ORGANISATIONS AS MULTI - LAYERED NETWORKS

face to face, e-mail and telephone interaction in the workplace

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0 Abstract

This paper investigates face to face, e-mail and telephone communications among staff in the work environment and their relations to the spatial layout and management aspects of organisations. In particular, the study analyses the London-based corporation Wolff Olins. Space Syntax techniques and observation methods are employed to study the building's layout and physical interactions. Network analysis methods and NetMap software are used for the analysis of e-mail and telephone logs. It is the aim of this study to bring all three communication forms in the work environment together and understand the mechanisms that underly their emergence and their relationship to organisational culture.

It has been proposed that emergent technologies such as the internet, have contributed to new forms of interaction among staff which are important in forming the organisational culture. Previous studies have shown the significant effect space has on people's movement and face to face interactions. Here it is suggested that although electronic communications take place in a non physical configuration, physical space has an important impact on the generation and practice of e-mail and telephone communication, together with managerial aspects such as type of job and seniority. The analysis shows that internally in the organisation, e-mail and telephone communications can overcome spatial isolation but, it is argued, only under specific conditions: when management tasks require staff to communicate and when difference in status in the organisation between interacting parties, is not significant. However, people of less seniority and whose job type is less colaborative, benefit the least from electronic and telephone communications internally. This is exacerbated if they are also spatially isolated. However for these staff, e-mail is to provide a powerful means for maintaining networks external to the organisation.

1 Communications in the contemporary work environment

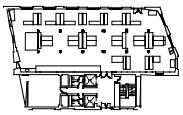
The workplace is changing quite dramatically. Globalisation, rapid changes in the business environment and emerging technologies are forcing contemporary organisations to adopt management structures which can respond more quickly and effectively to innovation and change. According to Morgan, one of the major challenges facing many modern organisations is to replace the mechanistic mode of thought that has applied since Taylor and Scientific management, with fresh ideas and approaches [Morgan, 1995].

Recently, we have witnessed ways of working that some years ago few could have imagined; teleworking, hotdesking, hotelling, roaming, desksharing, even virtual or-

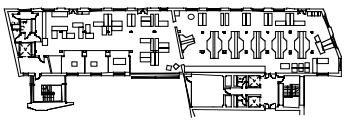
ganisations. Although it is not the purpose of the present paper to analyse the innovations these new ways of working have brought to corporate life, the importance of their existence should be emphasised since they are put into practice partly because new technologies can sustain them. Perhaps the most influential among new technologies has been cyberspace, which, according to Kitchin consists of the internet, the Intranets and virtual reality [Kitchin, 1998]. Most organisations in developed countries have already adopted the internet and the services it provides such as e-mail . Kitchin suggests that cyberspace is changing the basis of communications and that *emerging technologies do more than just simulate traditional forms of communication - they also provide new means of interaction* [Kitchin, 1998].

It is understood that new technologies in general, are not and will not always underlie new ways of working. According to some critics, traditional forms of working will still exist in the future together with those implemented by technological advancement. *New office buildings need a very strong identity and social focus, a robust infrastructure and adaptability. ..Some office buildings of the future will be extremely dependent on management and technology; the rest will be in more domestic, naturally ventilated buildings* [*Aldous, 1998*].

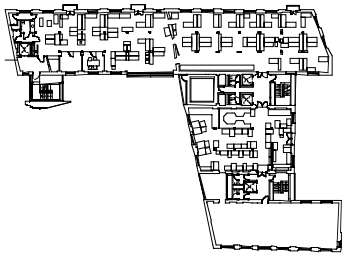
Figure 1. Wolff Olins plans



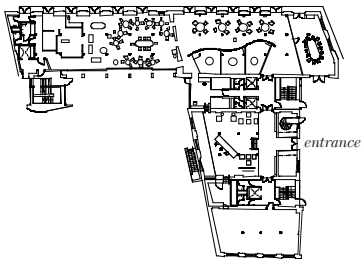
Third floor: project managers and accounts



Second floor: mainly consultants



First floor: mainly designers and studio department



Ground floor: reception, restaurant, post room and meeting rooms

It is within this framework that the present paper focuses on the investigation of both physical and virtual communications among the staff of a corporate image management business, Wolff Olins. The aim is to understand the mechanisms that underlie communication forms. Previous studies have shown that space plays a powerful role in the way staff uses the office space and communicate within it [Penn, 1995]. This paper will look at office communications with a more holistic approach and examine both physical and virtual communications. It will also concentrate on different communication forms according to the job type and seniority in the organisation which, together with space, play a vital role in forming communication patterns.

The study is presented in five parts:
- the discription of the organisation and its management structure,
- the observations of space use to analyse physical interactions between staff,
- the spatial analysis to understand the properties of the building's layout,
- the e-mail and telephone analysis to establish virtual communication patterns either among staff or between staff and the outside world, and
- the discussion which summerises the findings of the study.

2 Introduction to the study and the organisation

The study of Wolff Olins initiated in March 1998 as part of a Space Syntax Laboratory project. Spatial analysis and observations were conducted during that period followed by a report which described the building's space use and configurational analysis [Penn A, Spiliopoulou G, Karimi K, March 1998, Wolff Olins Space Use Study, Space Syntax Laboratory]. The study was then continued and extended as part of the author's Phd research. During the summer 1998 additional data were added to our database concerning the management structure of the organisation,

human resources, individuals locations and the e-mail and telephone logs. In October 1998, a collaboration with City University Business School and Alta Analytics Limited allowed us to use Netmap software for the analysis of the e-mail networks[1].
Wolff Olins is a leading company in the field of corporate image management. In his book, "The New Guide to Identity", the founder of the company, Wally Olins, describes the company's services: "*The totality of the way the organisation presents itself can be called its identity...Identity management can be defined as the explicit management of all the ways in which the organisation presents ifself to all of its audiences*" [The new guide to identity, the Design Council, 1995].

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Located in London, near Kings Cross, at the time of the study the company employed approximately 160 people and occupied 4 floors of its premises (figure 1). The work undertaken by WO is project-based with the length of each project varying from 6 months to 3 years, or more. Designated teams are assembled to work on each project with the intention to keep the same team running for the whole length of the project. There are 10 distinct departments operating in the company under a matrix management system:

Consultants: Are the "thinkers" and in charge of the project. They are the primary link to the client and responsible for delivery to the client of what has been agreed. They are located mainly on the second floor and number 34 members of staff.
Designers: Are responsible for the design aspects of the project, when this is design-driven. Their role is to generate design ideas. There are 57 designers in the company and all sit on the first floor.
Studio: Comprising of graphic designers, art workers, 3d modelers, animators, programmers and IT support, this department creates visualisations of the designers' ideas. They occupy a room on the first floor and number 22 people.
Market Services: There are seven people in this department located on the second floor. They deal with market research and presentations.
Project Managers: Are the project co-ordinators. They keep the team together, arrange meetings and make sure that deadlines are met. They occupy the third floor and number 16 members of staff.
Accounts: Are responsible for the financial part of the project: billing, invoices etc. They sit with project managers on the third floor and number five people.
Head Honchos: This department incorporates the most senior people in the organisation including the founder, the chief executive and their personal assistants. Two of them have desks on the first floor and the remaining six, on the second.
Reception: Sitting at the reception desk nearby the main entrance, three people deal with the switchboard, incoming clients, appointments and deliveries.
Facilities: Consisting of only two people, the facilities manager and an assistant, the former has a desk on the second floor and the latter on the ground close to the reception.
Kitchen: Wolff Olins has a restaurant-cafe located deep on the ground floor with three people as permanent staff. Due to the peculiarity of their job they have been excluded from the analysis.

In Wolff Olins departments occupy a designated area which is not however within

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strict spatial boundaries. Every member of staff has a permanent desk in an open plan area. No one is assigned a cellular office. The only exception is the video editor who, due to the nature of his work, sits in an enclosed room on the first floor. Although it is not possible to account for each department's importance in the organisation, it could be said with safety, that "Head Honchos" are regarded the most important since they are the most senior people and the heads of the different disciplines. Then follow consultants, based on the fact that their salary is almost double of the other departments. Designers and project managers depend very much on their seniority and their length of service in the company. Finally, the studio department is considered a production discipline; it is interesting to note that most of its members are called "macworkers".

3 Observations of Space Use

This section describes the observation methods applied to investigate space use and levels of physical interaction in Wolff Olins and discusses the main findings of the observation study. The observation survey of patterns of space use and movement was carried out in all accessible areas of all four floors[2] . The investigation focuses on

Figure 2. Stationary activity

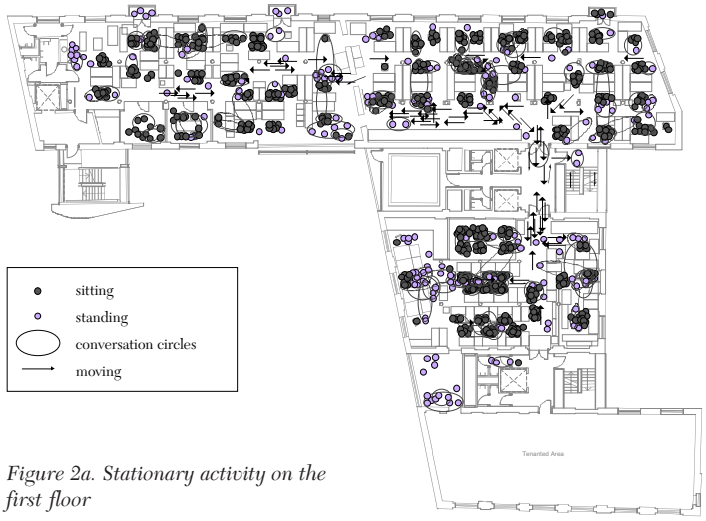

Figure 2a. Stationary activity on the first floor

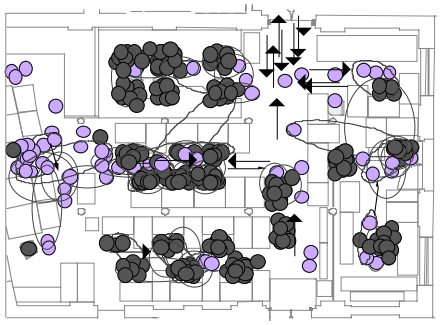

Figure 2b. Stationary activity in the studio department (detail of fig 2a)

Figure 3. Working activity

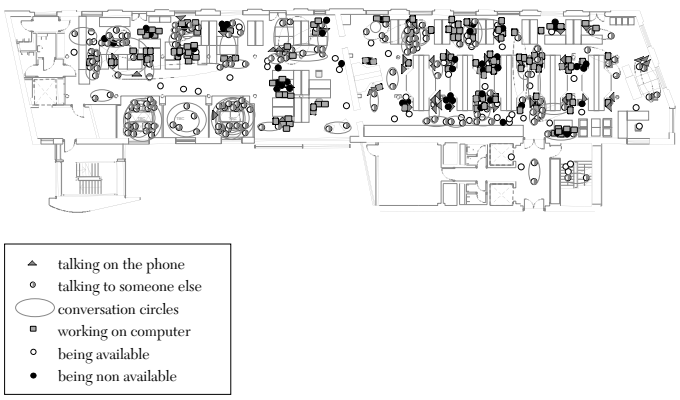

Figure 3a. Working activity on the second floor

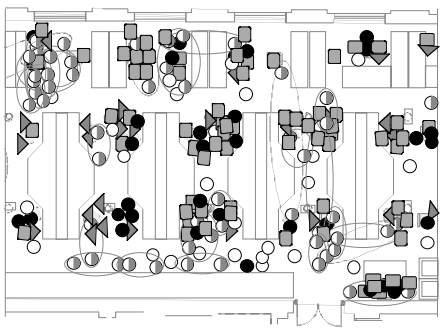

Figure 3b. Working activity in the Consultants' area (detail of fig 3a)

different levels of interaction within floors as well as between floors, leading to individual patterns of communication between the departments.

3.1 Observations of stationary and working activity

Two different patterns of activity have been observed; stationary activity (sitting, standing, talking, moving) and working activity (computer, phone, talking, available, non-available). The first set of data shows the degree of interaction (talking circles) and can reveal potential for interaction (standing and moving people). The second set of data adds to the first a more detail investigation of working patterns while double-checking levels of interaction. A sample of these observations is presented in figures 2 and 3 .

The third floor has the highest proportion of sitting people (76%) and the lowest movement (8%). At the same time, this floor being the smallest and at the top, is the most isolated floor. Although the nature of the work (project managers and accounts) would suggest that movement is essential to meet the other members of the team, given the results from the working activity it seems that interaction takes place primarily through telephones and computers. This floor presents the lowest proportion of talking people (21%) and the highest of computer (45.5%) and telephone users (13%). People here work mostly alone and their location in the building prevents them from interacting and socialising.

The second floor presents the lowest proportion of seated people (72.5%) and at the same time the highest proportion of movement (10%) apart from the ground floor which is not a working floor in any case. Talking to other people seems to be a significant activity (39%), the highest of all floors, while computer activity drops to only 28,5%, the lowest of all. Given this floor's location in the middle of the three working floors, and analysing it as a separate system, the second floor is easily accessible from the two other working floors. This can also be seen from the movement observations where the greatest number of people were observed to visit the second floor (table 1).

The first floor, compared to the other two working floors, presents medium percentages in sitting, moving, talking and computer activity, low telephone activity and a significantly higher proportion of standing activity. These observations may be justified by the nature of the work (designers-production). Nevertheless, it is interesting to point out the difference between the designers and the production department. We have suggested elsewhere that the ratio of standing to sitting [Penn, 1995], shows the "visiting" ratio for each area. If we take the visiting ratio for production and designers separately, for the designers it is 0.22 while for the production (studio department) it is 0.34. Previous studies in similar organisations have shown that the average visiting ratio was around 0.25. In company X, which is an advertising agency, the visiting ratio for the production floor was 0.30 (including cellular spaces). In WO, the visiting ratio for the studio department is the highest observed. Even if we exclude the cellular room in the studio area it still remains relatively high, at 0.29 (table 2).

floors	using stairs	using elevators	total
3rd	*33*	*10*	*43*
2nd	*78*	*19*	*97*
1st	*67*	*17*	*84*

Table 1. Observed numbers of people arriving or leaving each floor using the stairs and the elevators

floors	WO	Co X	Co Y
4th		*0.23*	
3rd	*0.21*	*0.23*	
2nd	*0.24*	*0.31*	*0.27*
1st	*0.26*	*0.30*	*0.15*

Table 2. Visiting ratios for Wolff Olins and two advertising agencies

	people/desks	people/desks excl empty
3rd floor	0.528	0.604
2nd floor	0.706	0.812
1st floor	0.757	0.797

Table 3: occupancy ratios accounting for all workstations or excluding those found empty during observations

occupants		arrive + leave/h	ratio(arr+leave / occupants)
3rd	21	64.5	3.07
2nd	40	145.5	3.64
1st	75	126	1.68

Table 4. Number of observed people arriving and leaving each floor against the total number of occupants per floor

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Another important measure of space use is the occupancy ratio (occupants per workstation) which shows the intensity of occupation of the working areas. Low occupancy ratios have been found to be associated with reduced interaction between staff, while very high occupancy ratios can create problems for environmental quality in the workplace. According to our observations, the third floor presents a low occupancy ratio (table 3) which perhaps results in part from its isolation. Even if we exclude the number of workstations that were found to be vacant during the whole day of observations, assuming that either these workstations were not permanently occupied or that their occupants were absent on that day, the occupancy ratio for the 3rd floor remains constantly low. The same ratio for the studio department alone is the highest of all, at 0.824.

What seems to explain the high occupancy of the second floor, is not only that people remain within their working area most of the time, but that they are visited by people from the third floor. The ratio of the number of people working on each floor and the average number of people arriving and leaving the floor is presented in table 4. By comparing the ratio of table 4 to the occupancy ratio, it could be suggested that there is a significant flow of movement from people working on the third floor to the second floor and that those working on the first floor move primarily within their floor. It therefore seems that the building layout, rather than enabling people from different areas to be brought together, currently reproduces the management division among the staff. The isolation of project managers may contribute to a low degree of interaction among them and between them and the other employees. At the same time, to overcome isolation and their need to communicate and socialise, they tend to leave their floor and visit the second floor which is more active. This phenomenon may be emphasised due to the fact that consultants, who occupy the second floor, are considered to be amongst the most important people in the organisation. However, designers and the production department who occupy the first floor, seem to be left alone by consultants and project managers although their working floor, being highly integrated, enables them to interact with each other. The studio department appears not to mix with other disciplines apart from the designers which is exactly what might be expected from the nature of their work.

Figure 4. Movement traces

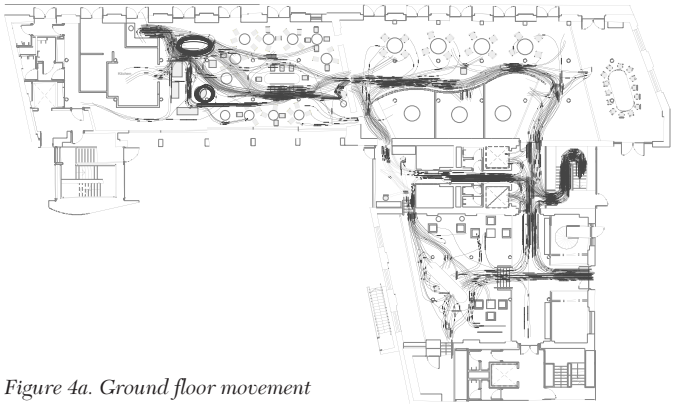

Figure 4a. Ground floor movement

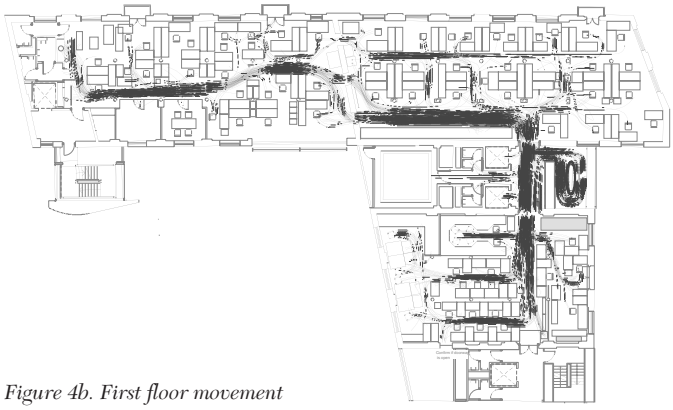

Figure 4b. First floor movement

for local journeys and excludes global movement. The greater proportion of people passing through this area prefer to take the most 'public' route to avoid the working areas. Conversations in the deep side of the plan seem to be concentrated in the most easily accessible areas. Services, which are located on the main corridor, attract a mixture of global and local movement. In the studio department, there is a significant amount of local movement, especially in the drawing board area. "Through" movement has not been observed since

the studio department is at the edge of the floor plate therefore people visit it for a specific reason, not by coincidence. The main flow of movement towards this area comes from the designers' area with the exception of movement from the stairs and elevators before and after lunch time which is most probably generated by the production staff themselves.

Figure 4c. Second floor movement

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The third floor is primarily a starting or an end point of journeys . It also presents a fair amount of local movement. The finance director, not surprisingly, seems to attract a lot of movement although he sits in the most segregated area. The end points of the movement traces and the lack of conversation circles from the snapshot observations suggests again that staff on the third floor primarily visit other floors rather than being visited. The location of the photocopiers on this floor, does not seem to encourage interaction between floors. Of the 33 people that have been observed to arrive at, or leave this floor using the stairs, only 12 of them visited the photocopy room without entering the working area. The rest seem to be the third floor staff.

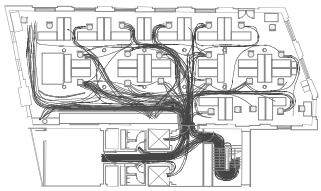

Figure 4d. Third floor movement

4 Space Syntax Analysis of the building's layout

The spatial configuration of Wolff Olins has been analysed mainly using the all-line technique. All-line maps are computer-generated models of spatial configurations. Given the floor plate layout, the computer first draws all the possible lines of movement and sight and then calculates all the connections between each line and all the other lines in the system. This allows us to measure the complexity of routes from each space to all others in a building and to define a measure of accessibility which in Space Syntax terms is called 'integration'. Visually, integration follows the hot to cold colour coding, from dark (highly integrated) to light greys (highly segregated). Previous research has found that all-line maps are good predictors of movement within buildings [Penn, 1995]. In some cases, we have found, a more local measure is a better predictor of movement. This is a measure of "local integration" that takes into account only the neighbour lines in the system, usually up to three changes of direction from every line.

The all-line technique has been applied in two different ways: firstly, each floor has been analysed independently; secondly, all floors have been treated as a system of floors connected via the staircase. Whereas the former method reveals the characteristics of each floor as an individual spatial system, the latter investigates the configuration of the whole building as one system.

4.1 All-line axial analysis

The ground floor analysed on its own, both globally and locally presents highly integrated lines of sight and access which cross the meeting area and enter the restaurant. The entrance and the reception area are relatively segregated globally but gain integration locally. When embedded in the whole building, the ground floor is globally segregated due to its location at the "edge" of the system. However,it presents the most locally integrated lines within the restaurant and the meeting areas as well as in the reception area. (figures 5 and 6)

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On the first floor, integration shifts towards the central core (lifts and staircases). When analysed as part of the entire configuration, the first floor is the most integrated floor globally. This is a result of its central location in the system as well as an outcome mean Rn (global) /neigh. mean R3 (local)] forms the basis of the analysis. When plotting overall movement against global and local integration, we find a very weak relationship (figure 7). However, the positive trend suggests that what appears to be an insignificant correlation might be the result of a different behaviour of different floors, with some performing more locally while others perform more globally, as well as an effect of the central core of staircases and lifts. This is investigated in this section.

On the ground floor, overall movement does not seem to correlate with integration. This is mainly a result of the restaurant that presents high flows of movement during lunch time, but only then. If we exclude the restaurant, the lifts and the large meeting room which attracts only programmed movement, the correlation becomes very strong. By excluding also the lunch time period r^2 becomes 0.85 (figure 8).

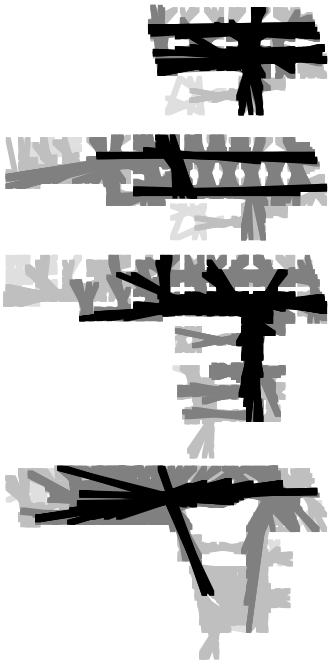


Figure 5. All-line integration maps for individual floors

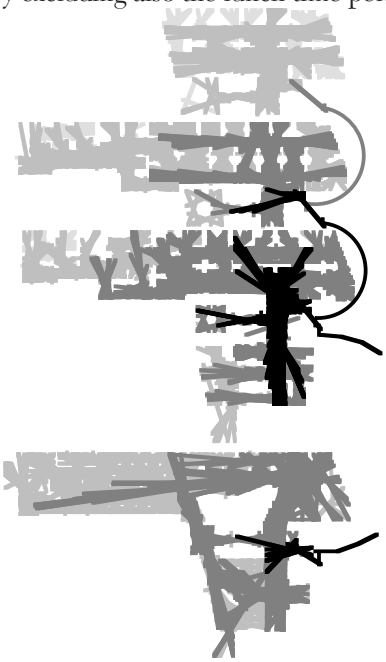


Figure 6a. All-line global integration map for connected floors

Figure 6b. All-line local integration map for connected floors

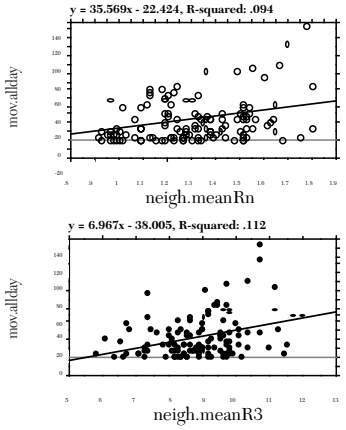


Figure 7. Overall movement against global and local integration for the whole building

On the first floor, local integration seems to correlate better than global (figure 9). 10a). However, good correlations are found when main routes are analysed on their own (figure 10b). Similarly, the rest of the building presents a fairly good relationship between movement and integration (figure 10c). This seems to be the cause of major flows of movement which cannot find the spatially appropriate route, and therefore create a different pattern from the rest of the plan. As discussed earlier, the second floor has been found to be highly visited from the third floor and this might contribute to two different patterns of movement (global and local), separated from each other.The third floor seems to create yet another pattern of interaction between movement and spatial structure. Movement correlates well with global integration either as a separate floor or embedded in the whole building. Few gates have been excluded in scatters 11b and 11c; the main entrance , the fax machine and the elevator in the case of 11b with the additional exclusion of the central core in 11c.

Summarising, each floor presents a different pattern of movement and space use. The segregation and small size of the third floor minimise interaction between its occupants and drive them to visit the floor below. As a result, two different patterns of movement are being generated on the second floor: a global network consisting of the main circulation routes which both occupants and visitors use, and a local network of more segregated routes used only by the occupants of the floor. The second floor's central and well integrated location in the middle of the three working floors results in keeping its occupants within the limits of their area and make their space the most active in the building. Having consultants and project managers interacting with each other, designers and the studio department are left alone. Since the first floor is highly integrated, it can sustain interactions among its occupants without one having to visit other areas to socialise. However, the spatial separation of the north and south part of the first floor, creates two separate patterns of space use, the "designers" pattern and the "studio's" pattern, sustaining as such the management division in the organisation.

Figure 8. Movement against global integration on the ground floor

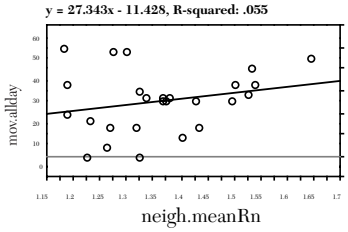


Figure 8a. Movement against global integration when all gates are included

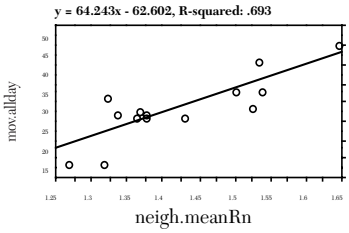


Figure 8b. The restaurant, the big meeting room and the lifts are excluded

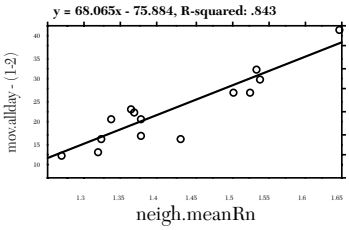


Figure 8c. As fig 8b, omitting the lunch time period

Figure 9. Movement against local integration on the first floor

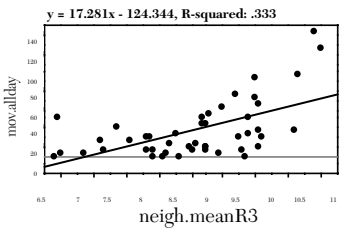


Figure 9a. Movement against local integration when all gates are included

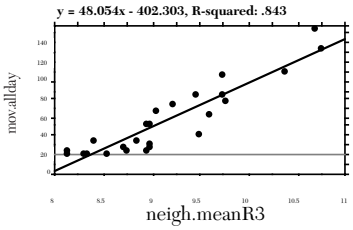


Figure 9b. When only the north part is included (designers) omitting gates at the end of long-integrated lines or near facilities in segregated areas eg coffee area

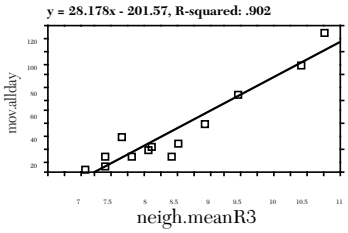


Figure 9c. When only the south part is included (studio) omitting gates in deep areas where long lines penetrate.

So far we have investigated movement, space use and face to face interaction patterns, resulting primarily from the spatial configuration of the organisation. In the next section we analyse the interaction patterns through electronic and telephone communications.

5 Electronic Communications

The investigation of e-mails aims to examine the ways in which different disciplines interact. The detail of the data allows us to examine electronic communications in more detail than physical interactions. Each person is treated as a member of his/her's department, as senior or junior and as a person occupying a specific location in the building's layout. This allows us to investigate whether the electronic communi-

Figure 10. Movement against global integration on the second floor

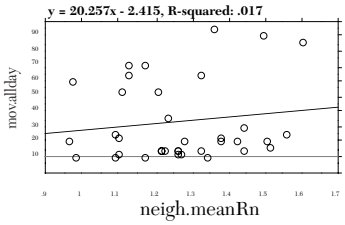


Figure 10a. Movement against global integration when all gates are included

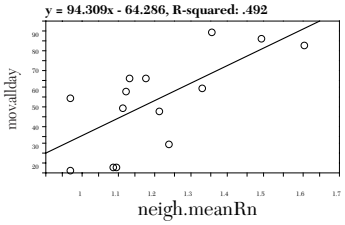


Figure 10b. When only gates on the main circulation route are included

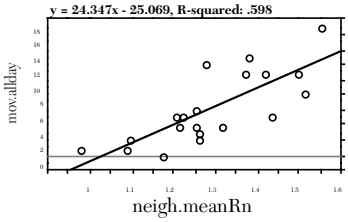


Figure 10c. When all gates on the main circulation route are excluded

A1.10

cations are related to the type of job, seniority and spatial location. This analysis has been carried out using a combination of statistical analysis and NetMap software. NetMap is a network analysis tool which allows the visualisation of networks in the form of nodes and links. One of its properties is that it can automatically analyse the emergence of groups, by isolating groups of nodes that share more linkages with each other than they do with nodes outside the group[4] . This is a useful tool for organisational analysis since it can reveal informal communication groups within the company. Apart from the main network which is represented as a circle with the nodes at the periphery and the links connecting the nodes (figure 16), Netmap can group nodes according to shared properties, eg departments, in the form of satellites detached from the main network and show the interdepartmental relationships.

Figure 11. Movement against global integration on the third floor

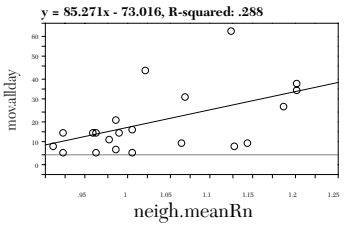


Figure 11a. Movement against global integration for the third floor embedded

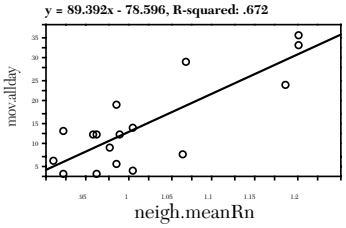


Figure 11b. As fig 11a, three gates have been excluded

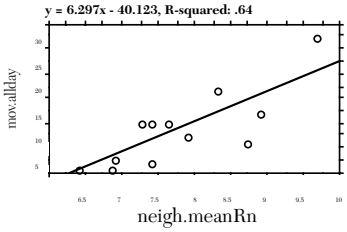


Figure 11c. Movement against global integration when analysed on its own

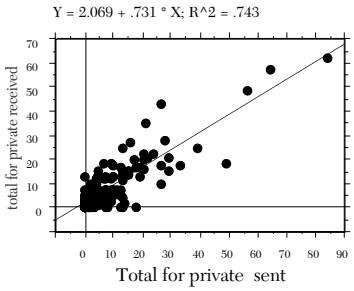
First we present the e-mail data and its statistical analysis. For consistency, the compiled data represents the same time period as the observations. For the e-mail analysis the logs from four working days

A1.11

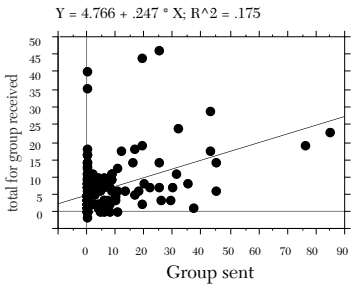
data. In the case of private communications, out of the 144 people involved, 28 people did not sent any e-mail (while they received 81 messages in total), and 13 people did not receive any messages (although they sent 71 in total) during the four day period. The average number of outgoing messages within this network is 2.89 per person while the average number of private incoming internal messages is double, at 5.46 per person.

A1.12

In the case of group-internal communications, 165 people were found to be involved. Hence 21 people received or sent only group messages. With two exeptions who were senders of group messages, all others were just receivers. The two exeptions were a trainee consultant who sent 8 group messages and did not have any other kind of e-mail interaction and the founder's personal assistant who did not have any private communication but an active group interaction. All others who only received group messages seem not to share any common characteristic; some are senior like the chairman, others of medium seniority and others juniors in the company. They also belong to different departments. Of these people the largest number of incoming e-mails were for the head of Consultancy (18 messages) and for the chairman (16 messages). Overall, 60% of the staff were found not to have sent any group messages and 11% not to have received any group messages. The latter were mostly junior members of staff, while the greatest number of them sit on the main corridor of their designated area. Although this may imply a spatial attribute, it is suggested that most importantly their location is a result of their lack of seniority rather than their lack of group communications being a result of their location. Note that we did not have location information for four out of these seventeen people.

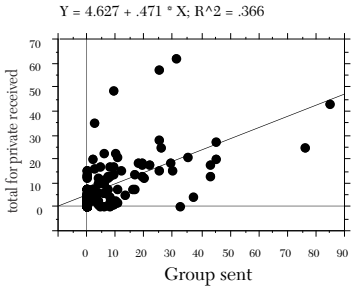


Scatter 1



Scatter 2

With regards to private communications there is a straightforward relationship between the number of e-mails each member of staff sends and the number of e-mails they receive (scatter 1, figure 12). This relationship is almost insignificant when group communications are plotted, excluding private messages (scatter 2, figure 12). There is also a positive trend to receive messages when one sends; this can be seen in scatter 3 where group senders are plotted against the number of private messages they received (scatter 3, figure 12). It seems that there is no such rigid threshold as to "how many e-mails one has to receive in order to send " or vice versa. People who never sent a private e-mail, received from none to five messages while people who sent more than two messages usually received at least one.



Scatter 3

Figure 12: scattergrams showing the relationship between sent and received e-mail messages for both private internal network and group internal network.

The IT support person, sent and received the greatest amount of private messages (sent 84, received 62). Then follows the video-producer, the project accounts/billing person, an IT programmer, a project manager and the reception desk. The founder does not have an e-mail address. The chairman as mentioned earlier, did not send or receive any private messages but did receive 16 group messages. The executive creative director sent and received only 2 private messages, while he received 12 group messages. The client director sent 7 and received 6 private messages. The head of consultancy as mentioned earlier only received 18 group messages. The MD sent 18 private messages and received none. He did not send any group messages but received 35. Finally, the PA to the Chairman and the MD was found to be very active; she sent 13, received 15 private mails while she sent 25 additional group e-mails and received 46.

To summarise, senior people seem to receive proportionally a great number of group messages but do not usually send any. Their private communications are limited. In fact the relationship between private sent and private received messages is very strong only for less senior and junior staff.

If we look at the numbers of group-sent e-mails only, then the person who sent the greatest amount of this type of e-mails is the consultancy resource administrator with 85 group e-mails. Then follows the multimedia team project manager , a project manager and an IT support person, a consultant and one of the two personal assistants. The distribution of group e-mail senders is illustrated in figure 13.

5.3 External E-mail Networks

As in the case of internal electronic communications, two sets of data have been analysed, group and private. The peculiarity of external electronic communications is that Wolff Olin's server only records incoming external mails and consequently we do not have any information on outgoing external e-mails. In the group data we have excluded all bounced e-mails. In the private external data we have checked the logs to try and exclude automatically generated messages (listmaster, news, info etc). Figure 14 shows that the exclusion of automated mails does not change the data significally (r^2=0.931). For this reason, it was assumed that it was based on good grounds and was used for the analysis of the private external network.

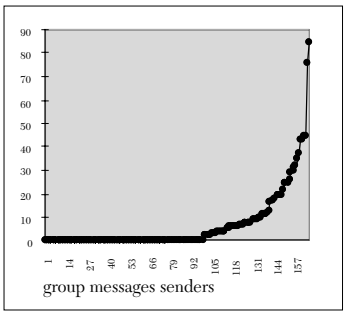


Figure 13. Distribution of group-sent e-mail messages

From the second set, it was found that the person who received the largest amount of external e-mails is a junior multimedia designer (64 messages). This person had only received 3 internal private messages and one group message. Then follows the multimedia team project manager who received 51 external messages while she had received 8 private plus 12 group internal messages. The person who received the greatest number of internal messages, only received 10 external ones. The same applies for the next person on the list, who received 15 external messages only. In fact the relationship between the total number of private incoming external mails against the total number of private internal incoming messages is districtly L-shaped (r^2= 0.084, figure 15).

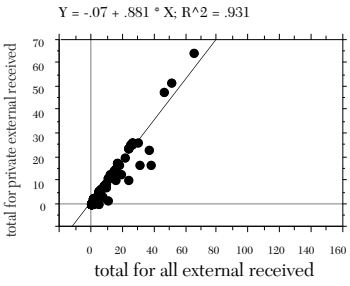


Figure 14. All incoming external e-mails against all incoming private external e-mails. Only one person who received 140 automated messages, has been excluded from this analysis

Based on the finding that people who send a fair amount of private e-mails receive proportionally a significant amount of messages, it could be argued that there is a very different mechanism between internal communications and external ones. Whether this phenomenon is related to individual or other characteristics, is yet to be investigated. However, it appears to be related to seniority. All people who received the greatest number of external mails were juniors or of medium seniority in the company. Some of these received a significant number of internal messages, others very few. The heads of departments that were found to receive a large number of internal messages, received very few or no external messages.

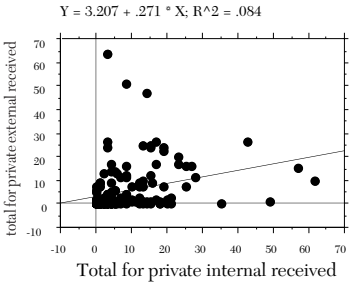


Figure 15. The relationship between the total number of incoming internal e-mails against the total number of incoming private external e-mails is bifurcated

The frequency distribution analysis for external received messages according to seniority, revealed that the most senior people only appeared in the first (0-6 messages) of ten intervals , the next senior people only into the first two intervals (0-13 messages) while people of medium seniority covered the first 8 intervals (up to 51 messages) and only the junior people in the company were found to have received the greatest

amount of external messages (up to 64 messages). The same analysis for internal received messages revealed that while the most senior people behave in the same way, for all others e-mail participation is more equally distributed.

5.4 NetMap Analysis

Figure 16 shows the visualisation of the private internal e-mail network, grouped by floor. The central circle shows communications between floors whereas the satellites, show communications within each floor. Table 5 summarises the degree of internal e-mail usage for each floor. According to the mean number of received and sent messages for each floor, it can be seen that on the third floor people use their e-mail 1.3 times more than those on the second floor and 2.14 times more than those on the first floor. The strongest links appear within the first floor and between the first floor and the third floor. This might compensate for the lack of face to face interaction between these two floors that was found in the observations. If we look closely at the number of messages sent and received on each floor, then we find that the greatest number of people on the first floor send the minimum number of messages while only half of the 3rd floor staff sends and receives the lowest range of messages (figure 17). It should be also noted that the third floor does not have any of the high users (those with more than 125 messages on their record). Therefore,proportionally, people on the third floor use their e-mail at a higher rate but more equally

	first floor	*second floor*	*third floor*
mean no of mails	19.65	31.73	42.00
people	81	41	22

Table 5. total number of internal e-mail exchange for each floor showing the degree ofusage.

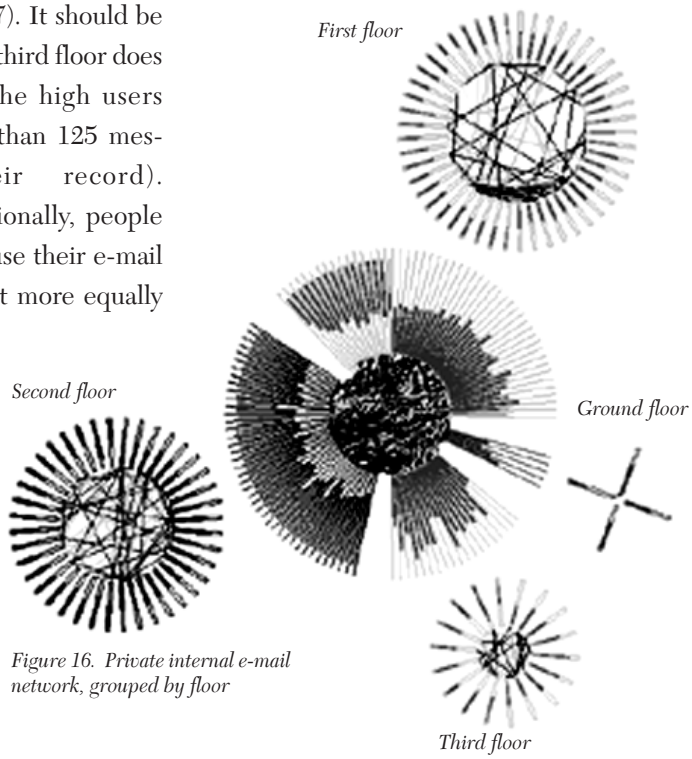


Figure 16. Private internal e-mail network, grouped by floor

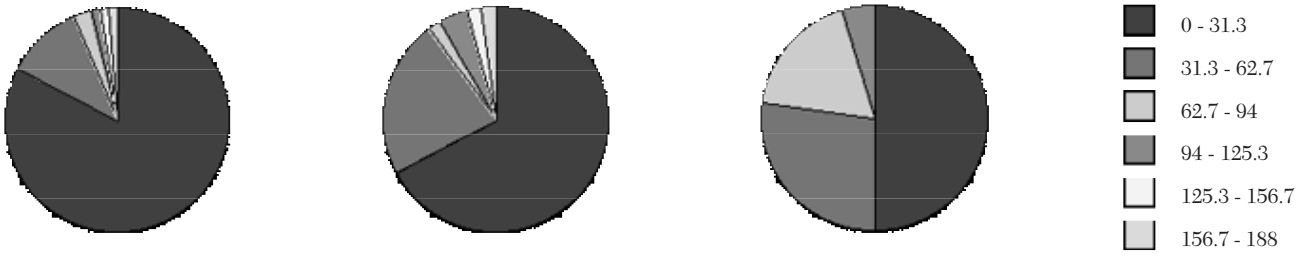


Figure 17. Frequency distribution for the total number of incoming and outgoing e-mail messages for each floor

distributed across staff while on the first floor there is a greater differentiation in e-mail usage: some do not use their e-mail at all, others use it more than anyone in the organisation. While this observation may be a result of numbers on the floors (more people, more chances for different behaviour) it could be argued that it is also a spatial result in the use of e-mail to overcome isolation, or related to the management task of those on the third floor.

The analysis of all private internal e-mails does not reveal the emergence of any groups. By defining the minimum number of links as 4 (at least one e-mail per day) and the minimum number of connected nodes as 2 (this person must at least talk to two other people within the company) then certain groups emerge (figure 18). In the first group people come from five different departments (designers, studio, project managers, consultants and accounts) but share a common spatial characteristic; they all sit in accessible areas. None sits on the edges and none are from the back part of the first floor, while the three people from the second floor that sit at the back side, all sit in the most integrated area with immediate access from the front side. If we take the mean global and local integration values of the neighbour lines of their locations , we find that their mean global integration is 4.11% greater than the average for all the other people in the organisation, whereas their local integration value is 1.5% greater. The mean convex connectivity value[6] is 25.5% increased, the mean control value 32% , the global integration value 9.5% whereas the local integration is increased by 14% . Figure 19 shows the spatial location of the people participating in this emergent group and figure 20 the global integration convex map of the building. The second group consists of six people who locate themselves in the inner circle of the satellite, thus making the group emerge, and then a great number of people attached individually to some of them. Those responsible for the emergence of the group are project managers on the third floor, production and a designer on the first floor sitting in isolated locations. It therefore seems that in this case the group is

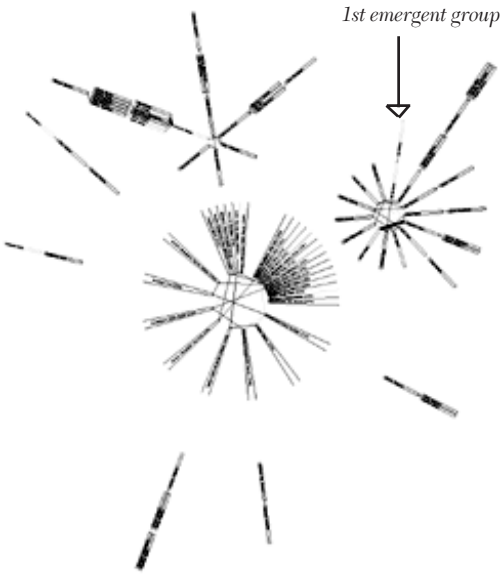


Figure 18. Emergent groups for minimum number of links 4 and minimum number of connected nodes 2.

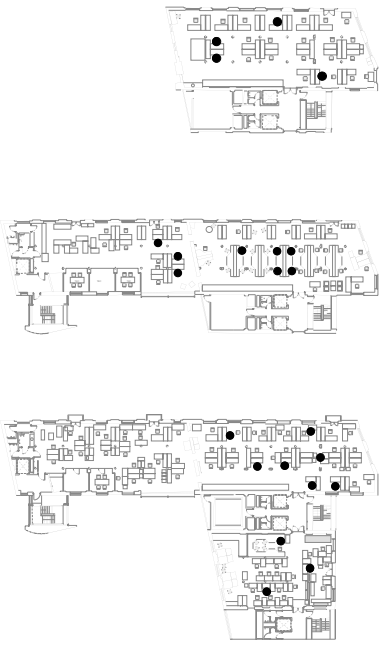


Figure 19. The location of people participating in the first emergent group (starting from the first floor on the bottom)

Figure 20. Global integration convex map for the entire building, including the ground floor.

A1.16

emerging either from the need to communicate to overcome their spatial isolation or is directly task related .

Finally, five smaller groups were found in which we have the following spatial characteristics: the first group consists of 5 people, four of which share, in pairs, the same desk and the fifth being in visual and permeable proximity to one of these pairs. Two other groups consist of two people each, where in both pairs, one person sits next to the entrance on the 2nd floor and the other person next to the entrance on the third floor. Another group is between three designers, one sitting at the front of the designers' area, the other one in the middle and the third one at the back. Finally, in the fifth group, one is a project manager on the third, the second a designer in the front side of the first floor and the third a production person, isolated in the studio area.

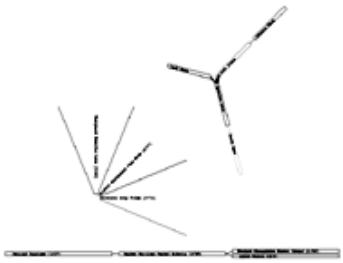


Figure 21. Emergent groups for number of links at least 7 and number of connected nodes at least 3.

The analysis of the internal e-mail network between departments shows that the strongest links within all departments exist between people that sit close together. Especially in the case of designers and consultants that split between the front and the back side, the strongest links appear between people sitting at the front side in both cases. In the case of consultants, two of them are located on a different floor and present very weak links with the rest of their department.

It therefore seems that there are different mechanisms generating personal electronic communications between the staff. Some electronic communications are being generated to overcome spatial isolation and distance; it is suggested that these are between teams where spatial distance makes it hard for them to communicate physically. On the other hand, spatial proximity, enables personal relations to be generated which result in intensive e-mail exchange although people sit closely together and could restrict their communications to face to face conversations. Additionally, people sitting in accessible locations, but not in spatial proximity, are more easily known to others and this seems to enable them create social connections via the e-mail.

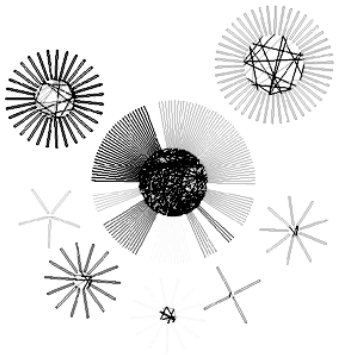


Figure 22. Internal e-mail network, grouped by department

The maximum number of links that create emergent groups is seven (with at least three connected nodes), (figure 21). In this case, two groups emerge consisting of 4-5 people each. In both of them, participants belong to different departments, do not sit within visual contact to each other, none of them is either very isolated or very accessible, half of them are juniors and half of them of medium seniority. Whether at the time of the investigation there were working on the same project, is not known.

The investigation of internal e-mails between departments reveals that the strongest link is between accounts and designers (third and first floor respectively), then between project managers and designers (again third and first floor respectively) and then between studio and designers (both sitting on the first floor), (figure 22).

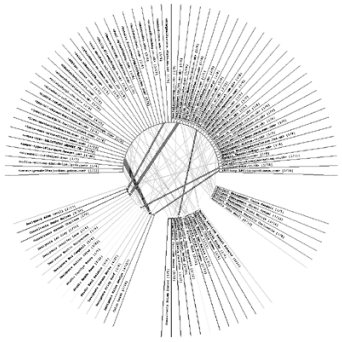


Figure 23. External e-mail network, grouped by floor

The private external e-mail network presented in figure 23, shows that the strongest links with external destinations are found on the first floor. There is only one strong link from a consultant on the second floor and none from the third floor. External receivers have been discussed earlier in more detail. What is interesting to add to the previous discussion is that the number of external senders outnumber the company receivers. No emergent groups were found from this analysis.

5.5 Telephone Analysis

As in the case of e-mails, we investigated whether type of job, seniority and spatial location are related to telephone communication forms. Additionally, we investigate the way people respond to different kinds of telephone calls (external and internal) according to their role in the organisation since incoming internal calls have a different ringing tone to external ones, thus making it possible for the receiver to be selective in answering.

The telephone logs for Wolff Olins during the week of the analysis contained the following information:

a: how many internal and external calls each person had received and of those calls, how many had been answered[7] and

b: how many external calls each person made, their duration and their cost.

The scatter in figure 24 shows the relationship between all internal calls that each person received and all external calls. Although the correlation is not strong, there is a positive trend.

The person who received the greatest number of internal calls is the video producer who also received the greatest number of internal e-mails after the IT support person. Then follows a project manager, a designer, the founder's personal assistant, 3 project managers and the head of project managers. Only two people did not receive any internal calls, a consultant and an IT programmer. The multimedia team project manager that we saw earlier being very active with regards to e-mail use, received only 3 internal calls and no external calls. The greatest number of external calls were received by the founder's personal assistant (88). Then follows an assistant project manager and a very senior person who answered all of her external calls but only 1/3rd of her internal calls. Six people (five of them junior) did not receive any external calls while the creative director received only five external calls and the head of consultancy only four.

To examine the different response to internal and external calls we have plotted them against the calls that have been answered. While we find an almost perfect correlation for external calls, in comparison, the correlation for internal calls is much weaker. (figures 25, 26).

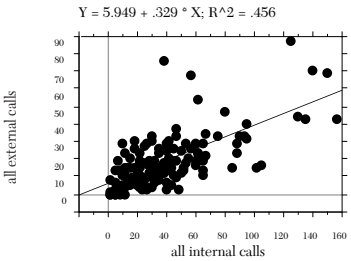


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Figure 24. External versus internal incoming calls

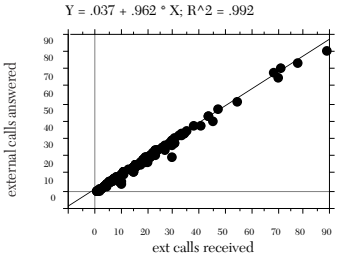


Figure 25. External incoming calls versus those calls that have been answered.

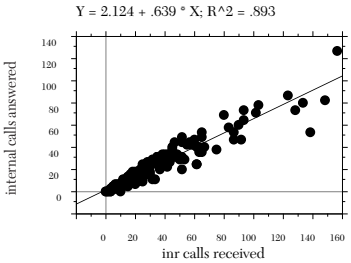
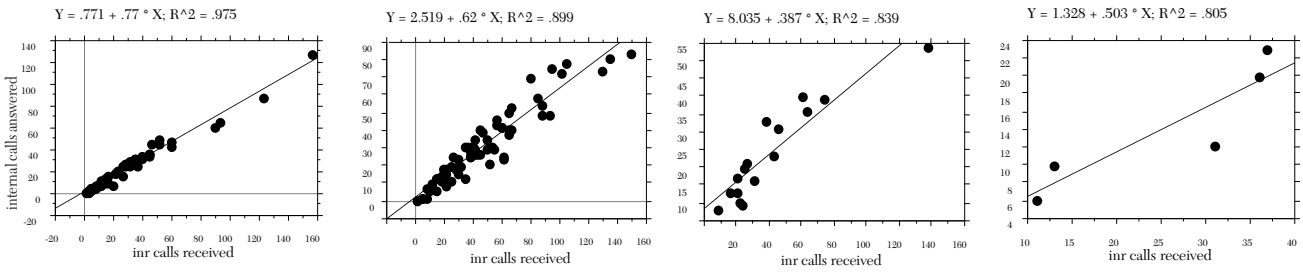
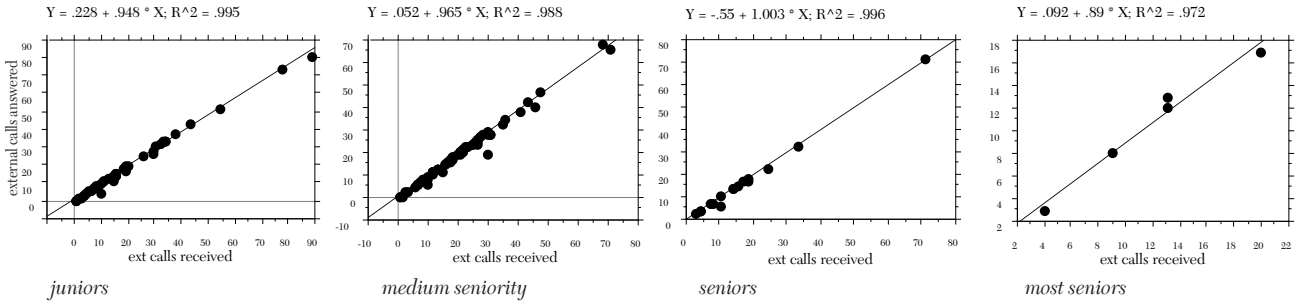


Figure 26. Internal incoming calls versus those calls that have been answered.



juniors *medium seniority* *seniors* *most seniors*

Figure 27. Internal incoming calls versus those that have been answered, according to seniority.



A1.18

Figure 28. External incoming calls versus those that have been answered, according to seniority.

The analysis reveals that as seniority drops, the more people answer their internal calls (figure 27). However, for external calls, regardless their seniority, everyone answers their calls (figure 28). Therefore, it could be argued that the reason senior people do not answer their internal phone to the degree that juniors do, is not because they are away from their desk or on the phone but out of personal choice[8] . The same analysis for internal calls according to departments, shows that project managers present the weakest correlation, although highly significant at 0.82, while the studio department the best correlation at 0.997 suggesting that for their department internal calls are regarded as important. Correlations for external calls are almost perfect for every department.

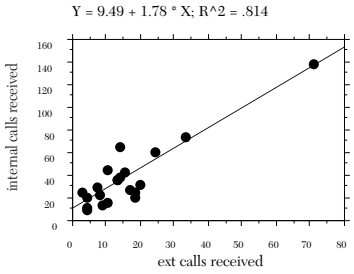


Figure 29. External versus internal incoming calls for all senior people.

It seems that seniority also affects the proportion of internal to external calls individuals receive. For the most senior people, the correlation between the number of internal to external calls gives an r^2=0.81 (figure 29), although the exclusion of just one person (the head of project managers who received the greatest amount of both internal and external calls) forces the correlation to drop to only r^2=0.5. Staff of medium seniority give a weaker correlation (r^2=0.446) while junior staff are even weaker (r^2=0.414)[8] .

The analysis of departments shows that the best correlation between internal and external incoming calls is found for the studio department while the analysis of seniority and departments together, gives a good correlation only for senior consultants (figure 30).

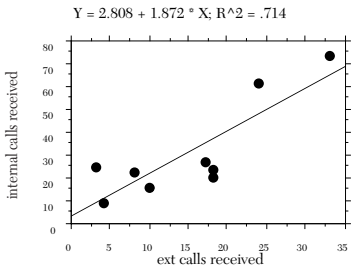


Figure 30. External versus internal incoming calls for senior consultants.

Senior people make and receive on average and in proportion to the entire organisation, the highest number of external calls (table 5). Then follow the seniors with less than half of the calls, then the juniors and finally those of medium seniority. Table 6 shows the average number of internal calls made and received from individuals falling into the four levels of seniority[10] and the ratio of the average number of calls made to those received. Note that juniors are the sole category where more internal calls were made than were received.

table 6: numbers of incoming and outgoing internal calls for individuals of all levels of seniority calculated as the ratio of the percentage of calls each level received against the percentage of the population each level represents.

	most senior	*senior*	*medium*	*junior*
outgoing internal calls	4.82	2.0	0.54	0.9
incoming internal calls	4.93	2.2	0.58	0.81
ratio	0.98	0.9	0.93	1.11

For department Designers, Consultants and Studio the number of external incoming calls is the lowest, while for Facilities the greatest (note that this department consists of only two people). Facilities also made the highest number of external calls, then Head Honchos and Project Management. The lowest number of calls were made by Designers and Consultants. The Studio department made more calls than they received, then follow Project Managers and Consultants. Designers is the only department that made the same number of calls as they received. Accounts received almost double the number of calls they made (table 7).

The lack of information on the number of internal calls individuals made, does not allow for a similar investigation. However, the ratio of internal to external incoming telephone calls, can give us a fair description of which departments have proportionally, closer ties to clients and services outside the organisation than within. The departments that fall into this category are those that present a ratio lower than 1. For instance Market services communicate by phone more with outside the organisation than within as do Facilities and Head Honchos and to a smaller degree Consultants. The Studio department, has significally stronger communications internally than externally as do Designers, Accounts and finally Project Management.

To summarise, the sequence for incoming telephone communications beginning with those most strongly linked to the outside world is:
Market Services - Facilities - Head Honchos - Consultants - (ratio < 1)
Project Management - Accounts - Designers - Studio (ratio > 1)

At this point, it is interesting to view the previous table for e-mail communications and compare it to telephone communications (table 8). Contrary to the sequence for incoming telephone communications, the sequence for incoming e-mails beginning with those most strongly linked to the outside is:
Consultants - Market Services - Designers - Head Honchos - Studio - (ratio < 1)
Project Management - Facilities - Accounts (ratio > 1)

In both cases Market Services, Consultants and Head Honchos are more strongly

	Accounts	*Consult.*	*Designers*	*Facilities*	*Head*	*Market S*	*PrManag*	*Studio*
external								
calls made	1.12	0.45	0.24	10.3	3.00	2.10	2.50	0.76
calls received	2.04	0.42	0.24	11.29	3.42	2.20	2.00	0.60
ratio made/rec	0.55	1.07	1.00	0.91	0.88	0.95	1.25	1.27
internal								
calls received	2.33	0.38	0.28	9.80	3.00	1.57	2.27	0.93
ratio inter/exter	1.14	0.90	1.16	0.87	0.88	0.71	1.13	1.55

table 7: numbers of external incoming and outgoing calls, numbers of incoming internal calls and ratio of internal against external incoming calls.

	Accounts	*Consult.*	*Designers*	*Facilities*	*Head*	*Market S*	*PrManag*	*Studio*
external								
mails received	3.15	0.92	0.29	6.58	1.47	2.14	1.35	1.03
internal								
mails received	6.14	0.46	0.18	11.8	1.45	1.10	1.76	1.02
ratio inter/exter	1.95	0.50	0.62	1.79	0.98	0.51	1.30	0.99

table 8: numbers of incoming external and internal e-mails and their ratio.

related externally than internally, suggesting that their type of job is related to a greater extent to clients and services. Project Managers and Accounts are more strongly related internally which might be anticipated from the type of the job they perform. Facilities, Designers and the Studio department present a different behaviour. Facilities are related externally by phone and internally by e-mail. On the contrary, Designers and the Studio department are reached externally by e-mail and internally by phone. If we accept the personal character of the telephone as well as the immediate results it involves, then it could be suggested that the nature of the designers' and production department work, demands immediate communications and perhaps problem - solving. Earlier the spatial analysis, showed that these two departments, due to their location, receive few visitors from other disciplines. Therefore, it might be the case that the other members of the project team overcome the lack of face to face interaction with telephone communications. The e-mail analysis revealed strong links between the first floor, that is Studio and Designers, and other departments located on different floors. Hence it seems that telephone communications accomplish different objectives to e-mails.

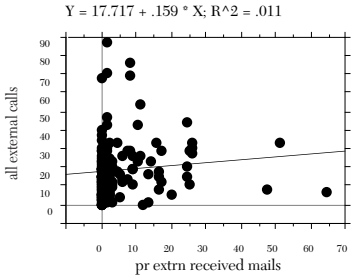


Figure 31. External incoming e-mails versus external incoming phone calls.

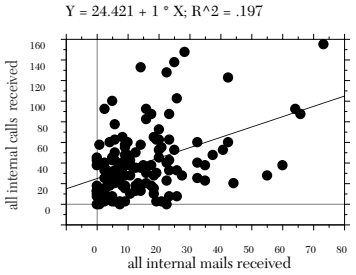


Figure 32. Internal incoming e-mails versus internal incoming phone calls.

The different way staff use the e-mail service than telephones, at least when it comes to the outside world can be illustrated in figure 31. The total number of private incoming external e-mails against the total number of incoming external calls shows a bifurcation (figure 31). In the case of internal mails and calls, the correlation is slightly better but still shows only a positive trend (figure 32).

6 The Organisational Culture

The analysis of the spatial layout and the physical, electronic and telephone communications among the staff of Wolff Olins, constitutes a first step towards an integrated understanding of communication patterns in the work environment. Interactions between staff is considered to be a major issue in organisational culture with important implications for workers' productivity, generation of new ideas, innovation, quick response to change, competition, motivation and other human factors. Office space and the spatial layout in particular, has proven to be a significant factor on the generation and practice of different forms of communications. The evaluation of these different communication types, is not a present concern although some analysts argue that face to face interactions between staff are preferable to other types. Whatever the value and implications of different types of interactions, their generation and practice should be well understood, at least where spatial effects are concerned, if we are to improve the ways we work through space. The current research suggests that their understanding should evolve from both a managerial and spatial configuration perspective; whereas the management structure and policy of the company reinforce certain communication mechanisms, space enables them or inhibits them, sometimes sustaining the management objectives, at other times creating different conditions.

The main findings of the present study are as follows:

a) The spatial study has revealed that the configuration of the building consisting of three working floors, creates accessibility problems between floors and consequently, between different departments since they are spatially designated. The third floor (project managers and accounts) is the most isolated area. On the contrary,

the second floor (consultants), being in the middle of the three working floors, is the most accessible area. The first floor, is the largest of all floors and highly integrated, but due to its configuration, it creates two distict areas, seperated from each other; the designers' and the studio's area. The model that has been adopted is of correspondance between spatial areas and management units. This serves to reinforce internal at the expense of intra-departmental links.

b) The observation study found that the isolation and the small size of the third floor, results in low levels of interactions among its occupants who are driven to visit the second floor to socialise and communicate. As a result, the consultants' area is highly interactive since it not only keeps its occupants but also attracts visitors from the third floor. On the contrary, people working on the first floor, do not visit the second but they remain within their working area which can sustain highly-enough levels of interaction due to its local integration. The central location of the designers' front side however, seems to be the only area that benefits from "through" movement. Both the back designers' area and the studio department rely on localised interactions, and in the case of the studio, on visits from designers who are actually their supervisors.

c) The analysis of e-mails has revealed several mechanisms which underly patterns of usage. Seniority plays a significant role in the degree employees use e-mail. Senior people attract electronic communications but do not respond. For juniors, usually e-mail is a preferable form of communication. The first and the third floor, maintain the strongest electronic links between them in order to overcome lack of physical interaction due to their separation. Space therefore, plays a powerful role in the generation of e-mail communications. People sitting in accessible areas are more known to others and sometimes form social groups that interact extensively via the e-mail. The same can occur for people sitting in spatial proximity to each other: they get to know each other better and therefore communicate a lot. E-mail in this case may be used to overcome time separation rather than spatial separation. On the contrary, spatial isolation and distance may work in two different ways; it either forces people to use e-mail to a higher degree if their work requires them to communicate with others (as in the case of project managers) or, it reduces interaction to the minimum (as in the case of designers sitting at the back side). Levels of e-mail exchange according the working areas, are presented in figure 33. This figure shows clearly, that both outgoing and incoming electronic communications are more intense for the integrated front side of each floor rather than the segregated back side.[11] Although no clear relation was found between integration and e-mail use, there is a positive trend when local integration is plotted against the total number of e-mails

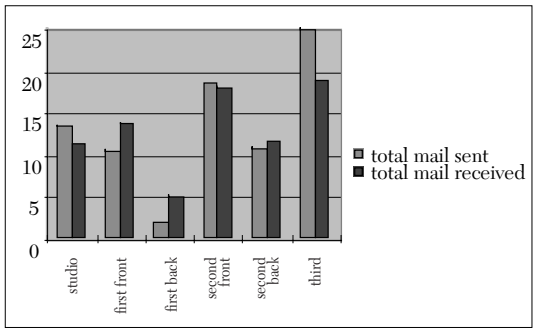


Figure 33. Average number of incoming and outgoing mails according to area.

according to area. It is suggested that the type of job and seniority have an even more significant impact on e-mail and telephone use than on face to face interactions. Between people working in same disciplines, the strongest links occur for those sitting in integrated areas and in spatial proximity. This was found for both designers and consultants who are separated between the front and back side of their floor. In the case of consultants, both people that sat in isolation from their department were found to have the weakest links with their department. These powerful spatial effects on e-mail communications have led us to suggest that diversity in the spatial layout, may contribute to an equal diversity on the degree of e-mail usage. We base this conclusion on the finding that occupants of the third floor use their e-mail less diversily, followed by occupants on the second floor and finally those on the first floor, according to the degree of spatial complexity of those floors.

d) The telephone investigation has allowed us to examine departmental and seniority effects in greatest depth. Although everyone in the organisation answers external calls, there is a consistent pattern of ignoring internal calls as seniority increases. The telephone is a preferable communication means for senior people who were found to make and receive the greatest number of calls. The studio department, which employs the most junior people in the company, is very constistant in telephone answering, a great number of which come from the project managers who are the least constistant in answering internal calls. As in the case of e-mails, the third floor communicates extensively via telephone with the first floor in order to overcome spatial distance. Finally, the investigation of external calls in relation to internal calls, has shown that Market Services, Head Honchos and Consultants have closer ties to external services and clients than within the organisation, in contrast to Project Managers, Accounts, Designers and the Studio which mostly depend on intra-organisational relations.

These findings, suggest important implications for the organisational culture. While face to face conversations require spatial proximity and accessibility, e-mail and telephone interactions help to overcome distance and isolation problems but only under certain conditions; when management tasks require interaction and when status difference is not an issue.

Different means of communication achieve different objectives. Face to face conversations require people to be at the same space at the same time (synchrony of space and time). Telephone interactions can overcome space whereas e-mails overcome both space and time. From this perspective, telephones and e-mails have the potential to bring together people who are spatially separated. However, seniority plays a catalytic role in communication behaviour. In some organisations, senior people are usually assigned a cellular office which makes them physically, less accessible to other employees. Physical distance then becomes a social distance. However, in order to maintain control, senior staff "walk the floor".

On the contrary, in Wolff Olins everyone has a desk in an open plan area, thus being easely reachable by other staff. In this case there is no physical distance to symbolise the distinction between senior management and their staff. We have observed that senior staff sitting in the open plan area appear to be cotrolled by those staff sitting

in visual and spatial proximity. To overcome control they seem to avoid types of behaviour that could bring staff close to them (the observations have shown low levels of interaction at senior staff workstations).

Senior people also tend to ignore their internal phone and do not reply to e-mails. It could be argued that this is either a result of more concentrated work, or a symbolic way of sustaining social distance and consequently status. It seems possible that senior staff located in open plan areas, can no longer rely on a spatial expression of their status and have turned instead to the new communications media by effectively denying access to internal communication.

Individuals whose job type and seniority do not enable them to create social connections do not benefit as much from e-mail and telephones. Although the open-plan policy of the company suggests an effort to bring together all employees , at least physically, and regardless of their seniority, it seems that this has not been achieved at the global level.

In the open plan office symbolic openness has resulted in behaviour which reduces communication using the new media. If we accept that status in organisations will always try to find a means of expression, then it is suggested, we should try to put into practise those that do not obstruct fundamental organisational functions as communications, at least for disciplines which are mostly dependant on intra-organisational relations.

Notes

1 The author would like to aknowledge and thank the City University Business School for their collaboration and support and especially Dr Chris Brady and Professor Clive Holtham, Head of the department of Management Systems and Information. Many thanks also to David Snocken, Managing Director and Malcolm Slade of Alta Analytics Limited, for their time , help and training on Netmap software.
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2 Snapshot observations were carried out every half an hour from 9.00 till 5.00, 16 rounds in total. Movement observations were conducted for a period of 5 min every hour for each area, 8 rounds in total (again from 9.00-5.00)

3 Three types of movement have been observed: "Global" movement which is movement through an area, "in-out" movement which represents people leaving or entering a working area and "local " movement, that is, people moving within their working area

4 The criteria for Emergent Groups are:

- minimum of 3 nodes in the group
- each node in the group is connected to at least 2 other nodes in the group
- each node in the group has at least half of its links to other nodes in the group.

Other properties of NetMap nodes include:

- Attached isolates which are the nodes in a satellite that connect to only one other node
- Tree nodes which are the nodes that connect the attached isolates to the rest of the satellite.

5 Since the analysis of a network in NetMap requires a substantial number of participants, it has not been possible to analyse group communications on their own

6 Convex analysis follows the same principles with axial analysis but instead of representing space with lines, it breaks it down to "convex" spaces (convex is a space where you can go everywhere and see everything from every point in the space to any other point in the same space). Therefore, darker convex spaces are more integrated (accessible) than lighter convex spaces when the map is processed

7 either because individuals did not answer their phone or because their line was engaged

8 Otherwise the correlation for external calls would not be almost perfect

9 even when we exclude the Founder's Personal assistant who received the greatest number of external calls but few internal ones, and the IT support person who received the highest number of internal calls but proportionally few external calls, R2 remains very low

10 in proportion to the whole population, eg, junior people are 33.8% of all staff and received on average 27.47% of all calls, thus 27.47/33.8=0.81 calls per person

11 Note that in both front and back sides, departments are the same: designers for the first floor and consultants for the second floor

12 One could also argue that the reason seniors do not respond to telephones and e-mails is because they try to enforce physical contact between them and their inferiors. However, observations showed minimised levels of interaction around all most senior people.

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