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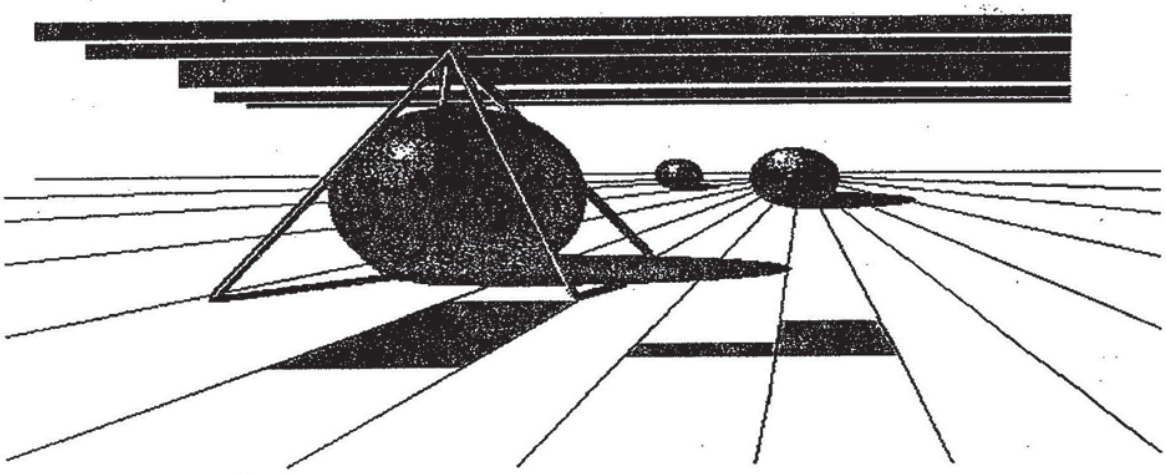

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THE IMPACT OF SPACE CONFIGURATION ON COMMUNICATION IN RESEARCH CENTRES

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Abstract

Previous research showed that consultation with colleagues from outside the research group but from within the organization proved essential to successful problem solving.

This research argues that the layout of the architectural plan is instrumental in promoting or hindering social interaction among inhabitants of a research laboratory. Using space syntax techniques, it quantitatively measures the ability of the layout of the architectural plans to promote social interaction. It also argues that the presence or absence of meeting facilities like cafes, meeting rooms and break out spaces aid or hinder social interaction respectively. Managerial decisions also play a role in the process. Plans are classified as "generative" or "conservative" models.

It is also argued that symmetrical plans if not properly linked, dramatically reduce communication among users of the floor plan and consequently hinder the process of interaction and thus have a negative effect on the progress of science in research laboratories.

ملخص:

تأثير التصميم الفراغي للمسقط الأفقي على تبادل الأفكار في مبان مراكز البحوث

تم تحليل بعض مراكز البحوث المصرية و الأجنبية فراغيا وقد أسفرت التحليلات الفراغية عن وجود نوعين من النماذج للمباني البحثية، أحداهما نماذج "مولدة" للحركة والتي تؤدى إلى التفاعل الاجتماعي والذي قد يؤدى إلي تبادل الأفكار بين الباحثين من مستخدمي تلك المبان والأخرى نماذج "ساكنة" لا تشجع الحركة بها وكذلك على العلاقات بين مستخدمي تلك المبان وبالتالي على عدم تبادل الأفكار العلمية واستبقاء الوضع القائم. كذلك لوحظ أن بعض القرارات الإدارية قد تؤثر سلبا على قدرة المبان البحثية المولدة للحركة مما يعوق تبادل الأفكار بين الباحثين من مستخدمي تلك المبان.

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*The authors would like to thank Professor Dr Hisham Fouad- Atomic Energy Authority for his effort while supervising this research.

كذلك تمت مراجعة معمارية لهذه المراكز المصرية و الأجنبية وقد لوحظ افتقار المراكز البحثية المصرية إلى الفراغات المجمعة (غرف اجتماعات، مطاعم، كافيتريات) مما لا يسمح للباحثين من مستخدمي تلك المراكز بالتعارف وتبادل الأفكار العلمية. لوحظ كذلك أن تماثل المسقط الأفقي قد يفقده بعض قيمته التجميعية إن لم يكن متصلا اتصالا قويا.

1.0 Introduction

Most previous research on research centres focused mainly on space ergonomics, technical problems like the supply of services like water and gas, finishing used in research laboratories, flexibility of design, design of program and some research focused on architectural form.

Previous research argues that consultation among colleagues working in the same organization but not necessarily in the same research group is instrumental in the achievement of better qualities of problem solving.[3]

What makes research better at a research centre rather than at home? There are two reasons for this: First, is using the equipment and facilities provided by research centre. Second, is the face to face interaction and consultations with fellow scientists and researchers that can lead to problem solving and innovation?

The question to be asked is: How can the building of a research centre aid in achieving interaction? Can it hinder interaction? How can a building help people interact without having to knock on each others doors?

This research intends to evaluate an international sample of research laboratories for the presence of the services which facilitate communication among users, that each building offers to its users. It also intends to spatially analyse research laboratory buildings, examine the results, compare them and then rank the buildings accordingly.

In this research the analytical and the comparative analytical methodology of research have been used. The space syntax analytical tools which are descriptive, quantitative and analytical have been extensively used.

[3] Allen, T.J., (1977) *Managing the Flow of Technology*. Cambridge: MIT Press, USA.

2.0 Space Syntax Methodology and Analytical Tools

2.1 Definition of Space Syntax

Space syntax was born in the late 1970s in the Unit for Advanced Architectural Studies at University College London, under the direction of Professor Bill Hillier.

2.2 The Methodology

Space syntax is a theory of description applied to the built environment. It deals with the relational patterns that arise as space is marked, divided, enclosed, differentiated, shaped and organized by means of physical boundaries. Underlying this descriptive emphasis is a question exiled from architectural discourse for a portion of our recent past: how is built space to be understood as a social artefact, how does it function, how does it support or constrain behaviour, how does it reproduce social relationships, how does it generate social effects? The key towards a syntactic theory of function is provided by the description of space use as another kind of spatial morphology. Examples of generic morphological patterns that mediate between layout, social function and cultural meaning include: the functional labelling of spaces, movement, co-awareness, encounter and exposure to information. The word "syntax" bridges between the twin motivations to describe built space and its occupancy and to understand how these patterns are means through which we recognize and construct society and culture. As an analytical, quantitative and descriptive tool, space syntax is used to test hypotheses in different domains of inquiry in which controlling of layout as a variable is an issue.[4]

A number of methodological tools have been developed at UCL for the description and analysis of complex buildings space. The one that will be used here is the **axial analysis.**

2.2.1 Axial Analysis:

The axial analysis simply identifies the longest and fewest straight lines that pass through all spaces in a plan. **Figure 1a** shows an architectural plan and **figure 1b** represents its axial lines. **Figure 1c** represents its axial integration core. The blackest lines represent the most integrated and the lighter lines represent the most

[4] Peponis, John. 'Interacting questions and descriptions: how do they look from here?' Proceedings of the 3rd Space Syntax Symposium, Atlanta, Georgia, USA, May 2001, p.1.

segregated. **Figure 1c** was produced by 'Axman'[5], a computer program which also produces values of other measures like connectivity and depth for each axial line, in a form of a table, which are going to be explained shortly. **Table 1d** is also produced by Axman program.

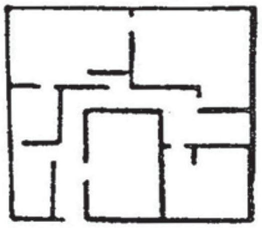


Figure 1a
An architectural plan

Figure 1b
Axial map of the plan

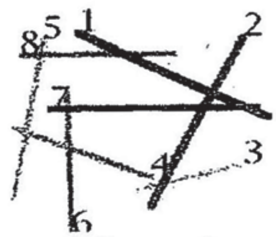


Figure 1c
Axial Integration core

Index	Line number	Integration	Connectivity	Depth
1	7	1.379	3	3
2	1	1.379	3	2
3	2	1.149	3	3
4	8	.985	2	1
5	6	.985	2	4
6	4	.766	2	3
7	5	.766	2	2
8	3	.575	1	4

Table 1d Axial table arranged in a descending order of integration

Connectivity, as its name indicates, is the index that accounts for the number of axial lines linked to the line into consideration. It is calculated by the number of lines the line into consideration intersects with. Thus highly connected lines are represented by high connectivity values and vice versa. For example line number 7 has a connectivity value of 3 as it connects with 3 lines.

Depth, as its name indicates, is a measure showing depth or shallowness of a particular line from the system. Thus line number 3 has a depth value of 4 as one has to pass through 3 axial lines to reach it.

Integration: Depth, however, will be used in a more developed and quantitative form which is called **integration**. The integration value of a space expresses the relative depth of that space from all others in the graph through the formula

[5] Axman is a computer program developed at UCL that runs on Apple Macintosh computers. The axial map is drawn manually (Fig. 1b) then scanned and redrawn in the program which produces the computed version (Fig 1c) and Table 1d.

$$\text{Integration value} = \frac{2(md-1)}{k-1}$$

where **md** is the mean depth of spaces, i.e. the number of spaces away from all other spaces from the selected space, and **k** is the total number of spaces from the selected space. A correlating factor is applied to eliminate the empirical effects of size, so that different systems may be compared. This measure is called **RRA** (real relative asymmetry). In theory this gives a value varying between 0 and 1 for maximum integration. In practice we use 1/x of RRA and call it integration. The higher its value the more integrated the space is, the lower the more segregated.

Intelligibility of a spatial system is measured by finding out the coefficient of determination, R-squared, between integration and connectivity in a system. It expresses the degree to which the local property of space is a good guide to the global position of lines in the spatial system as a whole.[6]

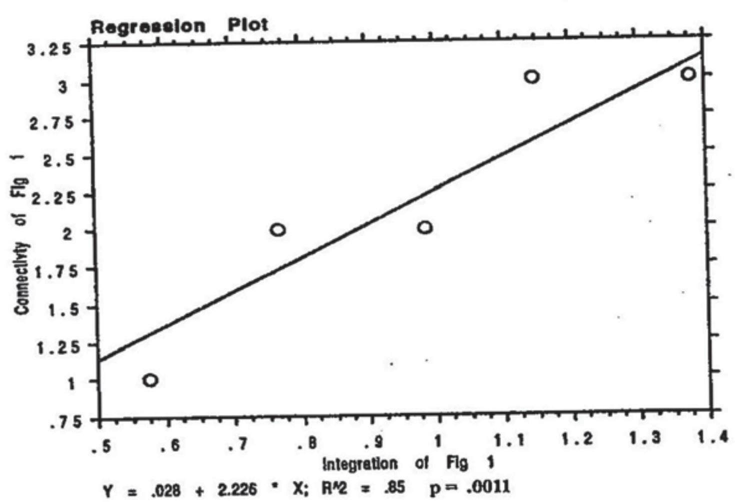


Figure 1f
Intelligibility of plan in figure 1a

Also the research centres were architecturally reviewed for the presence of facilities that promote communication. The review resulted in **table 2:**

[6] Hillier, Bill, "The Architecture of the Urban Object". Ekistics, Jan. /Feb. 334, March/April 335, 1989.

Table 2 Contents of Research Centre per building and site

	Architectural design			Work			Meeting				Recreational		Services			Visibility	Well being		
Convex Space/ building	No of Floors 10	Stairs 5	Lifts 5	Labs 10	Offices 10	Lab Supp-Ort 10	Audi-torium 5	Semi nar 5	Meet-ing room 5	Break Out Space 5	Coff-ee room/ 5	Cafes/ Dining 10	Lib-rary 5	Com-puter room 5	Photo-Copy-room 5	Atrium / Court 5	Reli-gious buildg 1	Fitness Sports/ Site 1	Total Score
NRC (Egypt)	4 2.5	16 .3	12 .42	88 6.5	72 5.1	33 1.11	1 1.25	2 2				2 5	2 10		1 5		1 1		40.18
HBRC (Egypt)	8 1.25	2 2.5	2 2.5	144 10	54 3.8		1 1.25		1 .14		1 0.63		1 5			1 5	1 1		33.07
GIF (Egypt)	2 5	2 2.5		46 3.2	13 .92											1 5	1 1		17.62
NCNSRC (Egypt)	9 1.1	3 1.6	4 1.25	88 6.1	72 5.1	24 0.81		1 1				1 0-10	1 5	1 5			1 1		27.96-37.96
IGER (Egypt)	5 2	1 5	3 1.7	31 2.2	33 2.3			2 2	5 .69				1 5	1 5	1 5	1 5	1 1	1 1	37.93
SCRC (UK)	1 10			21 1.4	50 3.6				1 .14	14 2.8		1 10	1 5	1 5		1 5			42.89
CBL (UK)	4 2.5	3 1.6	2 2.5	100 6.9	20 1.4	20 0.67			4 .55		4 2.5					1 5			23.64
JMS (UK)	5 2	4 1.25		28 1.9	55 3.9	22 0.74			3 .415			1 10				1 5			25.21
BSC (USA)	3 3.3	2 2.5	3 1.7	72 5	72 5.1	297 10			36 5	24 5		1 10	1 5						52.6
SIBM (USA)	4 2.5	4 1.25	4 1.25	136 9.4	35 2.5	255 8.6	4 5		8 1.1	20 4	8 5	1 10	1 5						55.58
RPRRC (USA)	3 3.3	4 1.25		96 6.7	141 10	54 1.81	1 1.25		18 2.5	15 3		1 10	1 5			1 5		1 1	50.26
KDNARI (Japan)	4 2.5	3 1.6	3 1.7	124 8.6	72 5.1	40 1.35		5 5			2 1.25		1 5			1 5		1 1	38.1
STRC (Japan)	2 5	3 1.6	2 2.5	121 8.4			1 1.25	1 1			2 1.25	1 10	1 5	1 5		1 5		1 1	47
BYRC (Japan)	4 2.5	2 2.5	2 2.5	72 5	48 3.4	30 1.1		1 1	2 .28	6 1.2	4 2.5	1 10	1 5	1 5	1 5				46.98

Table 3 summarises the results of **table 2** and arranges the research centres in a descending order according to availability of facilities.

	Research Laboratory	C.Y.[7]	Initials&Country	Score
1	Skirball Institute of Bio molecular Medicine	1993	SIBM (USA)	**55.58**
2	Biological Sciences Complex	1991	BSC (USA)	**52.6**
3	Rhone-Poulenc Rorer Research Centre	1993	RPRRC (USA)	**50.26**
4	Sandoz Tsukuba Research Centre	1993	STRC (Japan)	**47**
5	Bayer Yakuhin Research Centre	1994	BYRC (Japan)	**46.98**
6	Schlumberger Cambridge Research Centre	1982	SCRC (UK)	**42.89**
7	National Research Centre	1956	NRC (Egypt)	**40.18**
8	Kazusa DNA Research Centre	1994	KDNARI (Japan)	**38.1**
9	Institute for Genetic Engineering	1999	IGER (Egypt)	**37.93**
10	Housing and Building Research Centre	1963	HBRC (Egypt)	**33.07**
11	National Centre for Nuclear Safety and Radiation Control	1998	NCNSRC (Egypt)	**27.96**
12	The Institute of Medical Sciences	1993	IMS (UK)	**25.21**
13	Camelia Botnar Laboratories	1993	CBL (UK)	**23.64**

Table 3, The 13 research centres ranked in descending order of availability of facilities.

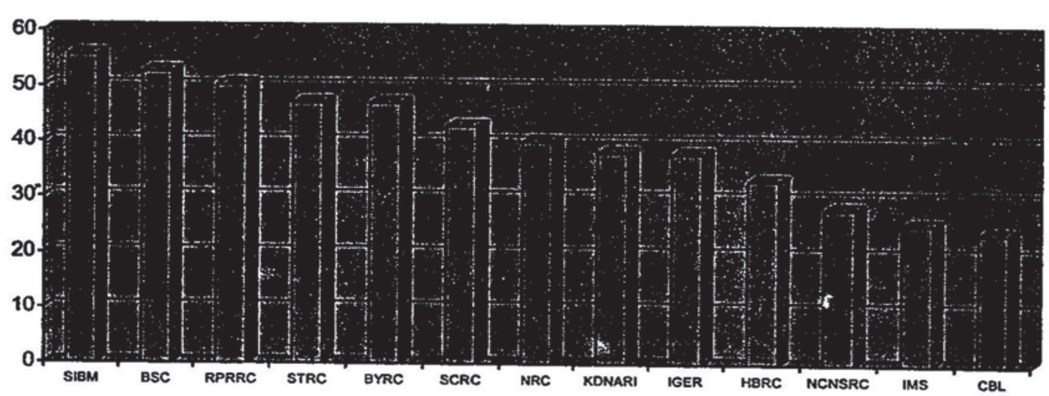


Figure 2, Bar chart showing scores of research centres according to availability of facilities that aid in communication.

[7] Completion Year.

In the following part, the research centres will be spatially analysed. They are going to be referred to by their initials. Because of the nature of research laboratory buildings, users are directed towards their place of work, it was legitimate to choose a floor for analysis from every building.

1) The National Research Centre (NRC), Egypt, 1956

The building under study is the main and first building of the NRC complex that exists today. The first floor was chosen for analysis.

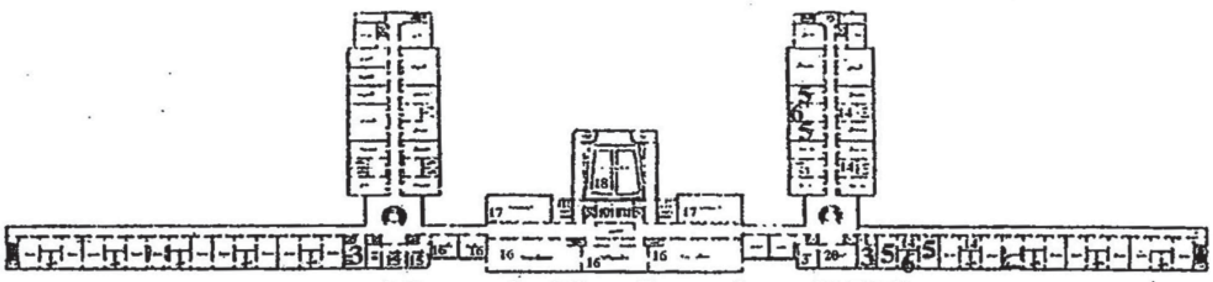


Figure 3a First floor plan of NRC

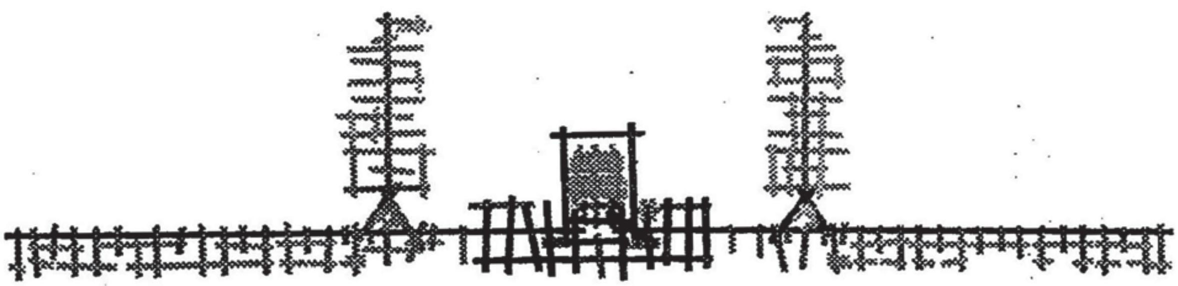


Figure 3b First floor plan of NRC, **Mean axial integration: 1.169**

2) Housing and Building Research Centre (HBRC), Egypt, 1963

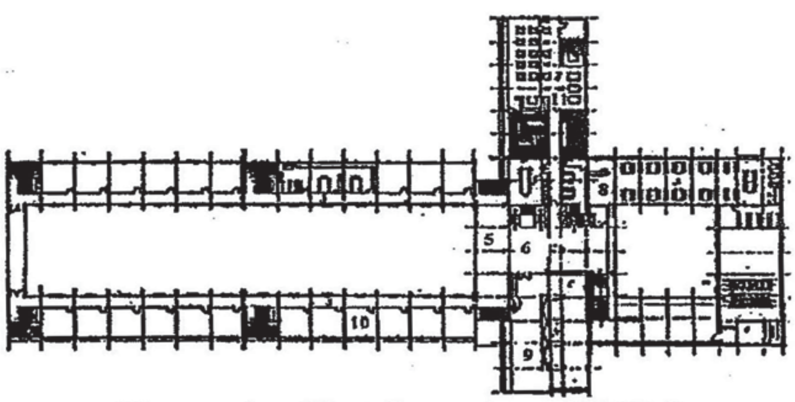


Figure 4a First floor plan of HBRC

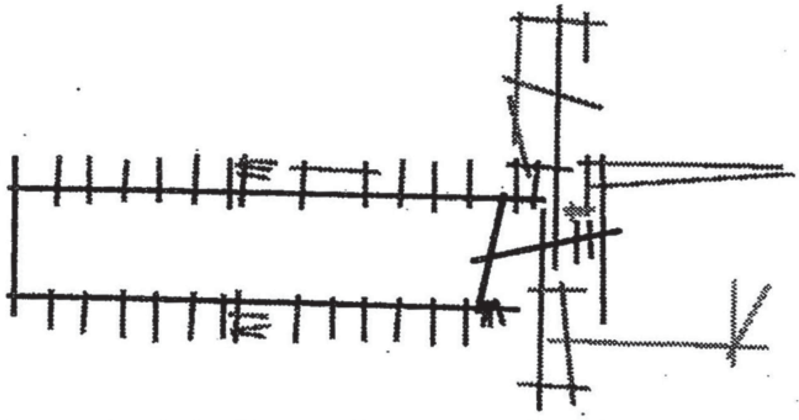


Figure 4b Axial Integration core of first floor of HBRC
Mean axial integration: 1.137

3) **National Centre for Nuclear Safety and Radiation Control (NCNSRC), Atomic Energy Authority, Nasr City, Cairo, Egypt, 1998**

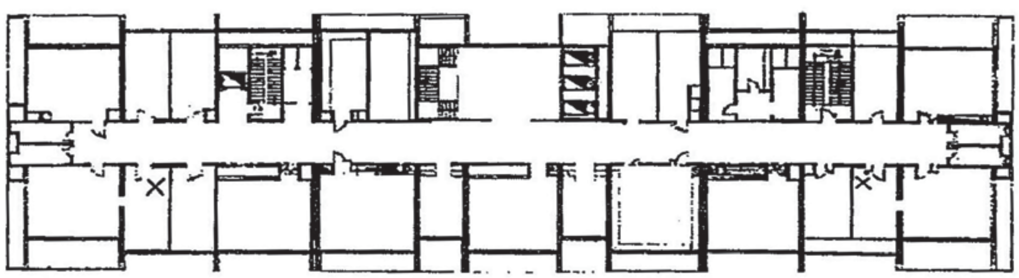


Figure 5a Third floor plan of NCNSRC

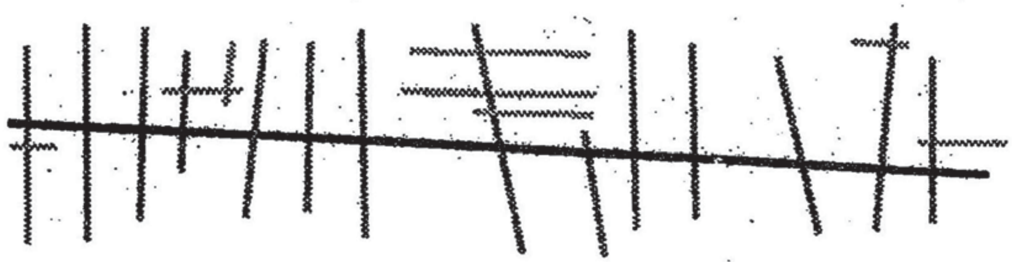


Figure 5b Axial Integration core of the third floor of NCNSRC
Mean axial integration: 1.606

4) Institute for Genetic Engineering (IGER), Mubarak City for Scientific Research, New Borg El-Arab, Egypt, 1999

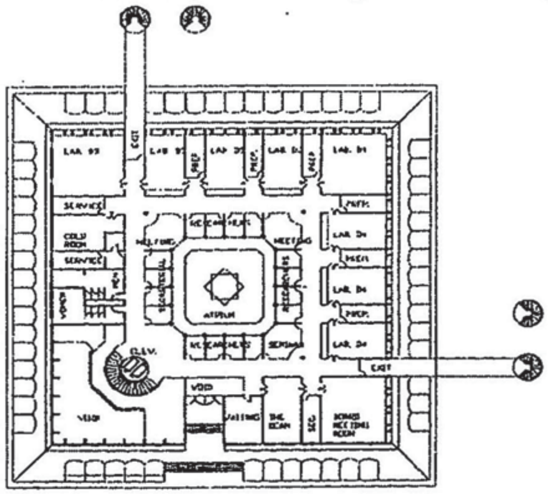


Figure 6a First floor of IGER, MCSR

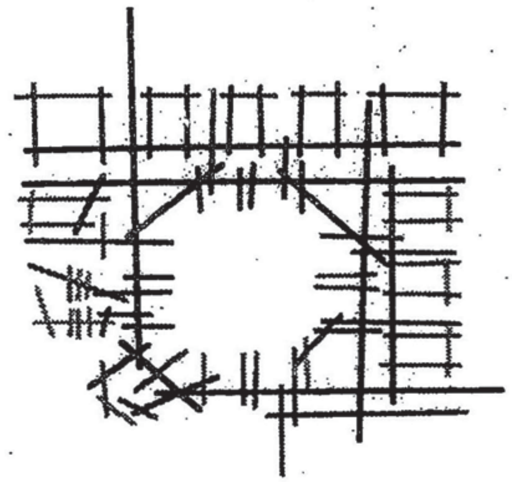


Figure 6b Integration core of first floor of IGER

Mean axial integration 1.345

5) Schlumberger Cambridge Research Centre (SCRC) Cambridge, UK, 1982

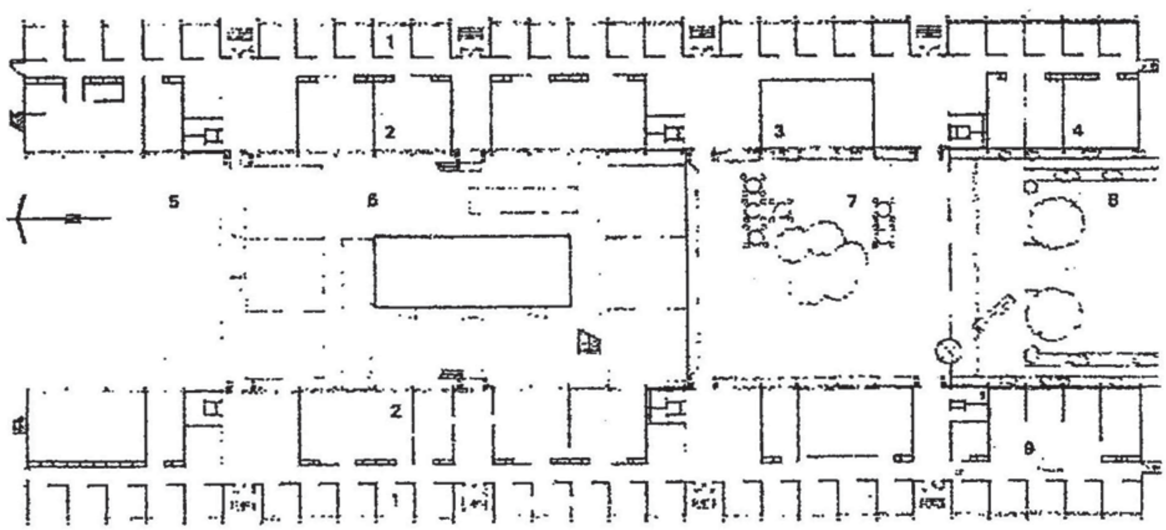


Figure 7a Ground floor plan of SCRC

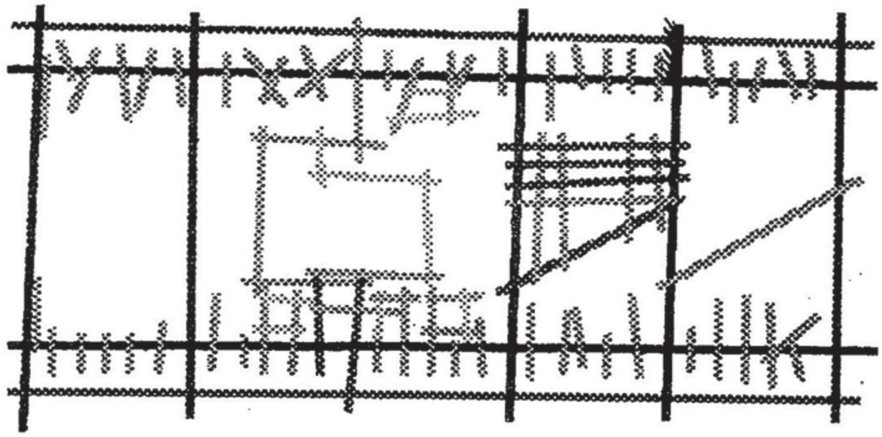


Figure 7b Integration core of the ground floor of SCRC
Mean axial integration: 1.813

6) Camelia Botnar Laboratories (CBL), Great Ormond St Hospital, London, UK, 1993

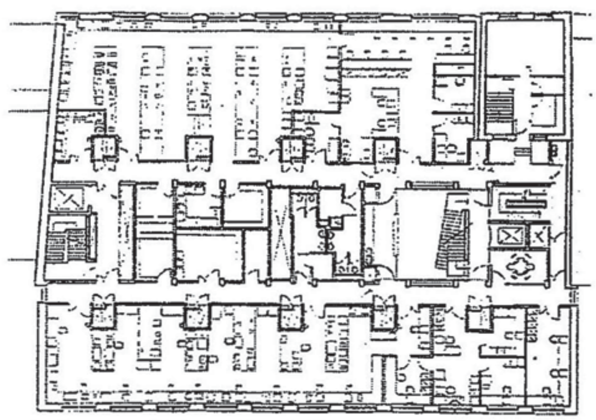


Figure 8a Typical floor plan of CBL

Figure 8b The axial integration core of CBL typical floor
Mean axial integration: 1.24

7)The Institute of Medical Sciences (IMS), Aberdeen University, Scotland, UK, 1993

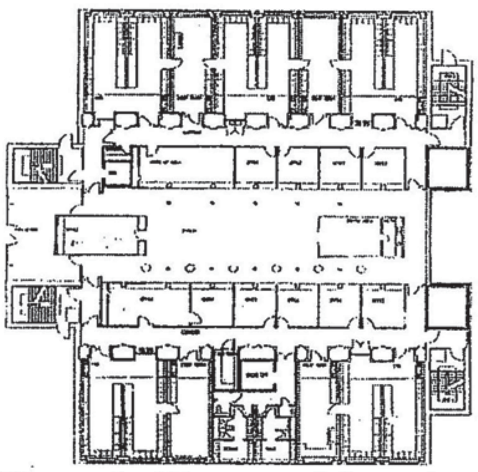


Figure 9a The ground floor plan of IMS

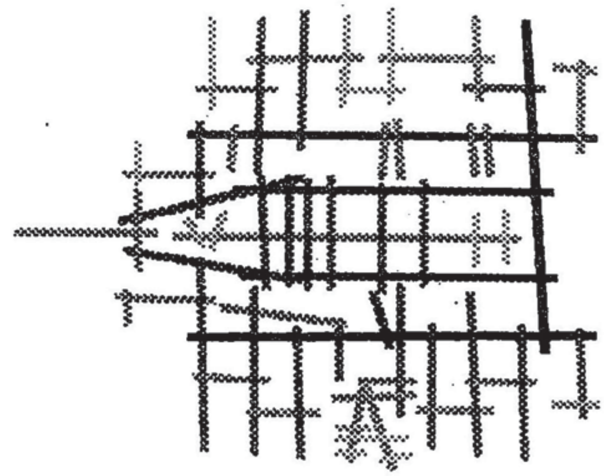


Figure 9b The axial integration core of IMS
Mean axial integration: 1.082

8) Biological Sciences Complex (BSC) Georgia University, USA, 1991

Figure 10a Second floor plan of BSC

Figure 10b Integration core of second floor of BSC
Mean axial integration: 1.051

9) Skirball Institute of Bio molecular Medicine (SIBM), New York, USA, 1993

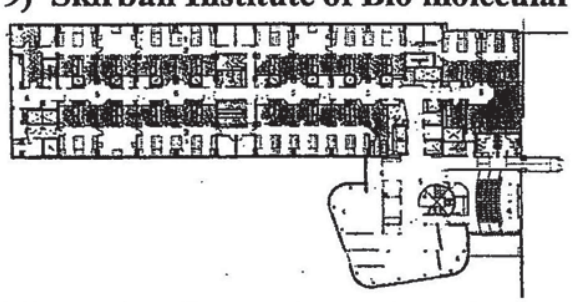


Figure 11a Second floor plan of floor of SIBM

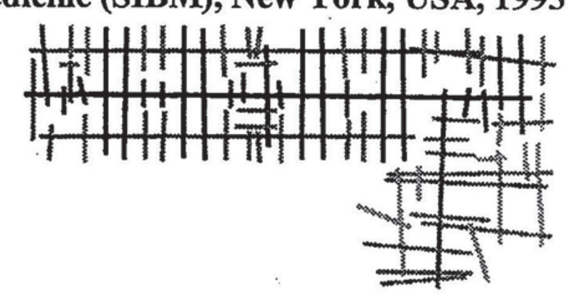


Figure 11b Integration core of second SIBM
Mean axial integration: 1.623

10) Rhone-Poulenc Rorer Research Centre (RPRRC), Collegeville, Pennsylvania, USA, 1994

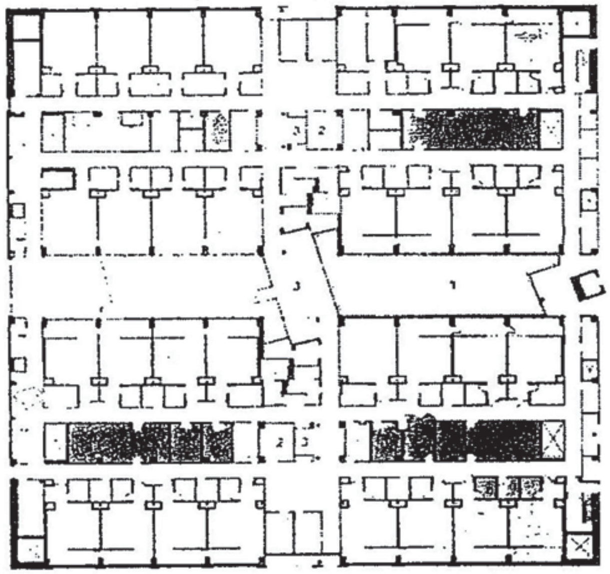


Figure 12a Second floor plan floor of RPRRC

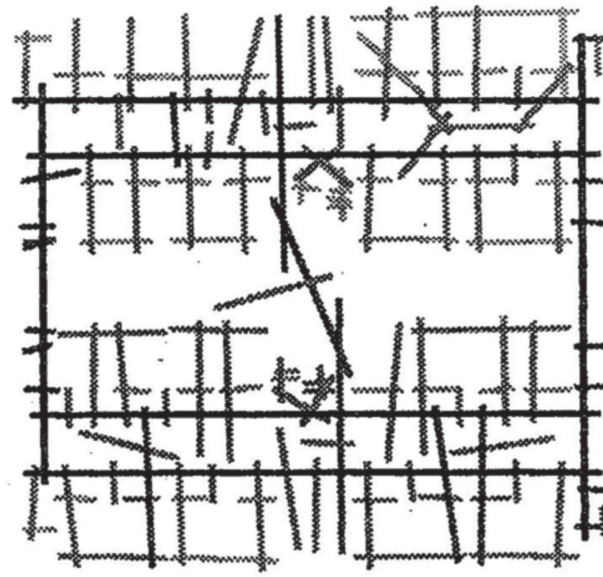


Figure 12b Integration core of second of RPRRC
Mean axial integration: 1.562

11) Kazusa DNA Research Centre (KDNARI), Kisarazu City, Chiba, Japan, 1994

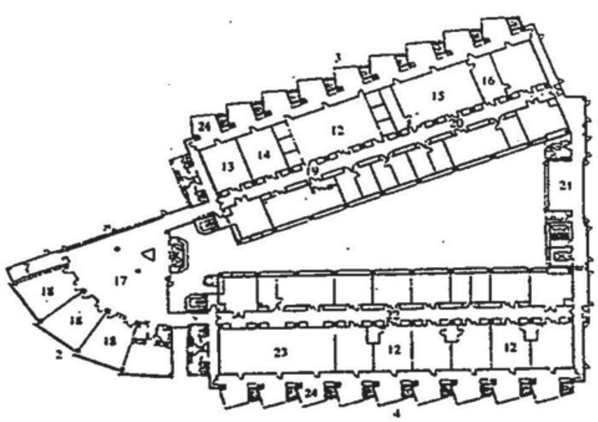


Figure 13a First floor plan of of KDNARI

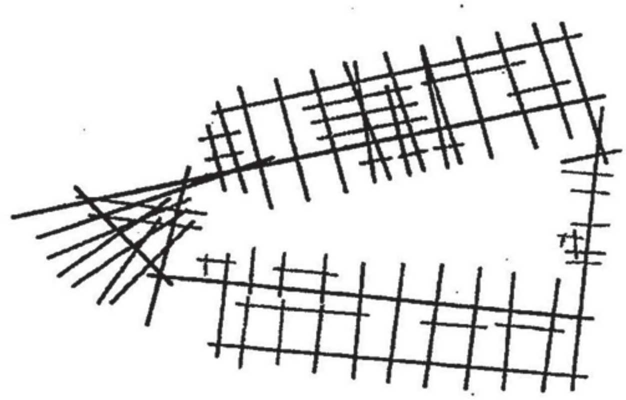


Figure 13b Integration core of first floor KDNARI
Mean axial integration: 1.485

12) Sandoz Tsukuba Research Centre (STRC), Kizu town, Kyoto, Japan, 1993

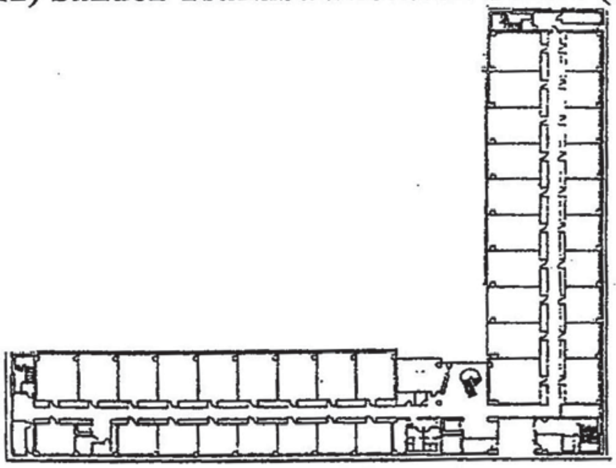


Figure 14a The ground floor plan of lab wing of STRC

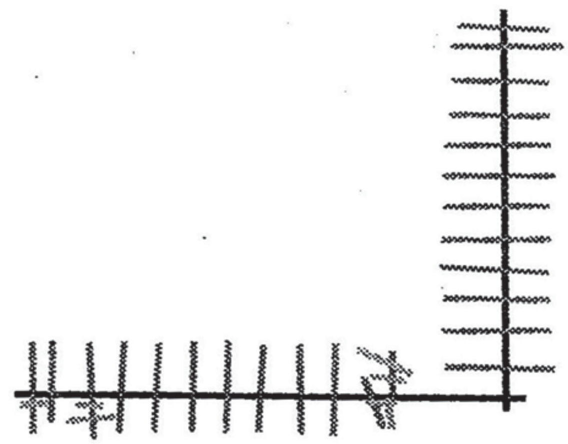


Figure 14b Integration core of ground floor of lab wing of STRC
Mean axial integration: 1.6

13) Bayer Yakuhin Research Centre (BYRC), Kizu town, Kyoto, Japan, 1994

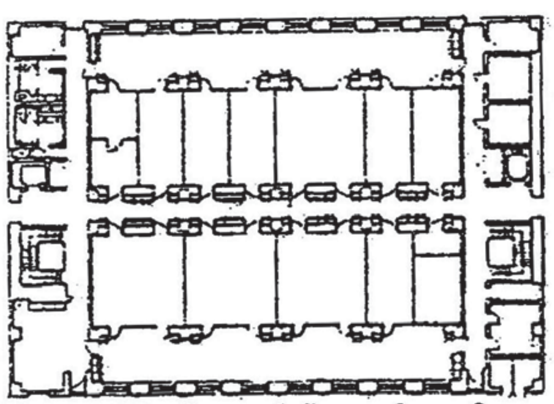


Figure 15a Second floor plan of Biological Research Building, BYRC

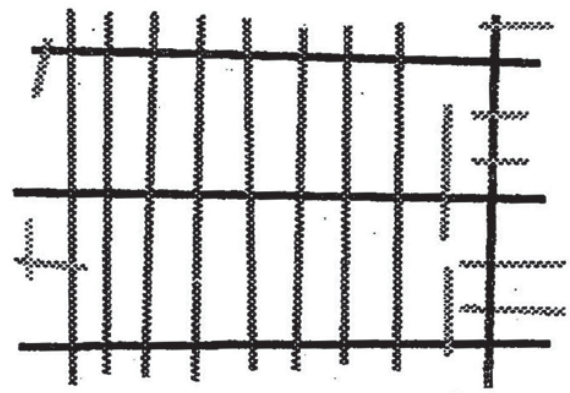


Figure 15b Integration core of second floor of Biological Research Centre, BYRC
Mean axial integration: 1.76

Table 4 represents the mean axial integration of the different research centres arranged in a descending order of integration. High mean integration values represent 'generative'[8] plan models that are argued to generate movement in the most integrated parts of the plans while plans with lower mean integration values

[8] **Hillier, B., Visible Colleges, *Space is the machine*, Cambridge University Press, 1996.**

represent 'conservative' plan models that are argued to conserve movement in the architectural plan.

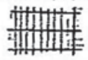
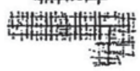
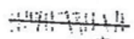
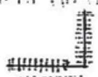
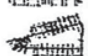
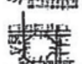
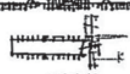
Axial map of Research Centre	Name of Research Centre	Mean Axial Integration
	SCRC (UK)	1.813
	BYRC (Japan)	1.76
	SIBM (USA)	1.623
	NCNSRC (Egypt)	1.606
	STRC (Japan)	1.6
	RPRRC (USA)	1.562
	KDNARI (Japan)	1.485
	IGER (Egypt)	1.345
	CBL (UK)	1.24
	NRC (Egypt)	1.169
	HBRC (Egypt)	1.137
	IMS (UK)	1.082
	BSC (USA)	1.051

Table 4, Mean axial integration values of research centres arranged in a descending order

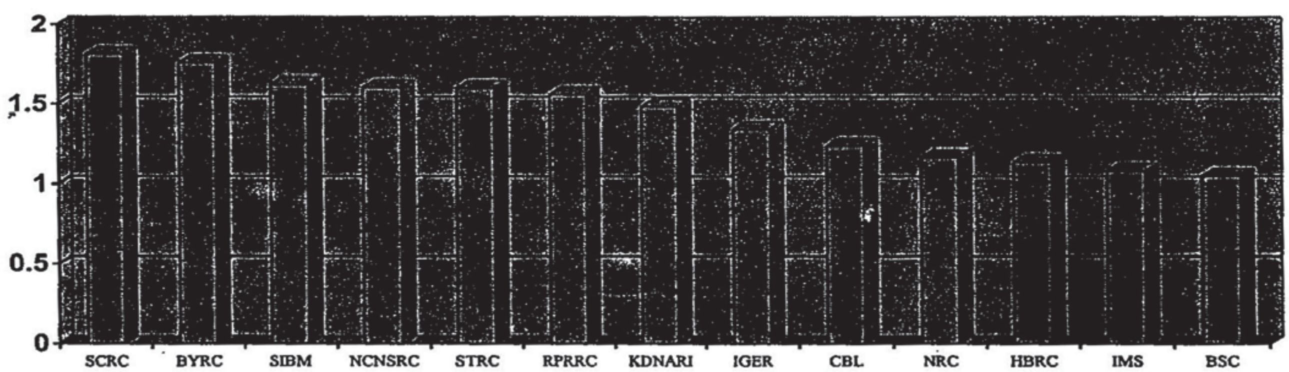


Figure 16, Bar chart of mean axial integration values of research centres arranged in a descending order

Table 5 represents the minimum, mean and maximum integration of the different research centres with the base difference factor between calculated.

Research Centre	Axial Integration			Base Difference Factor[9]
	Min.	Mean	Max.	
NRC	.645	1.169	1.829	.7992
HBRC	.55	1.137	2.2	.7
NCNSRC	.75	2.015	6.429	.23
IGER	.748	1.345	2.48	.73
SCRC	1.002	1.813	3.503	.70
CBL	.582	1.24	2.299	.70
IMS	.645	1.082	2.017	.74
BSC	.716	1.051	1.716	.84
SIBM	.87	1.623	3.291	.66
RPRRC	.987	1.562	3.203	.73
KDNARI	.673	1.485	1.927	.80
STRC	.794	1.6	4.248	.47
BYRC	.75	1.76	3.214	.64

Table 5, The base difference factor of research centres

Since NCNSRC and STRC have a low difference factor - which are underlined - than the rest of the sample then it shows they are different in their genotype. Those centres will be kept compared to each other as they constitute very simple ordered plans.

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[9] Base difference factor is the difference factor for the minimum, maximum and mean integration values in the complex, and thus gives some indication of how much differentiation is available in that complex, which may or may not be taken up by the various functions. It is calculated by the formula

H= -Sum [a/t* ln (a/t)] + [b/t ln (b/t)] + [c/t * ln (c/t)]

$$H = -\mathrm{Sum}\,[a/t \cdot \ln(a/t)] + [b/t \ln(b/t)] + [c/t \cdot \ln(c/t)]$$

where a=min, b=mean, c=max and t=a+b+c.

Base Difference Factor= $\frac{H - \ln 2}{\ln 3 - \ln 2}$

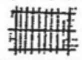
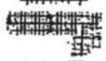
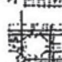
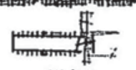
Axial Map of Research Centre	Name of Research Centre	Mean Axial Integration
	SCRC (UK)	1.813
	BYRC (Japan)	1.76
	SIBM (USA)	1.623
	RPRRC (USA)	1.562
	KDNARI (Japan)	1.485
	IGER (Egypt)	1.345
	CBL (UK)	1.24
	NRC (Egypt)	1.169
	HBRC (Egypt)	1.137
	IMS (UK)	1.082
	BSC (USA)	1.051

Table 6, Ranking of floor plans according to mean integration values after removing plans of different genotypes

Symmetrical Plans:

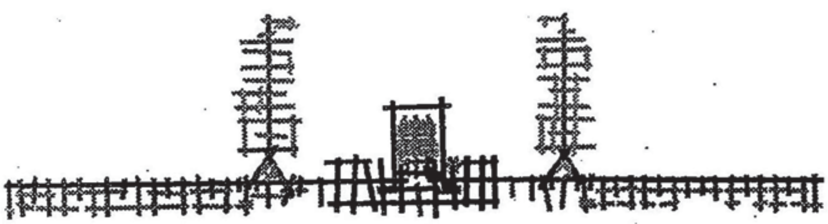
By examining the plans in **table 6**, it can be noticed that the ones with high mean integration values are unique plans with no mirrored or repeated parts. It can also be noticed that the ones with low mean integration values are spatially symmetrical plans mirrored around an axis.

It can be concluded from this part of research that symmetry of plans or repeating parts of plans in order to enlarge them- a trick that architects always practice- dramatically reduces the mean integration value of the plan *if* the mirrored part is not well connected to the other part. It also gives rise to notions of territoriality in the use of the plan.

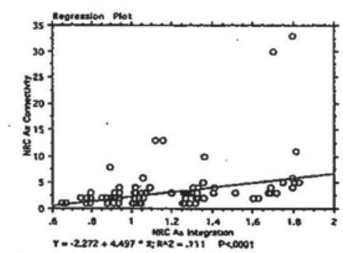
'he following part argues through mean integration and intelligibility values of ·lans that symmetric plans that are not well linked are worse in promoting ommunication among users of same floor, than in promoting communication mong users of different floors. This is because floors get connected by several 'ertical linking facilities like stairs, lifts or escalators especially if the plan is large, ›ut wings of large plans like the ones in the sample get sometimes connected with ›ne link like in the NRC and the BSC plan.

'he following part quantitatively argues against repeating parts of plans or nirroring them without well linking them. This is argued by measuring mean ntegration values and intelligibility values of these architectural plans in their nirrored and single cases and comparing them.

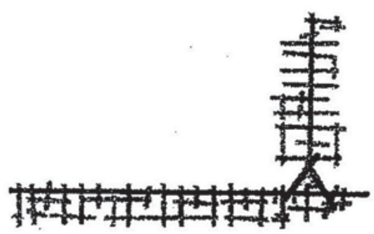
Che NRC plan:



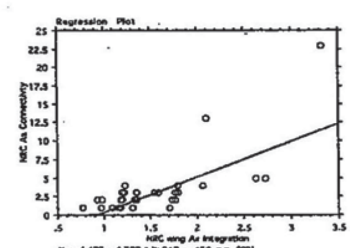
Mean axial integration: 1.169
Figure 17a Axial Integration core of
First floor plan of NRC



R-squared = **.111**
Figure 17b
Intelligibility of first
floor plan of NRC

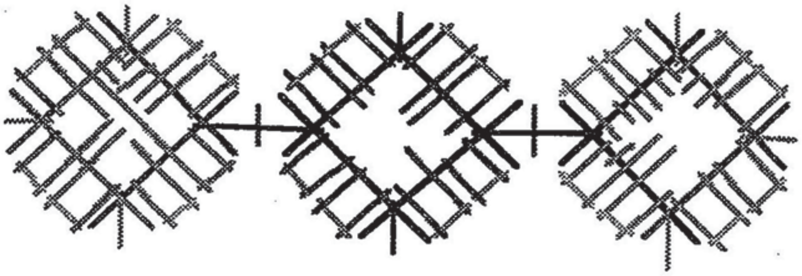


Mean axial integration: 1.509
Figure 18a Axial integration core of
One wing of the NRC floor plan

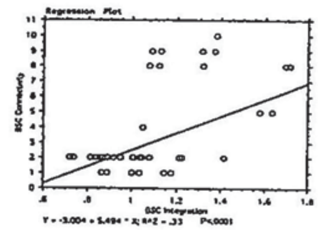


R-squared = **.469**
Figure 18b
Intelligibility of one
wing of the NRC floor
plan

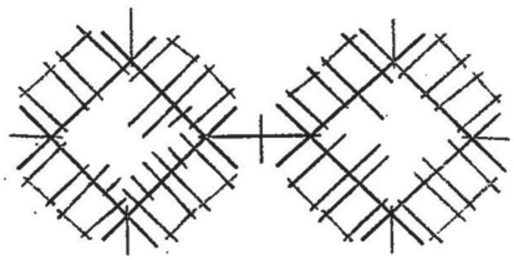
The BSC plan:



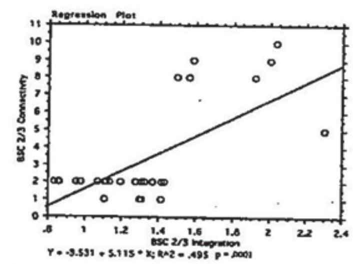
Mean axial integration: 1.051
Figure 19a Axial integration core of BSC floor plan



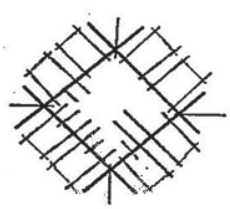
R-squared = **.33**
Figure 19b
Intelligibility of
BSC floor plan



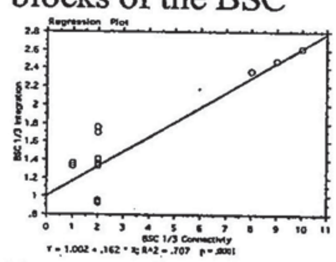
Mean axial integration 1.225
Figure 20a Axial integration core of two blocks of the BSC floor plan



R-squared = **.495**
Figure 20b of
Intelligibility of two blocks of the BSC

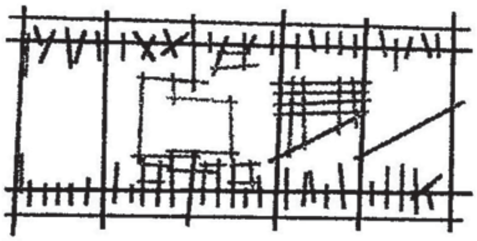


Mean axial integration: 1.434
Figure 21a Axial integration core of a single block of the BSC floor plan

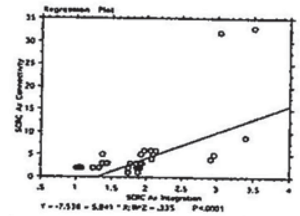


R-squared = **.707**
Figure 21b
Intelligibility of
a single block of the BSC floor plan

The SCRC plan:

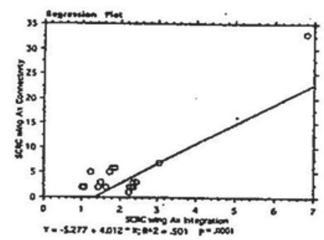


Mean axial integration: 1.813
Figure 22a Axial integration core of ground floor plan of SCRC



R-squared = **.335**
Figure 22b
Intelligibility of ground floor plan of SCRC

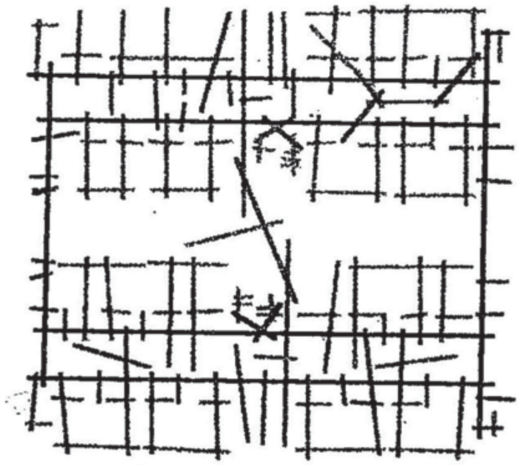
Mean axial integration: 2.106
Figure 23a Axial integration core of ½ of the ground floor of SCRC plan

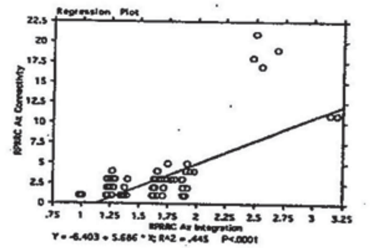


R-squared = **.501**
Figure 23b
Intelligibility of ½ ground floor of SCRC

Although the previous cases show that mirroring of plans without well linking the mirrored parts can be disadvantageous but also there are cases where mirroring as well as well linking plans can be advantageous. The plan of the RPRRC is such a case. **Figures 24a&b & 25a&b** are examples of this case where integration value and intelligibility value are higher in the full plan and lower in the divided plan.

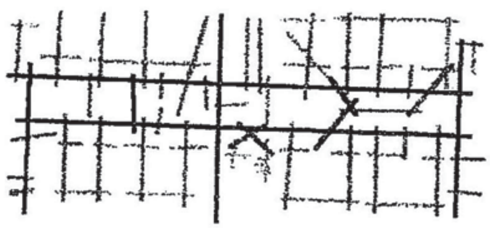
The RPRRC plan:

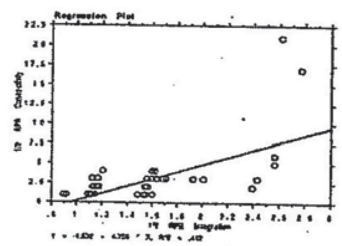




Mean axial integration: 1.562
Figure 24a Axial integration core of the second floor of RPRRC

R-squared= **.445**
Figure 24b Intelligibility of the second floor of RPRRC





Mean axial integration: 1.484
Figure 25a Axial integration core of ½ of second floor of RPRRC

R-squared= **.412**
Figure 25b Intelligibility of ½ second floor of RPRRC

Research Centre	Axial Integration 10	Intelligibility 5 (R-squared)	Score 15
NRC (Egypt)	6.45 1.169	1 .111	7.45
HBRC (Egypt)	6.27 1.137	1.97 .218	8.24
IGER (Egypt)	7.41 1.345	4.89 .54	12.3
SCRC (UK)	10 1.679	3.03 .335	13.03
CBL (UK)	6.69 1.24	3.1 .342	9.79
IMS (UK)	5.96 1.082	2.12 .424	8.08
BSC (USA)	5.79 1.051	2.99 .33	8.78
SIBM (USA)	8.95 1.623	2.3 .254	11.25
RPRRC (USA)	8.61 1.562	4.03 .445	12.64
KDNARI (Japan)	8.19 1.485	5 .552	13.19

Table 7a

Research Centre	Mean Integration 10	Intelligibility 5 (R-squared)	Score 15
NCNSRC (Egypt)	9.12 1.606	4.6 .882	13.72
STRC (Japan)	9.09 1.6	4.17 .803	13.26
BYRC (Japan)	10 1.76	5 .962	15

Table 7b

Tables 8a&b rank the research centres in a descending order of their spatial qualities which includes mean axial integration and intelligibility.

Research Centre	Score 15
KDNARI (Japan)	13.19
SCRC (UK)	13.03
RPRRC (USA)	12.64
IGER (Egypt)	12.3
SIBM (USA)	11.25
CBL (UK)	9.79
BSC (USA)	8.78
HBRC (Egypt)	8.24
IMS (Egypt)	8.08
NRC (Egypt)	7.45

Table 8a

Research Centre	Score 15
BYRC (Japan)	15
NCNSRC (Egypt)	13.72
STRC (Japan)	13.26

Table 8b

In review of the existing facilities, research centres were classified in terms of availability of facilities that aid in communication, these are aligned vertically on the left hand side of **table 9a**, where the highest represent the research centres with **better facilities** for communication and the lowest vertically represent the least in facilities that aid in communication. In the spatial analyses, the research centres were classified in terms of their spatial qualities that aid in communication. **Mean integration** was considered as a main factor, as well as intelligibility. Three research centres, **STRC (Japan), BYRC (Japan)** and **NCNSRC (Egypt)** proved to be different in their genotype than the other centres as they are very simple plans and lack structure in their design which resulted in a great variation between their base difference factors of integration values. Those research centres were classified among each other in **table 9b**. In tables **9a&b** the centres marked by **** contain the best facilities and are **generative** building models and consequently are the best research centres that aid in communication of researchers of the sample. The centres marked by *** have good meeting facilities but are **conservative** building models which means that the facilities are there to be used as a result of managerial policies rather than being generated by the architectural plan. The centres marked by ** are **generative** building models but lack facilities that aid in the increase of communication through meetings. The centres marked by * are the worst cases: they lack facilities that aid in communication and they are **conservative** building models.

Facilities		Spatial Qualities
SIBM (USA)****	+ve	KDNARI (Japan)****
BSC (USA)***		SCRC (UK)****
RPRRC (USA)****		RPRRC (USA)****
SCRC (UK)****		IGER (Egypt)**
NRC (Egypt)***		SIBM (USA)****
KDNARI (Japan)****		CBL (UK)**
IGER (Egypt)**		BSC (USA)***
HBRC (Egypt)*		HBRC (Egypt)*
IMS (UK)*		IMS (UK)*
CBL (UK)**	-ve	NRC (Egypt)***

Table 9a Classification of research centres according to availability of facilities and spatial qualities

Facilities		Spatial Qualities
STRC(Japan)****	+ve	BYRC (Japan)****
BYRC(Japan)****		NCNSRC (Egypt)***
NCNSRC (Egypt)***		STRC(Japan)****
	-ve	

Table 9b Classification of the three research centres of different genotypes

****** = good facilities + generative spatial qualities**
***** = good facilities + conservative spatial qualities**
**** = less facilities + generative spatial qualities**
*** = less facilities + conservative spatial qualities**

Summary

This paper attempted to make an evaluation of an international sample of research laboratories according to the presence or absence of architectural facilities that facilitate communication in research laboratories. It also attempted to take into consideration spatial variables that have an effect on social interaction in those buildings.

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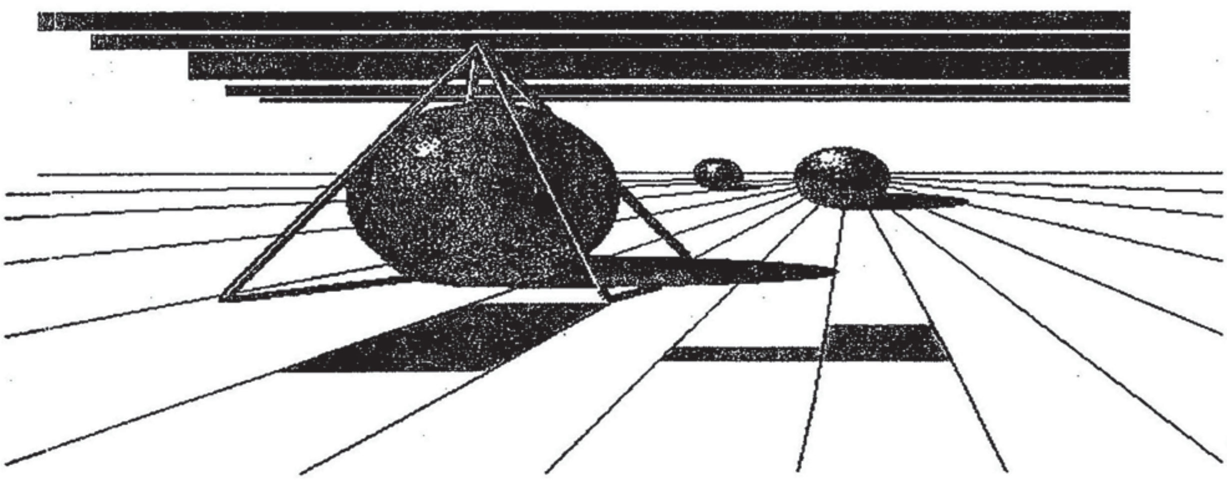

النشرة العلمية

الجزء الأول

هندسة معمارية ومدنية