SOCIO-SPATIAL ANALYSIS OF FOUR UNIVERSITY CAMPUSES;
the implications of spatial configuration on creation and transmission of knowledge

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0   Abstract

An exploratory study of space use, interaction and students' and academics' subjective perceptions of interaction and vitality in the four campus sites of the Pontificia Universidad Católica de Chile (PUC), in Santiago de Chile is presented. The four campuses, which differ substantially in their architecture, size and the programmatic nature of the disciplines they house, were modelled as spatial configurations using space syntax methods. Observations of patterns of space use and movement were carried out and a questionnaire survey of staff and students was used to elicit perceptual and reported communication network strengths for both academic staff and students. One might expect that, given the twin roles of a university institution in the generation of new knowledge and induction of alumni into a 'professional' social solidarity, the roles of global and local integration would tend to compete. Global segregation in combination with local integration can construct the conditions for students to appropriate the open space and generate a powerful local identity at the level of the academic unit. However, global integration appears to play an important role in making those local solidarities accessible to one another and therefore in the generation of new knowledge and solidarities. The data at hand, though exploratory in nature, suggest that the dynamic is more complex: local identity of the discipline appears to be a necessary component in the construction of interdisciplinary 'weak' networks at the scale of the institution as a whole.

1   Introduction

Since the 19th century society has entrusted universities with the production and transmission of knowledge. With such a vital task for the development of society in hand, university authorities around the world have taken the greatest care in selecting their staff and students, a well as designing appropriate curricular structures and academic systems. Somewhat less systematic effort has been devoted, however, to the design of the physical university environment. During the boom in new university building in the UK during the 1960's attention focused on space norms, utilisation rates and time tabling implications for campus design. Since then there has been relatively little investigation of university campus planning, and in particular, almost no research into effects of campus design on either the socialisation of students and staff or the effectiveness with which the mission of higher education can be carried out. Even outside the domain of higher education, only a few attempts have been made towards achieving a real understanding of the impact of the built environment in the process of new knowledge generation and its transmission to future generations.

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The focus of more recent research has been on the transmission of knowledge and innovation as a more general social and organisational phenomenon. Tom Allen (1977), in studying communication and innovation in engineering, refers to the production of new knowledge and states that problem solving and significant advances in knowledge depend much more on interaction between people that are not part of the same research group, profession or field, than on communication within work groups. This statement is supported by detailed empirical studies that have demonstrated that the most significant advances in engineering knowledge appear to have a random component, which often depends on chance meetings between people that work in different fields and who are not the members of the same team, but work in the same building.

Since the structure of space has much to offer in random encounter and copresence, it is possible to read an implicit strong spatial component in Allen's observations. While interaction between members of the same discipline or area of study arises naturally, either because of space (they will often work near each other) or in spite of space (programmed meetings tend to bring together those one would expect to have common interests); interaction between people from different areas of study does not arise naturally and has no real reason to occur (they work in different places, attend different seminars and conferences and do not have any special reason to need to meet). Even where management aims to 'bring disciplines together' they work within a framework of current knowledge and expectations about who might benefit from interaction. The type of interaction Allen describes as fundamental to innovation will tend not to be programmed, and as such will depend strongly on casual encounter. This suggests that the patterns of encounter generated by the movement of people through the public space network that links programmatic spaces within buildings may be a key factor in the generation of innovation.

Granovetter (1982) in studying social networks and social support systems makes an important distinction between 'strong' and 'weak ties' between people in social networks. By strong ties he refers to friends that know each other, where both would cite each other in their network, and by weak ties he refers to acquaintances, friends of friends, and associations that would only be cited by one party. He stresses the importance of weak ties as bridges which enlarge the individual's realm of support and information, and the key role that they play in providing much of the information for people's most important life changes. So far as socialisation is concerned Granovetter's findings suggest another strong role for space and spatial configuration in generating the weak networks on which socialisation ultimately depends.

Relating this argument to the formation of professionals suggests that just as it is important to create solidarity among members of the same field it would be important to allow for the formation of weak ties between different professions and disciplines. This argument has some interesting spatial implications for university campuses. The importance of creating solidarity among members of the same profession is not doubted, and in general terms, it is something that most universities aim at. In fact, this can be read in the architecture of schools and institutes, with their emblematic buildings, common rooms and patios or courts. But the importance of creating weak links among members of different professions has received little formal atten-

tion, relying on student accommodation to provide this component through mixing in halls of residence, fraternity and soriety organisations and traditional 'Oxbridge college' structures.

Hillier and Penn (1991) incorporated a spatial component in this analysis formally for the first time. Based on the theoretical background and space syntax methodology put forward in Hillier and Hanson (1984), and building on Allen (1977) and Granovetter's (1982) observations, they investigated the morphogenetic potential of certain types of spatial structure.

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The statistical spatial model proposed by Hillier and Hanson conceives social and spatial rules as restrictions on a random generative process. Hillier (1985) suggests that the interaction between rules and randomness allows for the production not only of known solutions, but also of new solutions or morphogenesis. In later studies, Hillier and Penn (1991) propose that morphogenesis tends to occur when the rules that restrict the random process are few or have a relatively local reach. They distinguish between "long models" and "short models", the first would be those which have many rules that determine the spatial relations (the activities, type of people, visual connections, etc.) and the second, where a minimum of rules is specified. The authors propose that long model buildings will tend to produce reflections or projections of the social rules, and so will tend to be conservative, while short models on the contrary will tend to be generative of new relations or knowledge.

Hillier and Penn (1991) also make the distinction between two types of knowledge, suggesting that knowing can refer either to the set of abstract rules that allow us to act socially and in general terms form the ideas "we think with", or that they refer to a particular more concrete set of rules on a specific subject, which in general terms are "ideas we think of". They call the first, Type A, and can be loosely be defined as social knowledge, and the second Type B, which they suggest could be defined as scientific knowledge.

Hillier and Penn (1991) combine these concepts and propose that the production of Type B knowledge will tend to happen as long as Type A knowledge is absent in spatial terms, that is in a short model building, whose spatial conditions will essentially be generative. On the contrary, the reproduction of knowledge, lies in the conservative, type B, mode.

The authors emphasise the importance of random encounter in the use of open space. Just as random encounters between programmatic buildings in a university campus can lead to the bridging of areas and to advances in knowledge, it can also attain the formation of significant weak ties that would enhance a transpatial solidarity among members of different fields.

There appears to be a prima facie case that the demands of conservation and innovation will be in some sense mutually exclusive. However, the precise way that the competing demands for generation of novel social structures, and for the conservation and reproduction of existing social structures can be realised spatially have received little attention. This paper presents an exploratory study which throws some

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light on the variables concerned in this dynamic. The study was carried out jointly by the Faculty of Architecture and Beaux Arts, Pontificia Universidad Católica de Chile (PUC), and The Bartlett School of Architecture and Planning, University College London (UCL), during 1994. The research investigated the extent to which spatial configuration can be held to have an effect on the type of community generated in university campuses. The hypothesis was that creation and transmission of knowledge, as well as the formation of new professionals, should relate strongly to informal encounter and the type of community generated on campus, and that spatial configuration of campus premises would be likely to affect both of these. The vehicle for the study was the Pontificia Universidad Católica de Chile's four existing campus sites, which present very different spatial structures, locations in the city and general atmospheres.

The subject was investigated from three perspectives: spatial structure, observations of patterns of use and movement in the open space and reported social interaction. In the first place, each campus was represented graphically, specifically in terms of its open space structure which were then analysed using computer based 'space syntax' models. Secondly, the use of open space was observed and recorded on site through systematic observations; and thirdly, the social network of a sample of students and academics was studied through a questionnaire survey which inquired about interactions that had taken place during the last year and asked for a subjective evaluation of the campuses and the university's academic units.

2   The PUC Mission
The Pontificia Universidad Católica de Chile (PUC) describes its mission as threefold: teaching, research and extension. Advances in all three areas depend on a series of factors, among which the interaction among students, academics and professionals in industry and commerce, are of the greatest importance.

The teaching mission is understood as the transmission of both specific disciplinary knowledge and of more general social knowledge. The latter relates to students' socialisation and refers to the way of thinking and behaviour of the future professionals (social culture, personal motivation, team work, ethics, etc.) as well as the construction of social weak and strong ties which the alumnae will share. In Hillier and Penn's (1991) terminology, these two could be assimilated to Type B and Type A knowledge respectively.

The prerequisites or conditioning factors of the transmission of specific knowledge relates to the quality of the academic staff and students and the construction of an atmosphere conducive to study. This takes place largely through programmed activities, at a certain time and place such as lectures, seminars and workshops. On the other hand, an important prerequisite for the socialisation of students lies in the construction of an adequate interaction (between students and staff and among students), which is not programmed and has a strong spatial component.

The research mission largely relies on the generation of new knowledge, or the application of existing knowledge and techniques to new fields. Traditionally advances in this area have been related to the quality of academic staff, and in recent years, to the

relation with the non academic world (industry, government, etc.) since it is increasingly by these agencies that research problems are defined and, in many cases, the funding to carry it through is provided. According to the theoretical background presented in this paper, the generation of new knowledge also links closely with the type of relation among researchers and with the creation of a generative atmosphere conducive to the creation of new knowledge.

The extension mission is understood as the diffusion of knowledge from the academic world towards the external world. The challenge here relates to the applicability of the knowledge generated by the university through its research programmes, the reputation of its courses, the quality of the education received by its students, their employment, success and so on.

According to this threefold mission and to our theoretical background, the main interfaces of interest for this study are the following:
- teaching   academics-students
          students-students
- research   academics-academics
          academics-external world
- extension   academics-external world
          students-external world

3   The PUC Campuses

The PUC is currently sited in four university campuses which are located quite separately in the city of Santiago (see Figure 1) and present their own characteristics with respect to size, image, programme and general atmosphere.

In terms of location, each campus is situated in a very different urban context. Casa Central which houses the administrative headquarters and is the historical origin, is part of the CBD, San Joaquín is inserted in a poor and peripheral industrial area, while Campus Oriente and Lo Contador belong to a middle class residential district, even though Lo Contador is also within the are of influence of a vital commercial and working centre of the city.

At the time of the study the PUC had 30 academic units, 13,249 students and 1,085 full time equivalent academics. San Joaquín was the biggest campus, and Lo Contador the smallest. The proportion of students and academics in each campus was as follows:

• San Joaquín   55% of students,   39% of academics
• Oriente   29% of students,   28% of academics
• Casa Central   8% of students,   25% of academics
• Lo Contador   8% of students,   8% of academics

Each campus has its characteristic atmosphere and its own restrictions. Casa Central hosted only three academic units at the time of the study, but it is the headquarters of the university and houses the general directorate and the administrative and financial directorates. Also it hosts the University Clinic Hospital, Extension Centre and a studio set for Television Channel 13. In general terms this campus is seen as the
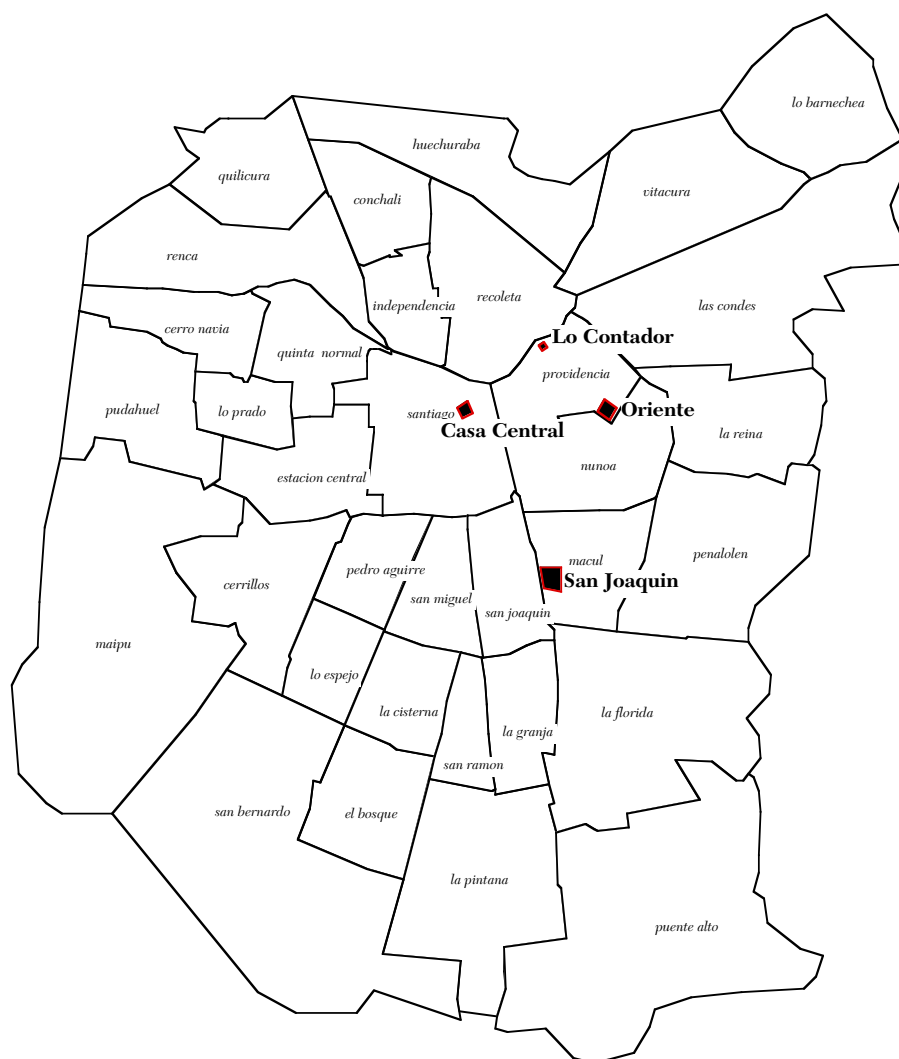
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Figure 1. PUC Campuses in Santiago (schematic plan of Santiago, pointing out the four Campuses).

corporate image of the university, and as more formal than the rest. It occupies a whole block of around three hectares in the centre of the city. The main restrictions on Casa Central are its size and inability to grow.

Campus Oriente, which used to be a nun's private school for girls, hosts ten academic units that relate mainly to the humanities and several of the student organisation offices at university level, such as the Student Union (FEUC), University Pastoral Office, Students General Directorate (DGE) and Work Centre for Students (UCR). This campus is seen as very lively, and its main restriction relates to the structure of its existing building which acts as a powerful constraint on change. It occupies over five hectares of land.

Campus Lo Contador, which used to be an hacienda house, is the smallest; it has only four academic units related to the fine arts and architecture. In general terms it has an informal atmosphere and its principal restriction is its size and the low density permitted by its architecture. It occupies less than one and a half hectares of land.

Campus San Joaquín has an 'American campus' structure and is the only one that was built with this specific purpose. Whereas the other three campuses comprise essentially single buildings, San Joaquín is made up of a range of discrete buildings and

Campus San Joaquín

Campus Oriente

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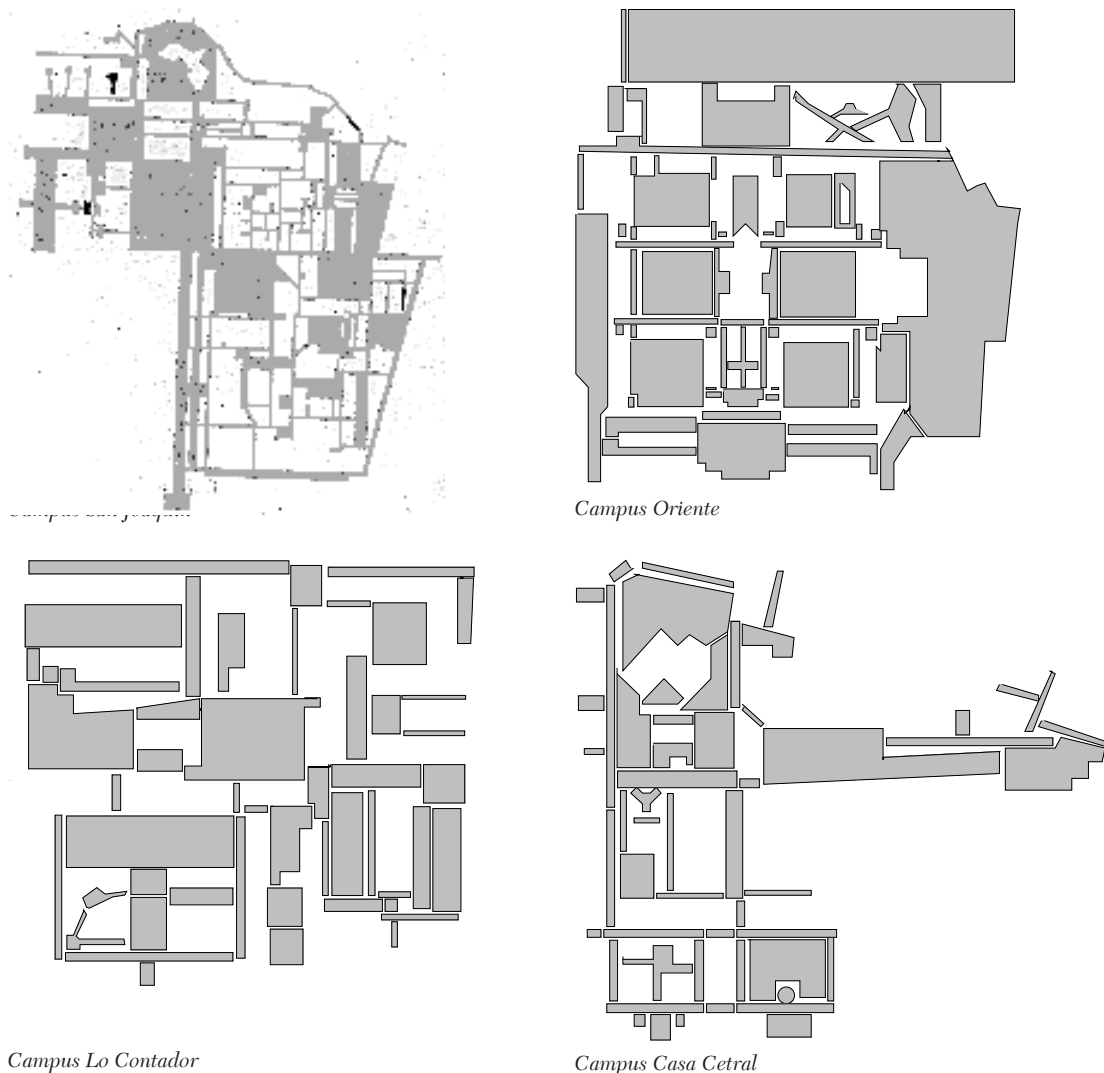
Campus Lo Contador

Campus Casa Cetral

building complexes in a relatively open landscape of paths, gardens and carparks. Unlike the other three, it is often described as dispersed, lacking in density, less lively and empty. It hosts twelve academic units that deal with the sciences, engineering, technology and the humanities. It also hosts the Diagnosis Centre. Its main restriction relate to its peripheral location in the south of the city, although accessibility is now set to improve with the construction of a new metro line. It occupies around fifty hectares of land.

Figure 2: Open Space Plans of the Four Campuse; Campus San Joaquín, Campus Oriente, Campus Lo Contador, Campus Casa Central
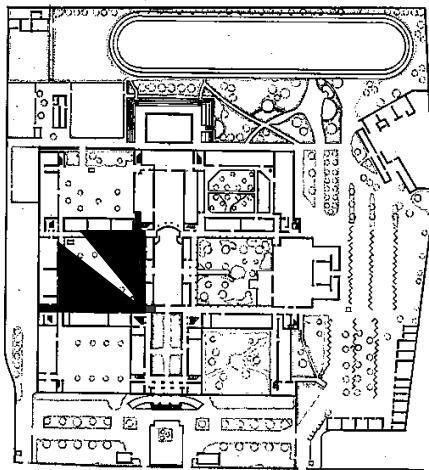
4   Graphic Representation of the Campuses

The first impression of the PUC campuses (see Figure 2) shows that the open space in Campus Oriente, Lo Contador and the front part of Casa Central, is structured by the articulation of hard-edge courtyards, while San Joaquín is built on the basis of buildings imposed over an empty space. Nevertheless there are other interesting similarities and differences that can be brought forward from the graphic representation and analysis of these spatial systems.
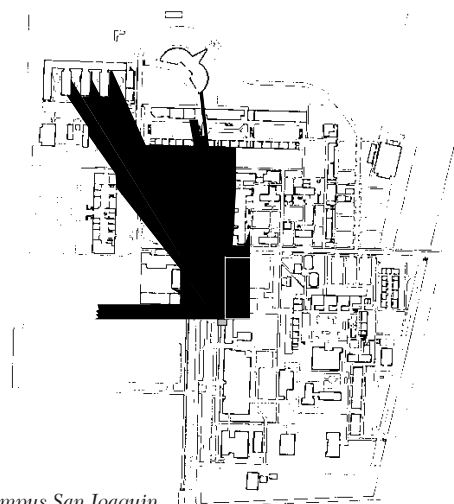
The graphic representation of Campus Oriente shows a high proportion of court-spaces (where the second dimension becomes relevant: the width) of similar dimensions, while in San Joaquín there can be seen a great proportion of corridor-spaces (essentially unidimensional: long) articulating court-spaces of different sizes. Campus Casa Central on the other hand, seems to be structured by more than one system, with different characteristics and relatively weak connections between them.
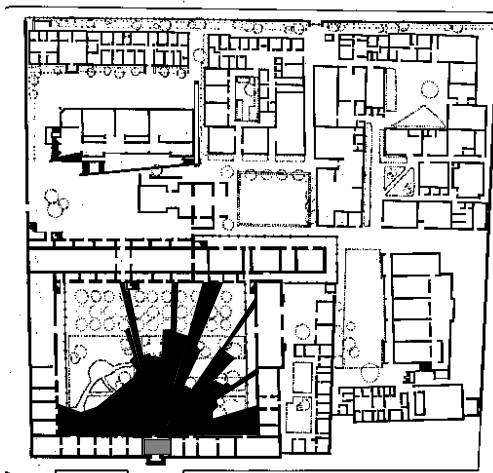
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Campus Oriente

Campus San Joaquín

Campus Lo Contador

Figure 3: Visual field from the entrance to three courts.

In the Campus Oriente court, the visual field is practically the same as the permeability relations and covers up a reduced number of convex spaces (the central space and its surrounding corridors).

In the San Joaquín plaza, the visual field is almost as big as the whole system linking far away spaces which are inaccessible (not all than can be seen can be reached directly).

In the Campus Lo Contador court, the visual field covers several convex spaces (the internal spaces of the patio and the surrounding corridors) all together constituting a sub system (the court) due to the strong boundaries of the same court.

Lastly, Lo Contador, of a considerable smaller dimension, seems to resemble San Joaquín in that the corridor-spaces predominate, articulating court-spaces of different dimensions.

This topological description only tells part of the story and in fact could be quite misleading, since the fundamental difference among the campuses lies in the visual articulation of its spaces. Most open spaces in Campus Oriente are strongly defined by two story buildings, leaving an open courtyard space in the centre with practically no direct visual connection to the other spaces. In this way there is an immediate local correspondence between permeability (where you can go) and visibility (what you can see), and a more segregated and unintelligible global circulation structure based on permeability without strong visual clues. On the contrary, most open spaces in San Joaquín are defined by green areas with restricted footpaths, but which allow visibility to a series of near and distant convex spaces.

The apparent contradiction between the graphic representation of open space in Lo

Table 1

	global integration	local integration	intelligibility
San Joaquín	RRA = 1.44	RR3 = 2.53	r² = 0.64
Oriente	RRA = 1.45	RR3 = 2.30	r² = 0.40
Casa Central	RRA = 1.38	RR3 = 2.54	r² = 0.57
Lo Contador	RRA = 1.52	RR3 = 2.45	r² = 0.83

Table 1

Contador (where you can see a majority of corridor-spaces) with its architecture (on first sight, characterised by its courtyards), also responds to the special management of visibility and permeability relations. The strong control of visibility and permeability between courts is complemented by permeability restrictions in their interior (footpaths, bushes and areas which are not open to access) which decompose the courts into separate convex spaces but manage to maintain the visual relations of the whole court, constituting sub systems (see Figure 3).

The surrounding buildings of these three spaces also have different programmatic characteristics which affect their use: the Oriente patio is fed by lecture rooms and, in general terms, rooms whose programmatic activity implies an important flow of students; the Lo Contador patio is surrounded by small rooms with less programmatic load, while San Joaquín is surrounded by empty spaces with little use or flow of people.

Lastly, it is interesting to note that there seems to be a natural compensation between visual integration and axiality: while the most visually integrated of the four systems, Campus San Joaquín, presents a 0.88 ratio of axial lines per convex space, the least integrated visually, Campus Oriente, presents a 1.30 ratio.

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5   Syntactic Models

Campus Oriente
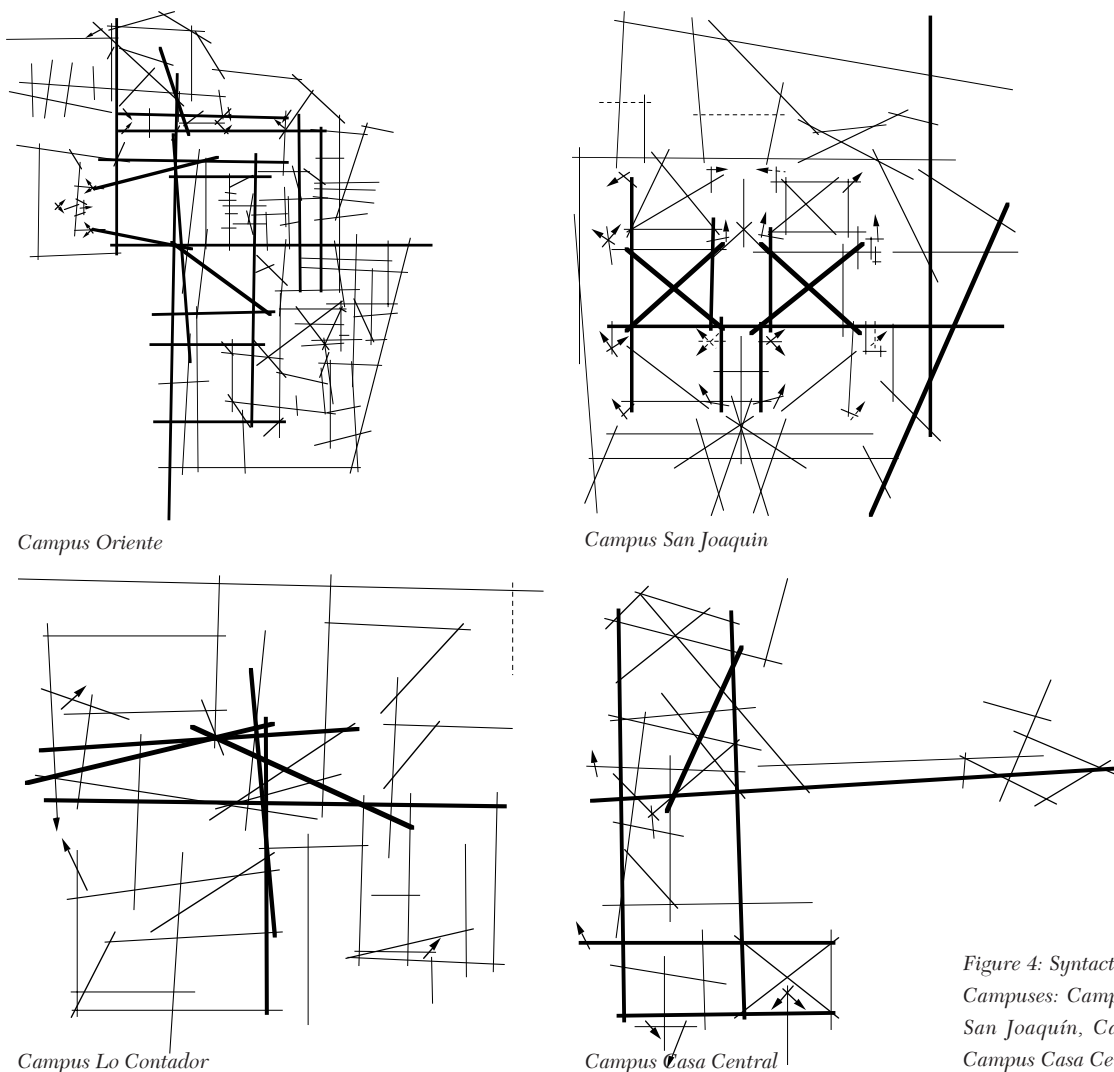
Campus San Joaquin

Campus Lo Contador

Campus Casa Central

Figure 4: Syntactic Models of the Four Campuses: Campus Oriente, Campus San Joaquín, Campus Lo Contador, Campus Casa Central.

The four systems analysed are surprisingly similar in their syntactic values; for example, their global and local integration values are practically identical (see Figure 4). Nevertheless, at a fine level of distinction Lo Contador and San Joaquín can be described as slightly more integrated globally and Casa Central as more integrated locally, while Oriente is the most segregated both locally and globally. The most intelligible Campus appears to be Lo Contador and the least intelligible Campus Oriente, while San Joaquín and Casa Central constitute intermediate situations.

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5.1 Campus Casa Central

The integrating nucleus links the more formal and institutional front part, with the more relaxed and informal area inhabited by students. In spite of presenting quite different images, both areas are therefore always present and feed each other. The integrating nucleus includes the most frequent paths from the exterior, making the building intelligible to the visitor. Nevertheless, as this nucleus does not include the axial line of the main entrance to the campus, it keeps a certain degree of introversion with respect to the outer world and allows for a degree of formality associated with the institution. On the contrary, the everyday entrance to the Medical School sector is part of the integrated nucleus where an important component of the movement and campus life can be observed. The most globally segregated lines, which are located on the second floor, attain a high degree of local integration. Therefore, no area is left without a natural flow of people.

5.2 Campus Lo Contador

The integrating nucleus is located in the common spaces of the campus where there is no appropriation by the academic units. In this way it appears to contribute to the campus cohesion and construction of a degree of solidarity between academic units. The most integrated line in the system corresponds to the everyday access of the campus, while the formal access is two steps deep from the integrating nucleus. In this sense, the system is more difficult to understand for the visitors, who approach on the 'formal' route, but offers a degree of functionality to its inhabitants. The most segregated lines are located in the upper floors of two lecture rooms and studio buildings. This means that the students working are not easily seen by the rest of the inhabitants giving the campus an emptier feeling than is really justified. Both local and global integrating nuclei coincide, which means that the campus' solidarity will be reinforced at the expense of the academic units' solidarity's.

Figure 5: Correlations Between Local and Global Integration and Observations

Campus San Joaquín: Local Integration and Log. of Moving People (r2=0.45)

Campus Casa Central: Global Integration and Moving People (r2=0.40)

5.3 Campus San Joaquín

The two more globally integrated lines correspond to the two access axis which cross at the geometric centre of the campus, where a new chapel is about to be built. The integrated global nucleus, unlike the two described, does not cover the whole campus, and does not reach the open spaces of the Engineering, Agricultural Studies and Business Schools. This obviously indicates a certain degree of segregation of these academic units; yet because they are located in the nucleus itself an effect comparable to condominia is produced: the academic units feed on the system, but do not offer back or share their life with the rest of the campus. The most segregated areas correspond to the upper storeys of three buildings, but only one of them hosts complete academic units: Psychology, Sociology and Social Work (the other two have sections of the Engineering and Business Schools), which have very little presence
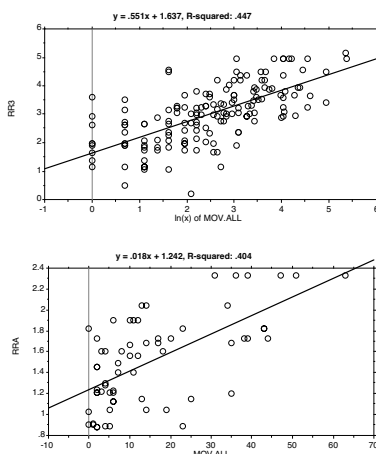
in the university. In fact, according to the questionnaire survey presented below, Psychology is considered one of the least lively of the academic units, with least identity and shows a very low index of 'known' academics and students by members of other academic units. However, the local integration nucleus compensates for some of the global segregation in the case of Engineering and to a lesser degree, in the case of the Business School.

5.4   Campus Oriente

The integrated nucleus is not only several steps deep from the main access to the campus, but also presents a certain confusion of axial lines towards the street entrance. The nucleus is quite compressed, only covering part of the campus and is formed of relatively short lines leaving large areas relatively segregated. This means that even though the vehicular access is part of the integrating nucleus the campus has an important degree of hermeticism and poor intelligibility for visitors and inhabitants alike. A significant proportion of the segregated lines occur in the staircases between the two floors of the building due to the way they are recessed from the corridors. This local 'hiding' of vertical circulation contributes significantly to the campus' lack of intelligibility. The local integration nucleus reaches the second floor and parts of the more globally segregated areas of the building. Given that the academic units in this campus are dispersed in more than one place in the Campus, global segregation appears not to have resulted directly in a correspondence model
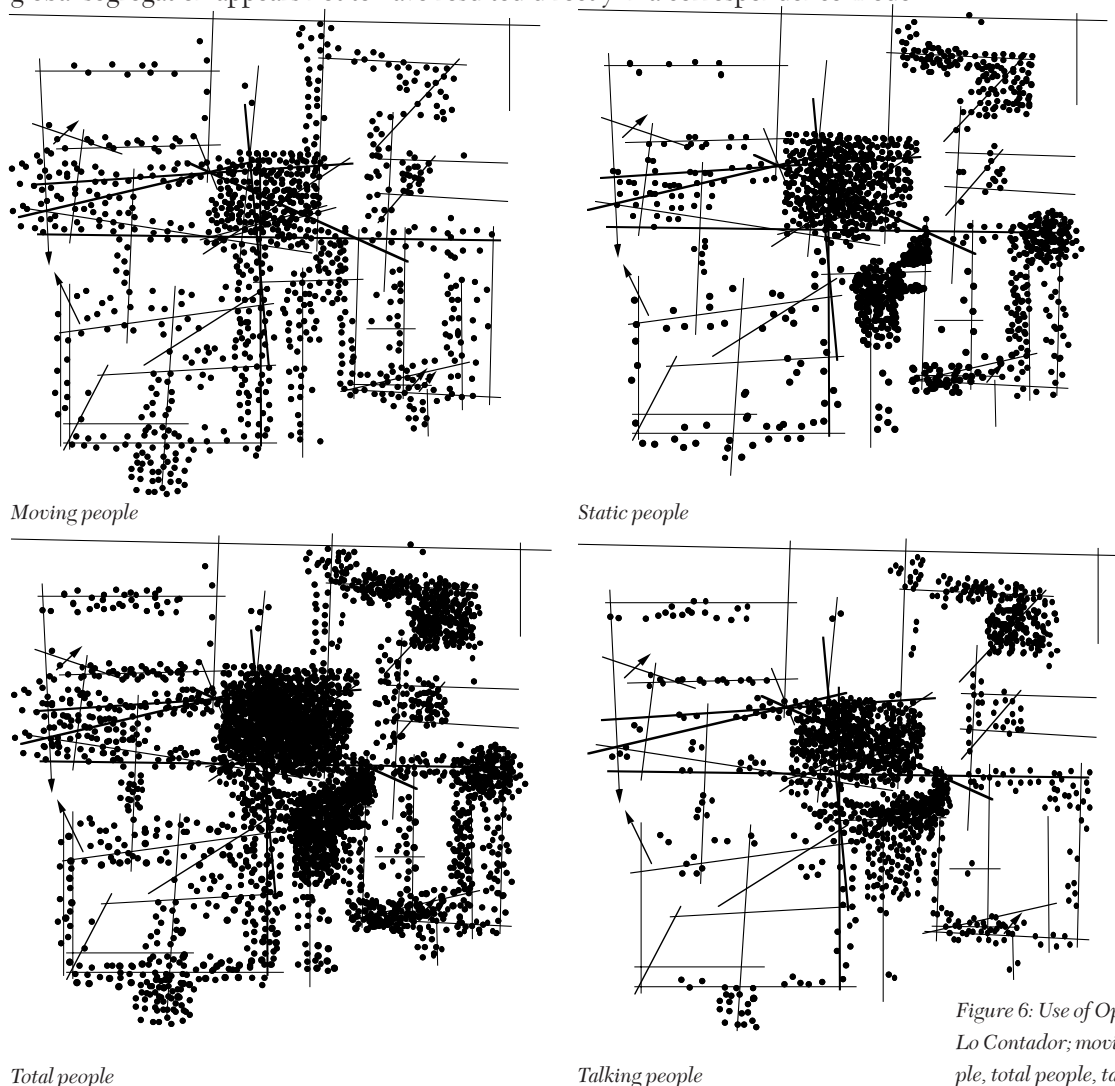
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Moving people

Static people

Total people

Talking people

Figure 6: Use of Open Space in Campus Lo Contador; moving people, static people, total people, talking people

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with strong solidarities at the level of the academic unit and a weakening of solidarity between units. In this sense a spatial restriction appears to have been overcome by programmatic or transpatial organisation.

6   Use of Open Space

The spatial characteristics of the campuses, together with the programmatic considerations, allow us to understand some differences in the use of open space and in their subjective perception. One first aspect to point out is that a smaller proportion of academics was found in the open space of Campus Oriente than in Lo Contador (2% versus 5%) and this could be related to an 'appropriation' by students of the open space of Campus Oriente with an 'expulsion' (or at least poor acceptance) of its academics. This could be read from the poor differentiation of its open spaces and the great density of students due to the programmatic load of the spaces that border the open courts. Compared to this, in San Joaquín 3% of the academics were found in the open space, and 10% in Casa Central.

Another aspect which can also be related to the quality of open spaces is that in Oriente a greater proportion of static people were found (72%), followed by Lo Contador (58%). On the contrary, in San Joaquín and Casa Central the majority of people were found in movement (52% and 54%). In the case of Casa Central this relates to the programme of the building and in San Joaquín to distance. On the other hand the greatest proportion of interaction was found in Campus Oriente (68% of people in open space were members of talking groups) as well as people studying (15%). Finally, Campus San Joaquín and Lo Contador also present a high proportion of interaction (64% and 59% respectively) while in Casa Central it is clearly smaller (45%).

Nevertheless, from the analysis of use of open space, the most interesting observation to make refers to the correlations found between integration and moving people, and to a lesser degree, with the total number of people. The greatest value of these is that through them it was possible to validate the syntactic models (see Figure 5).

On this line it is also interesting to underline the graphic representation of the use of space which gives a visual account of the real use of the system and allows showing the validation of the models (see Figure 6).

7   Subjective Evaluation and Social Interaction Network

The questionnaire to academic staff and a sample of students from each of the campuses asked a series of questions about the full list of academic teaching units and the four campuses as a whole. The questions asked respondents to rate the 'liveliness', 'identity' and 'ease of encounter between students and academics' and 'between students'. Questionnaires were traceable to the academic unit and campus of the respondent, and were split into staff and student responses. It was possible to rate the responses of those who were in the same campus but a different academic unit ('inhabitants'), and those from different campuses ('non-inhabitants').

The views of academics and students with respect to the 'liveliness' and 'identity' of the four campuses varies considerably. Academics and students evaluated the Lo Contador and Oriente Campuses more positively than San Joaquín and Casa Central

which were evaluated relatively negatively (the latter receiving the lowest evaluation in both aspects). In general terms it must be said that the academics and inhabitants evaluate their own campuses and academic units more positively than students and non-inhabitants.

The 'ease of encounter between students and academics' was generally evaluated worse than 'identity' and 'liveliness'; in general terms the trends described for the above are maintained, although Lo Contador is better than Campus Oriente in this respect (80% consider this relation easy among the Lo Contador inhabitants, in comparison to 73% in Oriente). This could be understood in terms of the spatial and programmatic characteristics of Campus Oriente, which have led to an appropriation of the open space by the students with little presence of academics. Nevertheless the students in San Joaquín and Casa Central qualify this aspect more negatively: in the first case only 54% and in the second 60% consider the interaction between academics and students to be easy.

A relation between the integration of each academic unit and the subjective perception by the members of the academic unit, inhabitants of the campus and of other campuses was also looked for. Each academic unit was allocated a global and local integration value according to the axial line of the system that best characterised (the one that passed through its access or through its main spaces when no access was clearly identified) and these values were correlated with the survey data. However it was not possible to identify any clear relationship between the degree of spatial integration or segregation of the academic unit and the perceptions of its inhabitants. A possible conclusion from this exercise would be that perceptions are derived from the way individuals experience the whole campus or university as they move around it rather than just the particular locational characteristics of the academic unit.

One of the most interesting results of the study was finding that the social network of students and academics relates with the integration values of the academic units. The global and local integration values assigned to the academic units were correlated with the survey information on the number of academics and students from other academic units who claimed to know academics and students of the respective academic unit, as well as with the stated frequency of contact.

Integration was found to explain the number of academics and students known by the other inhabitants of the campus to a significant degree (r2=0.44 in the case of academics and 0.33 for students) and also to the frequency of contact indicator among the inhabitants of the same campus (r2=0.36 for academics and 0.30 for students). Although the degree of correlation is relatively low, the trends are positive and significant. These same indicators were analysed with data from the inhabitants of other campuses, finding that although the relations were weak, they were indicative of the same tendencies (r2=0.24 for academics and 0.15 for students in respect of the number of academics and students known, and r2=0.10 for academics and 0.15 for students in respect of frequency of contact). An interesting aspect is that for both measurements (number of people that know someone and contact frequency) global integration better explains the relations between students and academics of the same campus and local integration better explains the relations between students and academics of other campuses.

As a way of controlling for the effect of programmatic factors, the same indicators
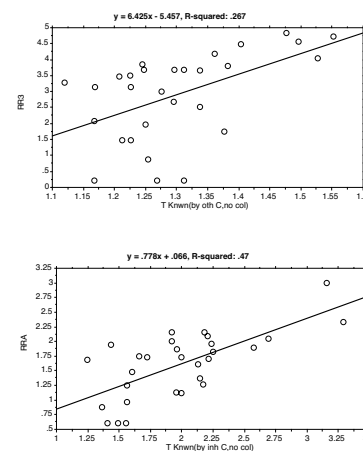
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Figure 7. Correlations between Integration and Indicator of Known Academics (without considering the academics that are actually engaged in collaborations).

Global Integration and Indicator of Known Academics by Other Academic Units of the Campus.

Local Integration and Indicator of Known Academics by Other Campuses.

were correlated, but only considering the academics that declared not to have had collaborations with the other academic unit during the last year and the students which had not attended courses in the other academic unit. The power of prediction of the syntactic measurements improved in the case of academics, but weakened in the case of students (see Figure 7). This suggests that the programme (academic collaboration) is indeed a significant factor for academic staff, but that it acts as a distinct variable.

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The significant aspect of these correlations is that they seem to indicate that the more integrated the academic unit, the better known its academics and students and the higher their frequency of contact with the students and academics of other academic units. According to our theoretical background, this would suggest that the academics of integrated academic units should have a better chance of generating advances in knowledge, and their students should have better chances of becoming part of an interdisciplinary (weak) university solidarity which will support them in their future role as professionals.

However, the fact that local integration best predicts inter-campus interactions and global integration best predicts intra-campus interactions suggests a somewhat more subtle dynamic. It would seem that powerful local integration in the absence of global integration, as seen at Campus Oriente, gives rise to a reinforcement of the local and largely student-student interaction and solidarity formation. This is clearly manifested in space in the form of very obvious high rates of interaction and static space use relative to movement. This is then perceived by non-inhabitants of the campus and, through a mechanism that at present remains unclear, gives rise to stronger reported interactions at a university wide scale. In this sense the perception of a strong local identity may be held to generate the 'weak ties' (using Granovetter's terminology) between different disciplines, at the same time as generating 'strong ties' within the unit concerned.

The main finding of this study is that it appears to be the transpatial factor of local group identity which is generated by local integration and, possibly, relative global segregation. At the same time the more spatially restricted networks between academic units but within single campuses depend most strongly on global integration. At this more localised scale spatial accessibility becomes the main factor - it is not the unit's identity that matters - but how often they are actually seen. It seems reasonable to propose that weak ties require strong ties for their creation - that interdisciplinary networks require well identified and locatable disciplines to link between. At the same time, strong ties require actual spatial realisation for their generation and maintenance. In this sense it is possible that the apparent conflict between the needs for innovation and conservation may not arise in reality. Spatial configuration, through its ability to function at more than one scale, can generate both local identity and global accessibility.

8   Final Considerations

After the presentation of this ambitious, though exploratory, study it is important to point out some of its restrictions. As we stated initially, the work did not include important aspects which should be considered to fine tune the models. In general

terms, this refers to the limited scale at which we worked. A deeper study would include on the one hand, the insertion of the campus in its urban context and on the other, incorporate the rooms which feed the open space network. In addition, more observations of the use of open space would be included and a larger and more representative sample of academics and students of the different academic units would be considered in order to estimate the interaction network in a more precise way.

Nevertheless, it is also necessary to underline the contributions of the study, which can be described as both practical and theoretical. On the practical side, the study has delivered preliminary models of local and global integration which allow the simulation of interventions and prediction of their effect on pedestrian flows and encounter between people. In the light of the more substantive theoretical findings of the study this permits us to evaluate the type of spatial community that is being generated and the effects that this could have on the PUC mission. These models have already proven to be valuable planning tools. We are referring here to the competition for the new general plan of Campus San Joaquín, which was won by Architect Renato Parada. His proposition started as an intuitive idea and was later strengthened by the syntactic analysis described in this paper. Unlike the propositions of other competitors, he proposed a new access to the campus through its integrating nucleus and the location of the new chapel at precisely the intersection between the two most integrated lines.

13.15

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