values range from 0- unsuitable to 1- suitable. As mentioned hereinabove, WOCSIT v.2B was the result of EX-POST quantitative analysis of survey data from Stata and ITU facilities.

It is appropriate to outline how this version of the index was developed:

First, a chart was set up that indicates how each variable measured by different questions in each case study maps to the set of observation variables used for the qualitative version of workplace suitability index (WOCSIT). Next, the Stata/ITU comparative survey was administered to the whole population (about one thousand people) in both facilities. **Four hundred and forty-four people** initiated the survey. Of the respondent dataset, about **ninety cases** were statistically analyzed. The objective of the analysis was to assess the relation between several select variables measuring workspace architectural design (represented by answers to questions on an ordinal scale) to identity, communication and productivity (ICP). In this framework of multivariate statistical analysis, the multitude of interdependent variables hindered the ability to investigate the nature of the relation. Thus, the combination of the variables into fewer composite measures, preferably independent of each other, was necessary. This objective can be accomplished with the use of factor analysis, a statistical method that produces linear combinations of variables, mostly independent of each other. Although each factor is calculated as a linear combination of all initial variables (based on the Least Squares Method of Principal Components), it is considered surrogate of only the initial variables that have the maximum linear coefficient among all factors. Even though factor analysis is best applied in continuous variables having a normal distribution, it is commonly used in settings that deviate.

Naturally, the substitution of factors in place of the original variables leads to loss of information, expressed as a percent of variance explained by the factors. The applicability of the method is assessed by an index of internal

stability – reliability called Cronbach's Alpha, which measures the existence of common patterns in answering questions in a given questionnaire. Values of alpha in excess of 0.7 are considered a very good indicator of the applicability of the method. In social science questionnaires, the values may range as low as 0.4. Due to the survey's low response rate, it was not possible to apply the method to all the variables used in the study. As a result the method was applied to the following variable subset chosen because they had good response levels (see Appendix for survey questions):

Variable Subset For Factor Analysis
1. q9_3 : hours at desk
2. q13_i : knowledge span ist floor, i=1,....,5
3. q_15_1 : More on display
4. q_15_4 : Well connected to and aware
5. q_15_5 : Isolated
6. q_16 : public spaces availability
7. q_17 : unusual architecture
8. q18_1 : short trips WC
9. q18_2 : short trips kitchenette
10. q18_3 : short trips printer
11. q18_4 : short trips conf. room
12. q22_1 : In comparison to old workplace: more time away from desk
13. q22_2 : In comparison to old workplace: see familiar people more often
14. q22_3 : In comparison to old workplace: stronger sense of belonging
15. q22_4 : In comparison to old workplace: take short breaks more often
16. q24_1 : exterior
17. q24_2 : open spaces within research areas
18. q24_3 : semi-through workspaces
19. q24_4 : transparent conference rooms
20. q24_5 : seminar room patil
21. q24_6 : outdoor terraces
22. q24_7 : ground floor
23. q24_8 : elevator lounges
24. q26_1 : pop-up intensity: ground to 3rd floor staircase
25. q26_2 : pop-up intensity: outdoor amphitheater
26. q26_3 : pop-up intensity: Vassar-Main street entrance
27. q26_4 : pop-up intensity: my research group work area
28. q26_5 : pop-up intensity: fourth-floor passageway
29. q26_6 : pop-up intensity: Patil seminar room
30. q26_7 : pop-up intensity: Star seminar room
31. q30_1 : work on laptop
32. q30_2 : read a book
33. q30_3 : have lunch while discussing work
34. q30_4 : chit chat with a colleague

The resulting Alpha coefficient was 0.345, indicating that there were no clearly identifiable patterns in the answers, i.e. *it was not clear which questions were answered in similar ways*. Nevertheless, due to the exploratory character of the work, factor analysis was undertaken anyway. Out of the 38 original variables, 7 factors were extracted using the eigen value criterion, i.e. the factors for which the eigen value is over 1. These factors were chosen based on the size of the variance explained by each, accounting for 52.10% of the total variation (compared to 76.89%, of the fourteen factors). The agglomeration of variables into factors is presented in the following Table 2.

Table 1. Factors , original variables, and associated linear coefficients								
Component								
Variable	Question	Factor 1 ambient activity	Factor 2 knowledge spac	Factor 3 setspots	Factor 4 memorability	Factor 5 open space activities	Factor 6 short trips	Factor 7 exposure
Familiar people	q22_2	.808						
Sense of belonging	q22_3	.704						
Public space	q_16	.722						
Isolation	q_15_5	.694						
Own research area	q26_4	.680						
Short breaks	q22_4	.533						
Time away	q22_1	.494						
Kaplan-4	q13_4		.756					
Kaplan-3	q13_3		.752					
Kaplan-2	q13_2		.724					
Passageway	q26_5		.526					
Kaplan-1	q13_1		.447					
Elevator lounges	q24_9			.739				
Outdoors	q24_6			.595				
Conference rooms	q24_4			.564				
Ground floor	q24_7			.532				
Chit chat	q30_4			-.491				
Work lunch	q30_3			-.409				
Meeting room 1	q26_7				.773			
Main entrance	q26_3				.518			
Main staircase	q26_1				.507			
Kaplan-5	q13_5				.474			
Meeting room 2	q26_6				.470			
Outdoors	q26_2				.452			
Short trip to meeting rm	q18_4				.425			
Book reading	q30_2					.896		
Exterior	q24_1					.612		
Open spaces	q24_2					.594		
Laptop work	q30_1					.450		
Short Trip-Kitchen	q18_2						.661	
Deskhours	q2_3						.613	
Short trips-WC	q18_1						.569	
Short trips-Printer	q18_5						.478	
Visible workspaces	q24_3						.365	
Meeting room 2	q24_5							.656
Unusual architecture	q_17							.637
On display	q_15_3							.500
Connectedness	q_15_4							.430

Next, the mean levels of the factors were compared across three groups defined by the answer to question q_22_5 (i.e. subjective assessment of **productivity change** in three levels; 1=deterioration, 2=no change, 3=improvement). The non-parametric test of Kruskall-Wallis was used to test the means equality across groups. The following Table 2, contains the test results for all seven factors.

Table 2							
	factor 1	factor 2	factor 3	factor 4	factor 5	factor 6	factor 7
Chi-Square statistic	5,321	0,421	11,412	2,385	,700	,808	1,923
Degrees of freedom	2	2	2	2	2	2	2
Asymptotic Significance	0,070	0,810	0,003	0,302	0,702	0,668	0,818

As can be seen from table 2, only factor 3 showed statistically significant differences. This factor combined answers to questions relating to building tours for different types of people (q24_4, q24_6, q24_7, q24_8; positive relation) and two of the work-related activities that take place away from desk (q30_3, q30_4; negative relation). It should be noted that factor 1 exhibited borderline statistical significance, indicating that there could be some difference. This factor involved variables relating to degree of isolation (q_15_5), availability of public spaces (q_16), comparison with old workplace (q22_1, q22_2, q22_3, q22_4), and 'pop-up intensity: my research group working area' (q26_4). *It appeared that increased productivity was positively associated with 'more time away from desk, 'see familiar people more often', 'sense of belonging strengthened', 'take short breaks more often', and 'pop-up intensity: my research group working area', and negatively associated with degree of isolation, availability of public spaces.*

These results were confirmed for selected variables, using Fisher's Exact test for independence. Comparing, for instance, proportions of interviewees giving a positive response to discussing work during lunch (q30_3), across the three groups defined by productivity change, the test p-value was again borderline significant (0.053), indicating that *higher productivity was negatively associated with discussing work during lunch.*

Insights From Use of the Survey Method

Statistical analysis of the Stata-ITU dataset v.1 indicated the following:

1. There were not enough responses among respondents to draw meaningful conclusions. However, due to the exploratory nature of the study, statistical analysis was undertaken anyway.

2. Over and above basic descriptive statistics, factor analysis, regression and multi-dimensional scaling were considered. Of the three methods, only factor analysis was undertaken as the dataset was unsuitable for use of the other two. The pattern of missing data values was such that precluded the application of the MDS method, while most of the variables were ordinal precluding the application of regression analysis. (Regresssion methods apply to scale variables)

3. Factor analysis revealed seven factors that could explain 50%+ of the variance in the selected dataset.

These factors were named as follows:

Factor 1: 'ambient activity'

Factor 2: 'knowledge span'

Factor 3: 'hotspots'

Factor 4: 'memorability'

Factor 5: 'open-space activities'

Factor 6: 'short trips'

Factor 7: 'exposure'

Thus, WOCSIT v.2B would be as follows:

WOCSIT v. 2B	
Factor 1 ambient activity	1. *Familiar People* 2. *SENSE OF BELONGING* 3. **PUBLIC SPACE AVAILABILITY** 4. **Isolation** 5. *Personal Workarea - Own research area* 6. *Short breaks* 7. *Time away*
Factor 2 knowledge span	8. *K-span-floor no.1 ...n* 9. **Circulation Paths-Passageway**
Factor 3 hotspots	10. **Transit Points - Elevator lounges** 11. **Outdoors** 12. **Conference rooms** 13. **Ground floor** 14. *INFORMAL INTERACTIONS-CHIT-CHAT* 15. *Work lunch*
Factor 4 memora-bility	16. Meeting rooms 1..n 17. MAIN ENTRANCE 18. Main staircase 19. Awareness (K-span)
Factor 5 open-space activities	20. *Book reading* 21. **Exterior** 22. **Open spaces** 23. *Laptop work*
Factor 6 short trips	24. *Short Trip-kitchen* 25. DESKHOURS 26. *Short trips-WC* 27. *Short trips-Printer* 28. **Visible workspaces**
Factor 7 exposure	29. **Meeting room** 30. **Unusual architecture** 31. **On display** 32. *Connected* *& Aware*

4. Factor analysis for both facilities further revealed that

> a. *Discussing work during lunch is negatively associated with productivity* (an unexpected result).

> b. *Higher productivity is positively associated with the feeling that more public spaces improve communication*

> c. *Higher productivity was positively associated with the feeling that unusual architecture strengthens identity*

5. Comparison of the two facilities revealed that differences in only two of the seven factors:

> a. *People in Denmark have a higher knowledge-span than those in the US (Factor 2)*

> b. *People in Denmark, feel more on display, better connected, and more certain that architecture strengthens identity their than their US colleagues.*(see Appendix for basic descriptive statistics)

Low alpha and response rates may necessitate the collection of a new dataset so that statistical analysis can be considered as more meaningful.

Nonetheless, the use of the survey tool has been shown to be <u>relevant</u> to index development and methodologically applicable: i) conclusions from factor analysis (with the exception of 3a) were <u>consistent</u> with field observations and qualitative research ii) decreasing the number of measured variables while being mindful of all observed variables resulted in an <u>easier-to-handle construct</u> consisting of the chosen factors and their subcomponents.

[Coming up: In light of the low response rate and other issues related to the administration of the first survey, the results of the second survey (see appendix) will be discussed here in the next version of the paper]

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6. Index Application

WOCSIT and Synthesis

In the architectural synthesis of existing or new workspaces, WOCSIT can be an invaluable design tool.

A face-to-face discussion with the architect of the 150,000SF Athens 2004Olympic Village administration building provided insight on the **relationship of** WOCSIT to the architectural design process and on the application of WOCSIT to interventions of different types, i.e.:

- Psychological Interventions/Cognitive Re-engineering

- Ephemeral/Light Interventions

- Extensions/Relocations

WOCSIT and the Architectural Design Process

According to the architect, there are four factors in the architectural design process: the client, the architect, the specifications and norms of the law, and the artifact itself.
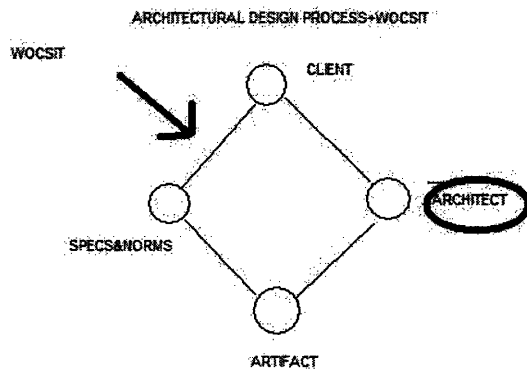
The architect, who may or may not identify the site and program of a new facility, realizes in form the client's brief and collaborates with other experts (civil engineers, light, acoustics specialists etc.) to prepare technical specifications and construction documents, get permits, prepare the budget and supervise construction. S/he, carrying his or her architectural ideology

and professional ethics[4], attempts to solve often contradictory problems by imposing a formal mastery to offer a buildable solution. The architect's focus is on circulation, function, structure, form and materials and by addressing these issues s/he gives form to the artifact. Architects thus seek to inject meaning that relates to their architectural vocabulary and ideology and is expressed often as a sketch a schematic solution/design that can then be processed downstream.

In studying WOCSIT, the architect declared that "WOCSIT is useful to the architect **as an analysis, strategy formation and monitoring tool** and in this capacity can be invaluable in the architectural design process and its remaining components as well, i.e. the client and the law."

The proposal that WOCSIT be viewed as an **evaluation tool** triggered an exchange on two issues inviting further inquiry:

First, the issue of subjectivity in _evaluation_ in light of the "political" and factual dimension of constantly changing user profiles– issues that are beyond the control of the architect. Suitability charts, introduced as integral components of the index, incorporate into the tool a mechanism for **addressing subjectivity while retaining the tool's structural integrity.** Second, the index _does not incorporate architectural vocabulary_, e.g. typology of space or elements of technique, material and structure.

Some of the other professionals that reviewed WOCSIT, seeked formal rules that could turn their workspace into a better communication and identity formation tool. For example, that light intensity should be 500lux, or, windows of a certain shape.

The translation of WOCSIT factors into architectural paradigms/recipes could bring the tool much closer to the daily practice of architects. For example, the sub-factor "familiarity" can be understood in terms of visual access,

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[4] Architectural ideology is understood as a system of values, often embodied in a style, e.g. modernist, post-modernist, while, professional ethics are understood as the justification an architect provides for the degree to which they deviate from faithful translation of the client values as they are presented in a design brief to the real artifact, or, conversely, the degree to which the client deviates from their own conception of an appropriate solution.

materials, scale, or the concept of approach, notions the architect can then further manipulate e.g. by shaping circulation paths in a facility. This, however, is the next step in the research process and opens new questions: is workspace "familiarity" just space planning of rooms and corridors, or, does it involve the use of multiple other techniques that leverage the concept of "public space" to address the factor? Should the focus of injecting architectural vocabulary into WOCSIT be on translating its factors in formal, typological architectural synthesis language, e.g. of the type shape grammar advocates, or seek to translate a factor into architectural language by focusing on materials, structure and technique?

In light of the discussion, WOCSIT was employed in interventions of different types:

Psychological Interventions/Cognitive Re-engineering

The use of the index can serve as a guide and analysis tool in the management effort to address facility issues without undertaking physical intervention. Members in the client committee of a new facility undertake its usage during the design process and, then, facility managers after building delivery to fine-tune the utilization and modification of the facility. Deciding how to address the issues/problems provides an interesting challenge:

Consistent with the notion of bi-directional adaptation, no physical change whatsoever might be necessary; one could talk' their way through the building-manage it by "myth"! *In this case WOCSIT is limited to an assessment of the existing situation at a workspace and serve as a tool for analysis:*

As seen from the research results, certain factors have emerged as critical in their ability to impact the structure and quality of user experience from the ICP perspective. These issues are accurately captured by the qualitative and quantitative versions of WOCSIT that identify and prioritise the factor "ambient environment" , the factor " common "happening places"" and the factor "memorability" of salient iconic/expressive qualities—cafeteria, gym, and classrooms.

Like Mies van der Rohe 'talked his way' through his designs by offering his client cigars and good wine, an advocate of the Stata design could 'talk their way' through by using narrative techniques based on knowledge of human psychology and the science of persuasion. It is conceivable that a sophisticated attention-management system be designed and introduced in the daily lives of occupants, one that detracts their attention from aspects of the physical environment that are considered troublesome. For example, one could persuade occupants that 'it is OK' to wear sweaters in response to temperature oscillations or to wear headphones to manage noise. Thus, the construction of the workspace and, ultimately, the design of the foundations of workspace users' cognitive development that guides behavior and performance are fundamentally social processes [Luria, 1935].

Accordingly, one could train users to avoid getting dizzy in an oddly designed room or to improve their innovation and creativity skills in a 'dissonant' physical environment. For example, the size of a prison cell is not per se an indicator of happiness or comfort for a prisoner—there are prisoners who are fine in a tiny cell only because the prison's management system and culture are appealing. Conversely, a prisoner could be miserable in a large and comfortable cell because of poor management and culture in the prison (Canter, 2000).

There is, however, irrespective of WOCSIT a cost to "myth" management: human attention needs to remain focused at the proposed narrative of experiencing the workspace. This requires motivation on the part of the user or the investment of resources aimed at reducing the cognitive load "working upstream" generates. The 'cognitive reengineering' designed to deflect

attention from acknowledged issues at the workspace should be a carefully planned and executed type of intervention.

Ephemeral/ Light Interventions

Another means of preliminary intervention in a facility is a design charrette. For ephemeral interventions like a charrette, WOCSIT can serve as a tool for strategy and monitoring work and, depending on the subjective perspective of its assessors as reflected in suitability charts, as an evaluation tool. The benefits of organizing a charrette are numerous. First, it draws attention of an otherwise indifferent population to the importance of physical space design. Second, it introduces the concept that the Stata Center is an artifact that can be modified. Third, it affirms the importance of end-user input in identifying activities and needs that can be facilitated/accommodated by architectural design. Fourth, it allows for the creation of an informal interest group in issues pertaining to the evolution of the Stata Center. Fifth, it engages members from the architectural community in a capacity other than what they have been used to—that of a consultant.

A charrette is a set-up for informal exchange among those interested in designing an intervention and is used as a tool for identifying new variables and as an opportunity to use WOCSIT as a guideline for end-user interventions or so-called "work-arounds" - changes at the physical subsystem or at the human subsystem.

The design charrette called "Tweaking Stata" was organized by the author and took place in the context of a student entertainment program in the Stata Center. Participants who were facility users were presented with a problem area—an underutilized corner in the building—and asked to spend an hour and a half to design an intervention. *The goal of the intervention was to make this space a "hotspot"- a nexus of communication in the facility.*
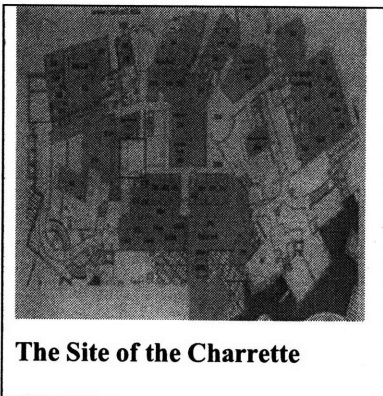
The Site of the Charrette

Participants were asked to make two decisions: first, to decide the specific function of the "hotspot" space and second, to set out the layout of different objects in that space. With Legos and clay they built models that they presented to their peers. Volunteers from the architecture department formed a jury that picked a 'winner' subject to evaluation of a set of different criteria that included originality, context sensitivity, realizability, excitement, usability, marketability, and adaptability as well as choice of "props" for the site, spatial relationships, circulation, model quality and presentation. While the objective was the upgrade of the space for an important WOCSIT factor, "hotspot", other factors were embedded in these criteria too, e.g. ambient activity, open space activity etc.

The results of the charette indicated that:

- Participants first and foremost relied on propos to achieve desired functionality. A coffee machine and a place to eat for the first group, an electronic game room for the second, an acoustically insulated 'fussball' rest area for the third, and a TV room for the last.
- Participants valued rest areas— there were couches in each solution— 'toys,' such as surveillance cameras, fancy coffee machines, hammocks, fussball tables, video games, and slides. Each of these shared characteristics gave clues about the end-user culture and identity and was reflected in factors of WOCSIT, i.e. ambient activity (Factor 1), hotspots (Factor 2) and open space activities (Factor 5)

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
ambient activity	knowledge span	hotspots	memora-bility	open-space activities	short trips	exposure

Extentions/Relocations

The new Media Lab building, designed by Fumihiko Maki was compared to a twelve-year-old Speer design of an office building in Berlin that was used as a point of departure for the design of a new headquarters for the Telco organization.

The MediaLab extension as well as the Telco new headquarters were needed as the original facility could no longer meet the needs of its users due to space constraints. Its design briefs asked that the solution remain "highly adaptable and flexible, able to respond as necessary to emerging and often highly unpredictable research priorities".

At the Media Lab, consistent with other research facilities, "all of the laboratory spaces take the form of common research areas surrounded by mezzanine offices putting the people first—providing lots of natural light, operable windows, views, and sociability... offering a central atrium, transparency, important public space for exhibitions and social gatherings encouraging, thus, cross-connections among research groups, and facilitating vital sponsor tours and demonstrations".

At Telco, open plan was a primary concern as well as making the building "green" and "friendly".

Here are further details for both projects:

A. Media Lab

Site:

The site of the extension building is adjacent and connected to the existing Wiesner Building, designed by MIT Alumnus I. M. Pei.

The new MediaLab site

• Six floors
• 163,000 SF
• Seven labs ranging from 5,000 to 8,500 SF
• Nine conference rooms
• 3200 SF of administrative space
• Auxiliary spaces include a café, small coffee areas, corridors
• Exhibition space
	• An atrium
	• An event space that includes
	    ○ a 100-seat theatre
	    ○ 3,500-square-foot multipurpose (demo/exhibition/large meeting) space
	    ○ 2,500-square-foot conference room with outdoor terrace
	    ○ 3,500-square-foot reception/dining area
	    ○ 1,800-square-foot catering kitchen

The proposed program was translated by the architect into a solution where the following architectural decisions were evident:

1. The labs face one another across a central atrium in a staggered configuration; that is, the first level of one lab is at the second level of an adjacent lab
2. There is at least one conference room per floor with the largest one on the sixth floor
3. The administration space is on the second floor
4. The atrium is in two parts - a four story high outer atrium that is linked with a staircase to a two story high inner atrium

F.Maki designed MediaLab Extention: Upper Atrium and Section Views

WOCSIT v.2B was used in the discussion with the architect to assess the program, circulation, function and form of the proposed design in light of the factors that were found to most closely relate to identity, communication and productivity (ICP):

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
ambient activity	knowledge span	**hotspots**	memora-bility	**open-space activities**	short trips	exposure

For the MediaLab site, on a qualitative level) the design seems to address each factor:

- Ambient activity is ensured with the presence of the inner and outer atrium which go beyond the need to meet basic needs such as light and address by their design other WOCSIT factors too, i.e. they increase public space availability, organize the facility's hotspots and increase its memorability as a result of the circulation system

- Users' knowledge span is facilitated with the staggered configuration of labs

- Multiple situations are created for hotspots both within lab spaces and in interstitial spaces

- Memorability of the facility is strengthened with the use of the atrium form as well as sixth floor views

- Open space activities are encouraged with the use of multifunctional exhibition spaces and ample circulation corridors

- Short trips are facilitated with internal staircases

- User exposure is ample due to the lab configuration

The only design decision that might invite inquire is the decision to place event spaces on the 6th floor as issues of isolation, evacuation might arise.

Without access to a full set of representations of the design, however, it is not possible to assess it more comprehensively.

B. Telco Relocation

Unlike the Media Lab, the Telco project was at an earlier stage in the design process.

As input in the design process a draft program and a reference facility, a twelve-year-old Speer design for an office building in Berlin, Germany, were available.

A program draft prepared for Telco by the author and an associate, had the following basic characteristics:

• Site yet to be determined
• 120,000SF
• Nineteen departments ranging from 5,000 to 8,500 SF
• Nine conference rooms
• Auxiliary spaces include a restaurant, a training center, kitchenettes
	• An atrium
	• An training and event space that includes
	    o a 200-seat theatre
	    o 2,500-square-foot conference room
	    o 2,500-square-foot reception/dining area
	    o 1,000-square-foot catering kitchen

WOCSIT Application: Sample HQ Department Program

For the development of the program, WOCSIT can serve as a strategy tool by setting priorities for each of its factors. For example, both the usable/auxiliary space ratio and the space planning of the program are issues that can be examined under this prism.
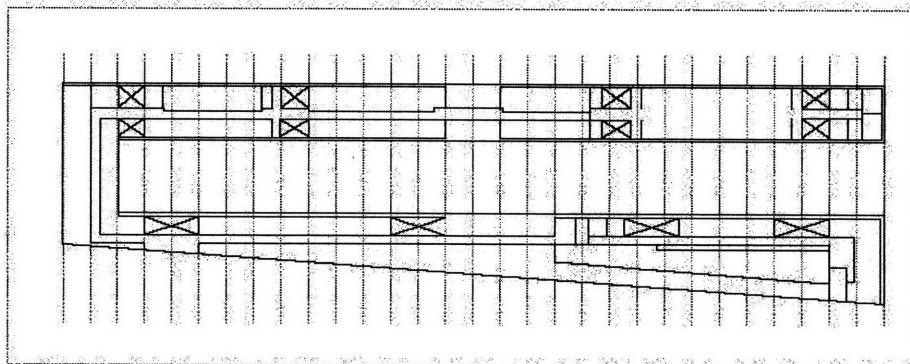
WOCSIT Application: Reference Floor Plan

For the Telco site, the creation of public space evident in the MediaLab design is juxtaposed with the conventional office building typology that organizes workspace around corridors while meeting requirements due to careful selection of materials The design would invite further development along most WOCSIT factors that can analyze, strategize and monitor architects' handling of certain common elements in their solution vocabulary such as:

- the treatment of the urban context
- the façade
- the reception area/entry point
- the atrium
- internal staircases
- internal courtyards
- top floor and roof terrace
- public area furniture

Overall, it has been possible to demonstrate how WOCSIT could be of use for different types of interventions. Nonetheless, the tool requires further development before it can be readily used in the design process.

7. DISCUSSION

The discussion chapter includes sections on insights from the WOCSIT derivation process, limitations of the research methodology, and proposed remedies.

A. Insights From The WOCSIT Derivation Process

The attempt to derive a workspace architectural design evaluation methodology has relied on the identification of variables that seem to have an impact on identity, communication and productivity (ICP)- three value-adding dimensions of organizational performance considered equivalent for the purposes of this study. The next step has involved the structuring of these variables into workspace communication suitability (WOCSIT) indices that are the result of either qualitative or quantitative derivation methods. It is useful to sum up what data analysis has revealed about identity, communication and productivity so far. It seems that these dimensions of organizational performance are enhanced when, in order of priority, the workspace:

- has an appropriate **ambient environment** present

- facilitates an increase in **awareness** of other people, the knowledge span of space users

- has **hotspots** (gravity points) that facilitate interaction

- has features that strengthen its **memorability**

- facilitates **layering of activities** in its open/public areas

- facilitates **short-distance circulation**

- enhances users' **exposure**

In the previous section WOCSIT, was claimed, could be used as an analysis, strategy and monitoring tool for both architects and clients.

Architects may empirically know when communication is negatively affected, e.g. when the workspace has areas that are vertically separated or isolated from one another, when they do not meet functional requirements, or lack gravity points for meetings and informal communication. Architects may also not be able to influence many of the factors that affect quality of communication in a workspace, e.g. groups having common interests/working on similar topics or towards similar goals. Yet, they <u>can</u> influence or determine many others and use WOCSIT to answer questions related to its factors:

a. **Ambient environment:** What architectural elements contribute to the creation of an appropriate ambient environment that supports productivity? What other factors can affect the sense of belonging?

b. **Awareness:** Under what circumstances is awareness of others in a workspace desirable? How can architecture manage necessary tradeoffs, for example between visual access and privacy?

c. **Hotspots:** What is the nature of human activity at hotspots? Who engages in spontaneous meetings? Where/when do they take place? What is their duration? Can spontaneous meetings take place in open areas such as corridors, business centers and lobbies?

d. **Memorability:** Are most architectural elements that can help increase memorability located in the public areas of the facility?

e. **Open area activities:** Are enclosed spaces needed for all spontaneous meetings – only some of which may be confidential in nature? Who are the most frequent users of conference rooms? What are the congestion times for conference room usage/ what is the daily activity pattern? What are conference rooms used for? What other activities can take place there? How many people are present? What is the reservations system like? Is it computer-aided? Is the phenomenon of holding meetings in the office persistent as a "back-up" solution when conference rooms are full or a pro-active solution? How do architectural features of personal workspace (e.g. open-plan vs. enclosed offices, room size, window size etc) relate to concentration?

f. **Short-distance circulation:** How is interaction quality and quantity affected by the spatial planning of WC, Kitchens, Printers and other auxiliary functional spaces?

g. **Exposure:** How does concentration or distraction relate to productivity and business performance?

Clients can also use WOCSIT to monitor the realization of project <u>intentions and goals</u>. Have the high-level institute goals of community, iconic value and campus connectivity been met? Have the tenant goals of collaboration, flexibility, adjacency, and cultural affinity been satisfied? Have any new goals been formed by either group that can or cannot be accommodated in the facility? What is the design rationale and main "architectural idea" of the architect's work? Is it consistent with client values? Is the interest of consistency and respect for the original resolution of the problem space relevant to the evolving life of the facility? If so, how can future architectural interventions be in the 'spirit' of the original architect?

End-users: Are end-users and occupants of the facility satisfied? Have their needs been met? How has their new working environment shaped their behavior? In terms of cumulative information exchange among end-users, how does the facility perform as an information system? What tests are needed? How does it respond to typical enterprise system problems such as integration and reliability?

Third parties: How does the facility fare with respect to benchmarks for end-user satisfaction, overall value-added, and sub-metrics like expressiveness, efficiency and effectiveness? How to understand space redundancy or perceived under-utilization?

B. Limitations of the Research Methodology

I. The tools of research may be inadequate for conducting multi-variate analysis

As with other workspace research, the task is to "identify salient links between architectural variables and occupant performance, to identify critical data collection needs and sampling intervals for the design-construction-occupancy phase and to standardize evaluation formats." (Becker/Joroff, 1995).

With the application of the techniques outlined above, an effort was undertaken to identify variables and standardize evaluation formats. Nevertheless, research can fall short of addressing the multi-faceted character of most facilities and faces the following challenges:

- Inadequacy of the metrics provided for standardization purposes: some metrics, such as temperature, are easy to record; many others though are not. For example, to measure 'chance interactions' is an elusive goal

- Absence of a robust explanatory theory that provides a causal structure between design variables and organizational performance or, as a practitioner explains:

  "[T]here are inherent intellectual and practical difficulties of charting the relationship between the physical environment and organizational performance. From the point of view of conventional social science, many of the problems are caused by the number of variables that lie between the effect of any single physical element—a particular color range, a certain level of humidity, a particularly convenient pattern of layout, for example—and any social or behavioral consequences." (Duffy, 1997)

- Inability or skepticism towards effectively leveraging knowledge and methodologies from other disciplines, such as computer science, economics, or experimental psychology

"In the absence of an active inter-disciplinary commitment, characterized by identity, accountability and mandates, the convergence of representatives of a number of disciplines...is little more than an interesting co-incidence" (Archea, 1975).

- Challenges with fieldwork and the diagnosis of phenomena in the facilities

  o While every effort is made to report dispassionately what the findings of the research are and how things are, it is inevitable that to some extent researchers will color the results with their own biases. Furthermore, experience in the field has shown that it is much harder to extract positive comments than negatives from user experience. It seems that people relate to space consciously when it is 'in their way' and are not conscious about ways in which it conditions their behavior. An unfortunate byproduct of the search for insight and issues is that the work is sometimes perceived as a search for negative information. Summer interviews suffered from this, as interviewees were selected among peers and questions posed had a negative bias. It is understandable why one's mind gravitates towards the negative. "What is wrong with the building and how can it be fixed?" was the common question.

  o Survey tool administration specifics:
    - in the pilot survey in the Stata Center, of the 16 people who started the pilot electronic version, about half finished half of it while only 3 finished it completely. In part this was due to their lack of interest in the subject matter, their lack of time, low motivation and few incentives to complete the survey. This phenomenon was known to likely repeat itself when the survey was administered to the whole population in each facility- yet, there was little that could be done about it at the time.

- the translation of conceptual variables to operational variables was difficult, largely because it was known ahead of time from qualitative analysis that respondents were uncertain about how to answer to some questions, e.g. had difficulty accurately stating how much time they spent at their desks daily. This created a need for trying to collect data for one variable by asking more than one question- there were many options on how to map index variables to questions. For example, to find out how much time a respondent spent at their desk, one could ask "how many hours do you spend at your desk?" but one could also ask "how many breaks do you take away from your desk and what is their duration?" Asking both questions allowed comparison, yet would also use up respondent's time. The survey had to be recoded due to software glitch.

o the survey may have been administered too soon after moving in and before occupants had a chance to settle on their views- this may explain why answers seemed haphazard resulting in a low-alpha measure and confounding the analysis. People's opinions of their environment change. Interviewees who expressed strong opinions in a summer interview have since changed their mind, either because of habituation or because of an intervention or because their initial opinion was the result of circumstantial corroborating factors arguing that knowing the difference is relevant is also an important step: for better or for worse, 'fickle' perceptions of reality are more likely to change whereas 'known' reality is anchored and harder to change. For example, the statement "We hang out by the whiteboards a lot," may not be accurate—it may be that subjects spend only a few minutes near whiteboards every week. (One method used in field research, the pulse-tracker experiments, aim at finding out what gaps exist between what people think they do,

what they say they do and what is actually happening). Nonetheless, the activity is deemed important enough to merit a nearly unanimous consensus that whiteboards are an essential feature in the building. It may not be materially true but it is psychologically true.

II. The mechanisms of adaptation can confound research objectives
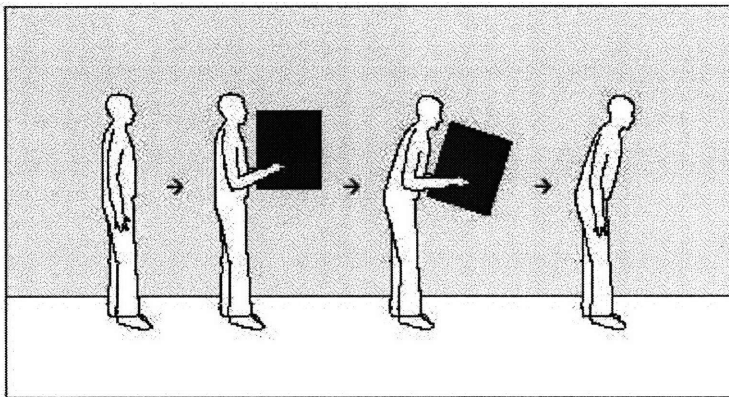
Studying the mechanisms of adaptation, interventions) taking place in the facilities is likely to provide significant insights. *Both buildings and humans can adapt and the presence of these phenomena significantly hinders the effort to derive an index that can predict the suitability of a workspace given field values for the different variables related to communication.*

On adaptation of buildings

"[A]lmost no buildings adapt well. They are designed not to adapt; also budgeted and financed not to, constructed not to, administered not to, maintained not to, regulated and taxed not to, even remodeled not to. But all buildings (except monuments) adapt anyway, however poorly, because the usages in and around them are changing constantly." (Brand,1994).

'The new priorities: light, air, and interesting views, along with the mantra adaptability. "We were struggling to break through—they just wanted what they had, they loved Building 20 because they could beat it up. So I said, 'How about a building where you feel comfortable banging the walls out, putting up stuff?' Building 20.1! Well, sort of." (Gehry, Wired Magazine, 2004).

On adaptation of humans

"Mies Van der Rohe had the following response to a client's shock at seeing the architect's design:

"'Yes,' said Mies viewing the tip of his cigar reflectively, '[the client] wasn't very happy at first. But then he smoked some good cigars, and we drank some glasses of a good Rhein wine...and then he began to like it very much.'" (Simon,1981).

It is further important to note that adaptive acts and interventions are essentially the same.

As a result of the above challenges, a marked shift has occurred in the early enthusiasm of researchers and practitioners. The once nascent field has lost some of its excitement, raising doubts, along with the critics of environmental psychology that "these threads of inquiry have not resulted in much" (Interview with Prof. Stone, 2004).

C. Proposed Remedies

Remedies to Research Tool Inadequacies

To address some of the issues raised above, and in order to secure empirical data that is usable in terms of application of statistical methodology, the following remedies are considered:

- To address the issue of a low response rate, the use of **the "distance analysis/imputation" method** is relevant (used by governmental statistics agencies in Europe) whereby answers from fully answered surveys are used to fill-in missing values in partially answered ones. For each record with missing values, one can select from the subset of records with all the values the one that has the most similar answer pattern with it. In addition, a second survey (see Appendix X) was designed, keeping in mind the limitations of the first one that resulted in a low response rate, which when administered, is expected to elicit better results.

- To address the issue of a low-alpha rate, once the imputation procedure is complete, one can derive correlations of all pairs of questions and remove from the dataset questions that have smallest correlation values with all remaining variables. Thus, **the issue of low alpha rate can be addressed with the existing dataset**. This is a very labor-intensive process. More effective would be to re-visit translation of observation variables to conceptual and operational variables and write- up an updated, shorter version of the survey keeping questions with good inherent measurability that can contribute to statistical analysis, leaving out those that do not.

- To address the need for reliable variable data, attention and emphasis on diagnosis using different data collection techniques from the toolbox currently under development must be renewed. (see Ch.2)

Remedies to Effects of Mechanisms of Adaptation

- To address respondent adaptation phenomenon, an inherent problem, one could administer the survey & analyze results to the whole population but also administer it to selected sub-populations with similar characteristics (e.g. months of occupancy). Those that have adapted to a stable modality of experience, results are expected to be more meaningful.

- Still, it is expected that as the subjects are human, different "truths" will still exist. How these different truths should be assessed is the task of cognitive scientists and philosophers who should explain how reliable knowledge about the world can be consciously obtained and also why 'truth in consciousness' (vs. 'truth in the world') is equally important in the context of human psychology of reward. Writes JP Changeaux (2002), "the search for the neurobiological bases of consciousness and rationality, far from impoverishing our conception of human integrity, offers an unprecedented opportunity to properly value the multiplicity of personal experience, the richness of cultural diversity, and the variety of our ideas about the world".

Data gathered by these techniques helps validate or modify explanatory theories of causality between the physical and human subsystems and ultimately impacts evaluation quality. In the diagnosis of human behavior in a working environment it is helpful to think, at the diagnostic level, of **how the techniques employed can improve with the help of computer technologies.** This exploration may be facilitated by a tentative taxonomy whereby computation can take place at the perceptual or 'physiological truth' level and thought of in terms of representations and processes. Verbal representation, such as words and numbers, is fixed, while visual representation of objects shapes or other entities in perceptual reality "leave open what exactly is there." Processes can be explanatory if procedural rules are transparent or results-oriented if what is of interest is the result (Stiny, Knight, 2001).

The diagnosis of changes in the cognitive and mental states of humans is a

result of their exposure to a physical environment. Significant progress, however, is underway, and there are techniques in different disciplines that can provide analytical frameworks for gaining insight in these activities and their causal structure. What started with psychological theories of cognitive development (Luria, Vygortsky, 1935) are in modern times found in applications like the study of human behavior in shopping centers (Underhill, 1999), motivation structures for human behavior in online environments (Malone 2005), or explanatory frameworks for human decision theory, e.g. the management of conflict (Hirschman, 1970).

The application of the basic data collection techniques consisted of reading and ciphering basic data arising. The analysis of more extensive data and the attempt to capture and account for the complex phenomena related to bi-directional adaptation introduce the need for using more abstract models that can reduce, encode or represent data for processing. From ciphering, it is necessary to compute or even calculate data, in the etymological sense. The proposed techniques used in the field of research have rapidly adopted technology to improve data inflow quality and quantity. Simple computational means like word-processor or digital recording and editing software are helpful in capturing and encoding end-user comments or the architect's design idiosyncrasies and rationale; they are pertinent input from other stakeholders involved in the design process in one way or another. In the quest to improve diagnostic ability, it becomes clear that computationally enabled tools of research add value and generate helpful data.

For example, one of the techniques in the toolbox, an experiment using cell phones, relies on a small custom-design program that tracks people's location and movement in the building. In one question, participants are asked to state how much time they think they are spending in different locations and a web-based application stays in touch with interviewees by assisting their monologues. In another experiment, the geometry of a conference room is recreated using parametric software design tools and an avatar introduced in order to improve the predictive power of computer modeling.

Thus, the phenomenon of 'psychological truth' which gives rise to subjectivity is elucidated and characterized through computational means improving the quality of statistical analysis as a result.

8. Concluding Remarks

The **problem** addressed in this paper involved the measurement of the impact of architectural design on the value of workspaces and on identity, communication and productivity (ICP) in particular.

The **hypothesis** was that, with the use of qualitative, correlational and logical argumentation research methods, value can be measured and generated by diagnostic techniques whose subject is a composite artifact. On this basis, a tool would be constructed that could measure and generate value for these composite artifacts.

The comparative case studies considered provided rich experimental conditions for the in-depth study of related issues. Allowing for the contribution of various fields and disciplines including architecture, cognitive psychology, ecology, computer, and management science, the result was a comprehensive evaluation methodology that can be incorporated in the design process of any working environment.

Specifically, the **main result** consisted of the identification and categorization of design variables that were used to construct this tool, the Workspace Communication Suitability Index (WOCSIT). These variables, when embedded in the systemic framework of an index, altogether adequately translate conceptual to operational variables and render the index useful as a tool for analysis, strategy formation, monitoring and evaluation of the impact of workspace architectural design on ICP.

The contribution of this work lies in its assertion that it is possible to design a comprehensive and formalizable means of assessing the impact of workspace architectural design on aspects of human behavior, especially those most closely related to organizational performance. This promise of accountability is invaluable both to architects who often design for complex organizations and for these organizations that require new workspaces that support their objectives.

Framing and facilitating the interaction between the two parties will increase utility of scarce resources like time. To avoid the 'stigma' of social science that demotes its perceived value for architects, or the 'stigma' of soft science that demotes its perceived value for organizations, future research can focus on: (i) further development of WOSCIT for use in formal synthesis by means of translation of its factors to accommodate architectural language and terminology; this will create a technical index that can prove invaluable in the evaluation of new or existing artifacts.

(ii) the refinement of the key variables/metrics, improvement of data collection techniques and triangulation for these variables by technology-driven tools, e.g. RFIDs, seat sensors and video games.

Probing into the form of physical space in relation to key human cognitive processes such as perception, navigation and movement, will shed light in the impact physical space and its management have on are identity, communication and productivity- key aspects of innovative or creative behavior in any high-performance working environment.

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APPENDIX I: SURVEY FOR STATA-ITU
(administered in May 2006)

INTRODUCTION

1 of 35.Please read the following statement before proceeding:

Thank you for agreeing to participate in the survey!
It should take about 10' of your time and you will be asked to answer questions about your experience working in the Stata Center. You also have the option of signing up for an interview, playing a videogame and registering in a raffle with a big prize! You can also take the survey in paper format. Your answers will help us **measure the impact of two specific architectural design decisions on human organizational behaviour:** the decision to increase the amount, type and location of public spaces available and the decision to adopt unconventional interior and exterior architectural forms. When the facility was commissioned, these architectural design decisions were expected to improve collaboration among members of CSAIL and strengthen the image of CSAIL in the MIT community and outside world both of which are key factors for CSAIL's organizational development. Your answers shall help verify these expectations. The findings of the study may trigger physical and administrative interventions that will improve your working environment. They may also improve the practice of designing research centres and other high performance working environments. Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable with any questions you may skip them or withdraw at any point. Your responses will be strictly confidential and data from this research will be reported only in the aggregate in accordance with guidelines of the Committee on the Use of Humans as Experimental Subjects (COUHES). Your information, including any personal information you provide (e.g. email, location) will be coded and remain confidential. Please contact Konstantinos Tsakonas (tsakonas@gmail.com) or write to statapulse@gmail.com with any questions you may have.
Thank you very much for your time and support!

2 of 35. Please indicate that you have read and understood the information hereinabove: *
Yes
No
Yes, but I would like to take the survey in paper format. Please contact me!

3 of 35.
SECTION I: SOME BACKGROUND INFORMATION ABOUT YOU: *
Your work location (e.g.32-232)?

4 of 35. How long ago did you first move in Stata?
One month ago or less
Three months ago or less
One year ago or less
Two years ago or less
Exact number of months (if you remember)
Tech Square
Building 68
I worked in another building:

5 of 35. What building did you work in before moving into your facility?
Tech Square (Glenview for ITU)
I worked in another building

6 of 35. Do you work in an "open space", i.e. any workspace that is NOT a conventional office with a door?
Yes
No
Optional comment:

7 of 35. OPTIONAL: Are you co-located with other members of your research group?
Yes
No
Not applicable
If you are not co-located, please describe your group's set-up:
Yes
No
Not applicable

8 of 35. Does your research/work group hold weekly work-related meetings?
Yes
No
Not applicable

9 of 35. On average, how many hours per week do you spend ...?
Number of hours
0-10 11-20 21-30 31-40 41-50 51+
On campus
In Stata
At your desk

10 of 35. Your age?
18-25
26-30
31-35
36-50
51+

11 of 35. Your gender?
Male
Female

12 of 35. Your position?
Faculty (Professor, Assistant Professor)
Graduate student (PhD)
Research staff (Principal Investigator, Post-doctoral Associate, Visiting scientist)
Administrator(SRS Administrative/Technical Staff, Support Staff)
Other student (Masters, Undergraduate)

13 of 35. SECTION II: YOUR PEOPLE KNOWLEDGE SPAN: For each floor, how many people do you know by NAME, FUNCTION and LOCATION?
Number of People
None 1-2 3-5 6-12 13+
Ninth floor
Eighth floor
Seventh floor
Sixth floor
Fifth floor
Fourth floor
Third floor
Second floor
First floor

14 of 35. SECTION III: YOUR GENERAL IMPRESSIONS AND OPINIONS OF STATA: Please indicate which aspects of the working environment are important to you but ABSENT from Stata:
Adequate physical and acoustic privacy
Easy navigation to people and places
Warm, inviting and comfortable furniture/props in public places
Good visual access to people and places in AND outside my work area
Other important aspect that is absent?

15 of 35. OPTIONAL: Please RATE your degree of agreement with each of the following statements.
Degree of Agreement

Disagree
Strongly disagree
Neither Agree nor disagree
Agree
Agree Strongly

It feels like we are more on display than where I worked before

Stata's architectural design sends the message that CSAIL is ready to take risks

Open spaces in my research area respect privacy while helping increase informal contact

Am well connected to and aware of everyone and everything going on everywhere in Stata

My workgroup is isolated from most other groups in the new facility

Walking around in the facility's public spaces during my breaks is energizing

Without the help of signs or formal maps, I could get disoriented

The quality of my working environment is a factor I pay attention to in important career decisions

The circulation system intrigues me and invites exploration: I use staircases a lot and pick new routes often

A lot of exciting new ideas emerge in CSAIL

A good alternate use of Stata is a dormitory and conversion would be easy!

Stata is a more "happening" place than the Media Lab

Is there a statement you are curious to find out what others think about?

16 of 35. Has the availability of more and varied public spaces in Stata resulted in a more close-knit CSAIL community?
Yes
No
Please explain

17 of 35. Has the unusual architectural form improved the image of CSAIL in MIT and the rest of the world?
Yes
No
Please explain

18 of 35. SECTION IV: YOUR INFORMAL INTERACTIONS NEAR YOUR WORK AREA: To measure your short-distance travel time, we d like to know many SHORT TRIPS do you make in an average day from your workdesk to
Trip frequency
0 1 2 3 4 5
Nearest bathroom
Nearest food& drink source (fridge, kitchenette)
Nearest printer/copy machine
Nearest research group conference room

19 of 35. Are your trips mostly on your own floor? Pls explain
Degree of Importance
Not important at all
Of little importance
Important
Very important
Indispensable
With faculty
With people in your research group
With people in other research groups
With random people

20 of 35. How many times in an average day, do you interact with people whose name, function and work-location you know..? (check all that apply)
Interaction Frequency
0 1 2 3 4 5
With a research group member during a trip to the bathroom
With a research group member during a trip to the nearest food &drink source
With a research group member during a trip to the printer/copy machine
With a non-research group member during any of the above trips
Comment:
Number Of People
None
One-to-two
People
Three-to-five
People
Six-to-ten
People
Eleven-to-fifteen
People
Sixteen or
More people
See (S)
Say hello to
(H)
Chit chat with
(C)

21 of 35. OPTIONAL: Please describe in longhand (or on the map you will be provided with in paper format) your most common short route on your floor in ITU and the location of informal face-to-face interactions you regularly havce along this route

Number of People: none   1-2   3-5   6-10   11-15   16+
See(S)
Say hello to(H)
Chit Chat with (C)

22 of 35. SECTION V: YOUR ADAPTATION PROCESS IN STATA! For each completed sentence, please indicate how accurate it is: "IN COMPARISON TO YOUR OLD WORKPLACE...
Degree of Accuracy
Not Accurate at all
Not accurate!
No change
Accurate
Very accurate!
Accurate!
..You spend more time away from your desk and in the facility's public areas
..You see familiar people pass by more often
..Your sense of belonging in the academic community of CSAIL has strengthened
..You take short breaks more often
..You get more work done
Side-effect On Informal Interactions
Yes, this adaptive act was undertaken in my area!
-

Decreased -2 -1 0 +1 +2 Increased
You erected partitions/walls in your work area's open space
You installed frosted glass
You rearranged furniture layouts
You use earphones more often
You work more at home
Other adaptive act

23 of 35. OPTIONAL: Note (Please read this question carefully) To improve your experience at work, what ADAPTIVE ACTS have you or your peers undertaken since first moving in ITU? (check all that apply) EXAMPLE: you were earphones to avoid this noise. Also, please indicate what is the side effect each adaptive act you undertook on informal interactions?
[Side effect on Informal Interactions: -2 (decreased) -1 0 +1 +2]
You erected partitions/walls in your work area's open space
You installed frosted glass
You rearranged furniture layouts
You use earphones more often
You work more at home

24 of 35. SECTION VI: DESIGNING A TOUR OF STATA: You have been asked to design a tour for an important visitor. Please indicate your THREE top picks for stop locations on the tour. Is there another tour-stop you would pick? What is the rationale for each set of choices?
Visitor Type
A friend or family
A new member of CSAIL
(faculty, student etc)
A visiting colleague or sponsor
The exterior
Open spaces within the
research areas
See-through workspaces
Transparent conference rooms
The Patil seminar room (Kiva)
Outdoor terraces
The Ground floor
Elevator lounges

25 of 35. Close your eyes for 10 seconds and think of the architectural features and details that define Stata ..
OK, I closed my eyes and thought of architectural features and details that define Stata

26 of 35. Now, please check the items hereinbelow that popped up in your mind (unchecked ones will be assumed not to have popped-up at all)
Intensity of Feature Retrieval
1- (Did not pop-up at all!)
 2
3-(Popped-up dimly)
4
5-(Popped-up immediately!)
Ground floor-to-third floor staircase
Outdoor amphitheatre
Vassar-Main street entrance to Stata
My research group work area
The fourth-floor passageway
Patil seminar room (Kiva)
Star seminar room
A" spiral stair" lounge next to the elevator
Kitchenette on my floor
Meandering circulation system
Outdoor terrace furniture
Elevator lounge sky views
Internal see- throughs and sky views
Coloured walls
Interior columns made out o concrete
Contrasting yellow panelling on the exterior
Ground floor sky views
Coloured floor carpets
4th-floor bar
Other item that popped in my mind:

27 of 35. OPTIONAL: What spaces in Stata do you have a vague idea about what is going on inside?("Blind spots")
Degree of vagueness
1- (Did not even know this place existed!)
2-
3-(Fairly vague)
4-
5-(Not vague at all!)
Basement spaces
Gates "upper" floors (5-9)
Gates "lower" floors (2-4)
Dreyfoos "upper" floors
(5-9)
Dreyfoos "lower" floors
(3-4)
Other space you are vague about:

28 of 35. SECTION VII: YOUR DEFINITION OF PUBLIC SPACE: How do you define a PUBLIC SPACE in the facility?
All spaces except my personal workspace
All spaces where every member of the community can enter
All spaces one has visual, physical, acoustical and social access to
All spaces customarily shared by more than one person
Other definition:

29 of 35. OPTIONAL: Please indicate your sense of how public each of the spaces listed is
Degree of Perception As Public
1- Not public
2
3
4
5
6
7-very public
Ground floor eating area
Ground floor kindergarten area
Transparent conference rooms
Elevator lounges
Break-out spaces in my research group's work area
Restrooms on my floor
Kitchenettes on my floor

30 of 35. OPTIONAL: Which of your work-related activities take place away from your desk or immediate research area?
Work on my laptop
Read a book
Have lunch with a colleague while discussing work
Chit-chat with a colleague in or nearby one of the seminar rooms
Other activity

31 of 35. SECTION VIII: If there is ONE physical or administrative intervention you would like to propose that will improve your experience at work, what would that be and why?
Write your comments below in each line
Preference
Yes
 No
A 10' one-to-one interview records your views in more detail. Would you like to sign-up?
A video game we designed maps your interactions and tests your navigational skills. Would you like to play?
In appreciation for your valuable time, you are entitled to a cookie or fruit that you can pick up near your area's administrator. Will you pick it up?
In appreciation for your valuable time, your e-mail can be added to a raffle with the top prize being an exciting gift! Would you like your e-mail to be added to the raffle?
Are you interested in the research topic and wish to receive a copy of the survey results in aggregate via e-mail?
Comment:

32 of 35 Please indicate your preference
An 10' one-to-one interview records your views in more detail. Would you like to sign-up?
A videogame we designed maps your interactions and tests your navigational skills. Would you like to play?
In appreciation for your valuable time, you are entitled to a cookie or fruit. Will you accept the offer?
In appreciation for your valuable time, your email can be added to a raffle with the prize being an exciting gift! Would you like your email to be added to the raffle?

Are you interested in the research topic and wish to receive a copy of the survey results in aggregate via email?

33 of 35. What was the purpose of the survey? (check all that apply)
To find out if and how a variety of public spaces improve interactions and the sense of community in
CSAIL
To find out if and how unconventional architectural features and details affect human memory
To provide me with an opportunity to express my opinions about Stata
I have no idea
Other comment:

Less than 10 minutes
10-12 minutes
13-14 minutes
15-20 minutes
What would you change or improve

34 of 35 How long did it take you to finish the survey?
Less than 10 minutes
10-15 minutes
15-20 minutes
What would you change or improve?

35 of 35.
THANK YOU! Questions? Please write to statapulse@gmail.com

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APPENDIX II: ARCHITECT INTERVIEW

May 2005, ITU, Copenhagen, Denmark

(M.Christensen, Senior Partner&Project Architect, Larsen Architects, Copenhagen,

Denmark) 26.05.05, ITK

The architect and researcher met at the lobby of ITK on a Friday afternoon at the end of a week when students handed in their theses and gathered at the ground floor bar to relax.The interview took place in the atrium on a bench.

Q. Hello, I am here with the project architect, a senior partner with Larsen architects, Copenhagen.
A. Our office has designed the Nordea bank in the center of Copenhagen, the Danish design center downtown. We are now working on two buildings at the Copenhagen Business School.
Q. What excited you about the ITU building?
A. We have a philosophy when doing buildings to **focus on social spaces.** In the modern way that education takes place is focused on networking, on working in projects that you go out and work in groups. So the building has to facilitate a lot informal learning areas, where people get to work here. To get the borderline between actually studying, working, doing research and social activities like playing football, being in a canteen, relaxing... a mesh. The building must address this.
Q. The client brief reflected that?

A. Not really. The brief was in a way not very ambitious. We are working on newer buildings now.. The brief was quite traditional.
Q. Was it written?
A. It was fifty pages long and answered questions like: How many square feet? What type of functions? What should the relations between functions be?
Q. What were the client values..?
A. The education at ITU is based on taking students from the university here in Humanities, and from the business schools having the idea that IT is the backbone of society, culture. So we have to make a triangle covering all areas. We knew that students would be from different backgrounds and the whole idea was synergy between the students, between different fields of work. So **this space is very much about making a powerful image,** which they are using on their website too, making people able to see each other- you have a feeling that a lot of other people are working at the same time. **An ambient sense of movement.** You are IN this social space all the time. We found that people can focus. None can be disturbed by the fact that they sit in boxes and can see other boxes, there are others moving around.
Q Why is that?
A. People are very good at making space, modern people...
Q. What were the project's key ideas, concepts?
A. Well, the key element in terms of what the building does for the processes in the building. Bringing people together, creating the notion of a large building being ONE organism as a function of the atrium. And then having the research departments in the corner being more focused, sort of withdrawn from the scene... Areas of focus and areas of socialization...
Q. Pretty dramatic juxtaposition it seems...
A. We were forced to make two sticks. The plan came from the other university. We would have dreamed of an even more complex, if we had done it more freely. It is too long a building but that was in the brief.
A. The second idea was the connection to the other two buildings. You have these urban spaces where the university takes part of the city. To integrate the university in

the urban context, mixing it up with the neighbors. Trying to make an urban university. Not a campus in the American style.

Another concept is to have **the building be very public on the ground floor**, the two big labs, the two big auditoria, the canteen, the bar and the library- all the common facilities are organized on the ground floor. In contrast to most universities in Denmark and Europe where you have all education classrooms on ground floor and all research on upper floors. The idea here is to **have education and research on ALL levels**, mixed.

Education, classrooms, team areas, group spaces, open workspaces on all levels. Not like you have a science department where you have to knock on the door and need a special keycard to get in there. With all research people being these strange people not getting in touch with the students.

Q. Is there something happening in the building you did not predict?

A. Not really. Last time we were here, they were playing badminton and tennis.

We did not predict this but we love it. They are doing what we meant them to do...

Q. Architects and designers CAN impact organization... You seem to agree with this idea

A. Oh, yes! Very, especially in education, knowledge-related. The building can really help

Q. What are the metrics for linking the two? What should we start measuring if we agree that this building makes the organization stronger?

A. Find the tools to classify areas in terms of informal spaces that can also be a canteen but definitely not dark corridors. All the communicative areas are translated into social spaces. Avoiding the absence of corridors. Try to find a system to measure this.

Q. Are there tradeoffs as an architect you had to socially accept?

For example, to allow people to socialize you need to open the space, but you have costs in terms of noise, decreased privacy, concentration e.t.c. Did these tradeoffs show up in the design process?

A. Not much. In terms of budget we were on budget.(65M usd). Fire marshal capacity is 2600. Permanent occupants at the same time 1700. Organization members 2500 researchers administration, students. But some students do night school, so at the same time you d have 1500.

Q. In the comparable building, the Stata Center, we have about the same number of users, yet the cost of the building was higher...

A. Gehry does not do cheap buildings. Ours is 19000m2, 180000SF without basement, with basement (800 bike spots, 4000m2) it is 220000SF, a third of the Stata Center at the seventh of the cost.

Q. We are asking people to do a small exercise regarding the **highlights of the design process.**

I ll give you a piece of paper with a line that starts when the master place was devised for the area (1998). You have ten boxes, which you place around moments in the design process that were dramatic, where important decisions were made. Something that eventually impacts how the building looks like today. Managers, users, owners, architects- different groups express their views and make up a mosaic of the design process...

A. Winning the competition. Doing the competition – we could make a timeline just for that. It is very tough to do in a short manner.

Q. Maybe you can describe how your office works

A. We do not have one leader. What binds us together is a set of common values. We have no set language that Gehry or Meier has, or even Koolhaas. It is the group dynamic that shapes the design. We have one idea, then the other. It is a very unpredictable process. It is one key element in the program that we focus on- we cannot make everyone happy. Our process is to try and highlight. We need the

specifics, not the generics. In this building, it was giving them an image of bringing people together.

Q. What other ideas did you consider?

A. In the beginning, we focused on the element of IT, the matrix, and the chip from a formal point of view. Thinking of the building as a computer. Then, we found out it has nothing to do with IT or technology. It is all about people and their social relations. It was stupid to think about a formal start point. So **our translation from program into architecture was based on a social idea.**

Q. Did Mr. Larsen have the final say? Is it consensus; is it reflective of the Danish culture?

A. We are discussing what exactly happened when we were involved in this process. There is a researcher at Copenhagen who just did this work (Maya Christensen). Not coming from me as the leader of the design team.

In our design process, we went from a formal point of view into a social point of view and being inspired by IT as a way of crossover, synergy.

Q. How large the team, how many work hours, over what period, what tools?

A. 3 people, 800-900 work hours, six weeks, 50-60 hours a week, illustrator/in-design

Q. Do you believe in physical models?

A. Very much, it is valuable because you can pick your view instantly. In a computer you have to wait..

Q. How was communication with the client?

A. We did have a conflict with the client. This is a government building.

It used to be that the government builds a building for the government and the people take it or leave it. Very little user representation. That is much changing now. The process is very democratic now making everything more complicated. They are renting the building which gave them much power, they had lawyers, were negotiating contracts.

Our project was attached to a contract...

Q. Did you read books magazines- how did this idea of social space come about?

A. It came from ideas that are 20-25 years old. It came from a formal standpoint. Not very modernist. The starting point of his architecture was based on the building as a small city. This will give you streets, squares, and social spaces. A formal starting point that changed into today's philosophy. I have a ppt to share that says how we see the basis...

Q. Now, you had an activist client. What was their main issue, other than cost?

A. They bought the idea. No conflicts on program. Some on light. Did architectural light give a headache? It reflects on computer screen and gives you a headache. They do not like the ground floor (we do). Time, the building was much delayed. We were not to blame but we were part of the process. Another consultant hired the contractor. The project from the engineering company was delayed and that delayed the contractors. It was the water. You did one meter down and you find the ocean.

Q. Did you talk to the users afterwards?

A. I talked to some of the researchers who say the plan is very simple but the building is complex. They always find new ways to look across. It is nice to experience new angle all the times.

Q. Did you predict this would happen?

A. Not exactly, but when you look at the plan there are 3-4 boxes on each floor. Yet in perspective, plans are overplayed on each other and altogether they build this complex geometric space. Depending when you are sitting.

Q. Any researchers to talk to that are expressive?

A. I have not met any just yet. But they have evaluated education and have a report where they note what people say.

Q. There is a difference with the other building where researchers and students sit together. Here, you have a very dramatic division. Finding out **how the mingling**

affects the quality of experience would be very interesting. Finding out the right methodology to assess this.

Q. What do you think about that decision? How does it affect quality of experiences?

A. In a negative way. It underlines the hard vision between researchers and students whereas our end was to make them be one. In the competition it was mixed. Now you have the atrium and the researchers are in the wings. In the competition the researchers were running in the common space. They wanted us to shut them up in the wings.

APPENDIX III: KNOWLEDGE SPAN

1.People in ITU Know many MORE co-workers than people in STATA

(OWN FLOOR)

			STATA	ITU	Total
people I know **on my floor**	none	Count	203	15	218
		% within people I know on my floor	93,1%	6,9%	100,0%
		% within country	64,0%	16,7%	53,6%
		% of Total	49,9%	3,7%	53,6%
	1-5 people	Count	55	30	85
		% within people I know on my floor	64,7%	35,3%	100,0%
		% within country	17,4%	33,3%	20,9%
		% of Total	13,5%	7,4%	20,9%
	6+ people	Count	59	45	104
		% within people I know on my floor	56,7%	43,3%	100,0%
		% within country	18,6%	50,0%	25,6%
		% of Total	14,5%	11,1%	25,6%
	Total	Count	317	90	407
		% within people I know on my floor	77,9%	22,1%	100,0%
		% within country	100,0%	100,0%	100,0%
		% of Total	77,9%	22,1%	100,0%

			Monte Carlo Sig. (2-sided) 99% Confidence Interval	
	Value	Significance	Lower Bound	Upper Bound
Fisher's Exact Test	67.840	,000	,000	,000
N of Valid Cases	407			

2. People in ITU Know many MORE co-workers than people in STATA
(ONE FLOOR AWAY)

			country		
			STATA	ITU	Total
people I know 1 floor away	none	Count	186	10	196
		% within people I know 1 floor away	94,9%	5,1%	100,0%
		% within country	58,7%	11,1%	48,2%
		% of Total	45,7%	2,5%	48,2%
	1-5 people	Count	53	16	69
		% within people I know 1 floor away	76,8%	23,2%	100,0%
		% within country	16,7%	17,8%	17,0%
		% of Total	13,0%	3,9%	17,0%
	6+ people	Count	78	64	142
		% within people I know 1 floor away	54,9%	45,1%	100,0%
		% within country	24,6%	71,1%	34,9%
		% of Total	19,2%	15,7%	34,9%
	Total	Count	317	90	407
		% within people I know 1 floor away	77,9%	22,1%	100,0%
		% within country	100,0%	100,0%	100,0%
		% of Total	77,9%	22,1%	100,0%

			Monte Carlo Sig. (2-sided) 99% Confidence Interval	
	Value	Significance	Lower Bound	Upper Bound
Fisher's Exact Test	80.026	,000	,000	,000
N of Valid Cases	407			

3. People in ITU Know many MORE co-workers than people in STATA

(TWO FLOORS AWAY)

			country		
			STATA	ITU	Total
people I know **2 floors away**	none	Count	208	32	240
		% within people I know 2 floors away	86,7%	13,3%	100,0%
		% within country	63,4%	27,6%	54,1%
		% of Total	46,8%	7,2%	54,1%
	1-5 people	Count	68	16	84
		% within people I know 2 floors away	81,0%	19,0%	100,0%
		% within country	20,7%	13,8%	18,9%
		% of Total	15,3%	3,6%	18,9%
	6+ people	Count	52	68	120
		% within people I know 2 floors away	43,3%	56,7%	100,0%
		% within country	15,9%	58,6%	27,0%
		% of Total	11,7%	15,3%	27,0%
	Total	Count	328	116	444
		% within people I know 2 floors away	73,9%	26,1%	100,0%
		% within country	100,0%	100,0%	100,0%
		% of Total	73,9%	26,1%	100,0%

			Monte Carlo Sig. (2-sided) 99% Confidence Interval	
	Value	Sig.	Lower Bound	Upper Bound
Fisher's Exact Test	75,064	,000	,000	,000
N of Valid Cases	444			

APPENDIX IV: IMAGES FROM INTRODUCTION CHAPTER
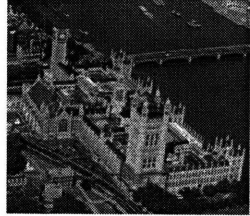
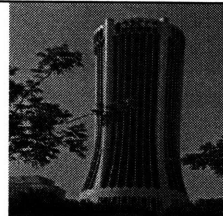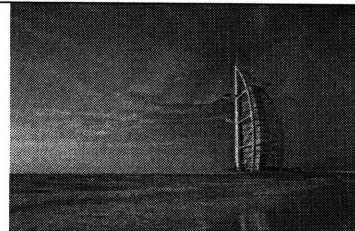|	
Image 1: Churchill said that "buildings shape the way we think".	Image 5: Mahathir in Malaysia built the "government corridor" to modernize government administration.
Image 2: Keynes insisted that his workspace have a particular configuration to optimize his productivity.	Image 6: Dubai's leaders invested heavily in the built environment including a unique hotel to spur and signal economic growth.

APPENDIX IV: IMAGES FROM INTRODUCTION CHAPTER (Continued)
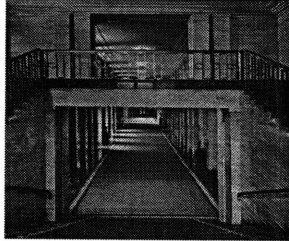
Image 3: Hitler collaborated with Speer to translate his vision of ethno-socialism into a built environment.

Image 7: The Chinese TV organization seeked a facility emblematic of its public opinion power and build the CCTV tower.
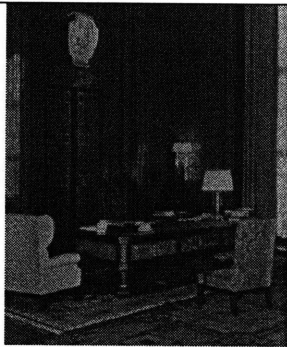

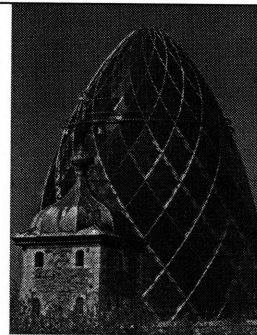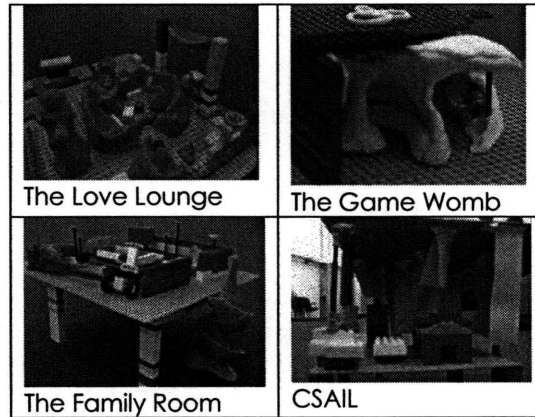Image 4: Hitler collaborated with Speer to translate his vision of ethno-socialism into a built environment.

Image 8: A Swiss insurance company, Swiss Re, invested in the "Gherkin" tower and gained instant recognition.

APPENDIX V: DESIGN CHARETTE JUROR COMMENTS

| The Love Lounge | The Game Womb |
| The Family Room | CSAIL |

Originality: The Womb is the only project that suggests changing the actual form of the space, instead of simply adding 'furniture'. It provides a space like no other in the building: isolated and enclosed.
Context Sensitivity: The Family Room provides, in a conservative fashion, a space that people with different needs/preferences can enjoy.

Realizability: The Turing Love Lounge is most easily realized because it simply involves the making of the furniture and the construction of a hammock. The Family Room differs in this respect only due to the slide (which would no doubt be very costly).

Excitement: The Game Womb provides one with the opportunity to be playful in design and with materials. The unconventionality of the idea leads to many possibilities.

Expected Popularity/Usability: CSAIL s could be the most popular project, assuming that the panels do work effectively in absorbing and redirecting sound, while not tremendously obstructing views; it could solve the acoustic problems in the building. In addition, these panels could also be incorporated into other areas of the building with similar needs. However, the project that would be used most, in the sense that it would increase traffic in the area, is the Game Womb. It would act as a destination point, at all hours of the day and night, whether it is to play video games, relax, socialize or sleep.

APPENDIX V: DESIGN CHARETTE JUROR COMMENTS (Continued)

Marketability: The CSAILs is the project that would be most photogenic, in part due to its elegance and simplicity. Its grand gesture is in keeping with the aesthetic of the rest of the building.

Adaptability/Flexibility: In general architects want to design something that will last, in part to justify the cost. With this building however, the architect has proposed that adaptability and flexibility can increase the longevity. The CSAILs project is the one that has the most potential in this sphere. The apparent random arrangement of the panels suggests that it can be modified depending on the program of the space at the time. As mentioned above, the potential for the use of these panels in other areas of the building speaks to its adaptability as well.