Decision support system for university campus quality of life evaluation based on users' perception

A case study applied to the Campus of the University of Minho

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Abstract: This paper presents the work that conduced to the development of an information system to evaluate and monitor university campi quality of life. The system embodies two main functions: to provide information to the community and to support campus planning and management. Using a scenario describing possible actions, some users evaluated how its implementation would interfere with the quality of life on the campus. Results showed that it would produce a global improvement, in comparison to the year of the study.

1. INTRODUCTION

The Commission of the European Communities (2003) refers that the growth of the society's knowledge depends on the production of new knowledge, its transmission through education and training, its dissemination through information and communication technologies, and on its use through new industrial processes or services. From that perspective, it classifies the universities as unique, for they take part in all these processes, at their core, due to the key role they play in the three fields of research and exploitation of its results, thanks to industrial cooperation and spin-off; education and training, in particular training of researchers; and regional and local development, to which they can contribute significantly.

So, Universities have been recognised as an important agent in societies' development. One of the landmarks of this recognition was the Magna Charta Universitatum (The Magna Charta Observatory, 1988). The document was signed by all the Rectors who were in Bologna to celebrate the 900th Anniversary of the Alma Mater (from "*Alma Mater Studiorum*" implemented in the oldest European continually operating degree-granting university, the University of Bologna, in Italy). In the Magna Charta Universitatum, it is assumed that the Universities must keep on promoting cultural, scientific and technical development, not only for the new generations but also extending their action to the whole society through constant training. They should also provide education and training to the future generations and that will teach them, and through them others, to respect the great harmonies of their natural environment and life itself. In this document, recommendations are made in order to contribute to the achievement of these objectives. One of the recommendations is that "Each University must – with due allowance for particular circumstances – ensure that its students' freedoms are safeguarded, and that they enjoy concessions in which they can acquire the culture and training which it is their purpose to possess". In this context of necessary conditions, the search for guaranteeing a better quality of life in campus fits not only for the students as well as for all users.

Nowadays, besides its specific role in higher level education, university campi have assumed the form and characteristics of urban spaces for several reasons: their location, implanted in mainly urban zones or, in some cases, even merged in the urban tissue; their physical dimension, to which, for example, concerns with internal mobility are associated; their human dimension, which suggests precautions and measures when leading with a significant number of users; and their organisation, influenced by the previous items, outlining different functional spaces, providing all kind of extra curricular activities and functions, but having a not less relevant role in every day users.

The concern about the quality of modern life is a characteristic of contemporary society. A major reason for this growing interest in issues related to life quality is the paradox of affluence in modern societies in which the concern in the quality of life has increased proportionately with technological progress and increases in income (Pacione, 2003).

Over the past few years, studies about the quality of life have increasingly been focusing on urban reality. It is known that a majority of the world's population lives in urban places. This is certainly a reason for the appearance of a new line of research on the quality of urban life (Santos and Martins, 2007). The European Commission has also recognised that

Health and the quality of life are top priority areas of the Sixth Environment Action Programme (European Commission, 2006). It even says that, for people living in cities, a good quality of life largely depends on the quality of the urban environment.

Therefore, the main objective of the work presented in this paper is to implement an information system to evaluate and monitor university campi' quality of life. The system embodies two main functions: to inform, allowing any user to know how the quality of life on campus has evolved and to be a decision support tool, mainly for facilities planning and management, taking advantages of users participation, through individual evaluations, in getting a global quality of life users perception.

2. QUALITY OF LIFE IN UNIVERSITY CAMPI

Along the last two decades, Portuguese Universities have been doing a strong effort in facilities investment. This was the result of an assumed policy of continued growth. It is agreed that the growing cycle will shortly achieve its limit, as all the initially foreseen valencies are installed, and an increasing offer is not expected due to the predictable demand reduction. The admissible growth will be necessarily focused on the creation of last valencies not yet contemplated and on the demand of new targets, namely at the level of postgraduate and continuous formation.

Through growth consolidation of the existent projects, a process, where the dimension increase will give place to quality improvement, must emerge. Quality of teaching and investigation projects also relies on the quality of the spaces where they are developed. Those spaces can be buildings, with their classrooms, laboratories, and services or exterior spaces on the campi, leisure facilities, or traffic and parking conditions.

From that point of view, two approaches can be considered for the management of physical infrastructures: investments in infrastructures and buildings; and the campus quality of life. The construction effort was not always followed by qualitative measures that could promote a balanced liveability to thousands of students, teachers, investigators, staffs and visitors who daily spend many hours of their life in university campi.

Besides the obvious needs associated to their specific activities, those users aspire to a healthy and secure milieu, with a good and comfortable architectonic environment, with appropriated and well located facilities, with good mobility and accessibility levels, etc. In short, they aspire to a University Campus with quality of life.

Quality of life became a common expression in our vocabulary. But it does not mean this concept has acquired a precise sense. About looking for a definition of a concept as vast as the quality of life is, Tobelem-Zanin (1995) refers to it as essentially a dimension definition problem. However, the author still considers that the concept frontiers remain fuzzy.

3. METHODOLOGY

3.1 Approach

In spite of the known difficulties to find a universal definition of quality of life in urban spaces, there is some consensus concerning the approach conducing to its conceptualisation. In this context, and without depreciating the discussion about the conceptual and qualitative aspects, the development of evaluation and monitoring tools to analyse the quality of life degree provided to campi' users are seen as relevant.

The methodology approach starts with the identification of a set of quality of life dimensions, which are related to aspects of the campi liveability (Rodrigues, Ramos, et al., 2005; Rodrigues, 2008). These dimensions, whose identification will necessarily result from the opinion of a set of users (directly or through a representation scheme) about a "standard" list previously defined, are described by a set of indicators. So, using an exhaustive number of indicators that describes several dimensions for the quality of life in campus (QlC), as well as their evaluation and monitoring, it is possible to conceive a system that contributes to the decision making in campus management. The same system will allow the community to have access to relevant information that will help to understand better how quality of life has evolved.

On the other hand, in Portugal, universities work in a context where the availability of funding resources is limited and depends on the ability to attract students. University Campus management and planning will benefit from any kind of support that could supply relevant information, in order to contribute to better decision making when searching the best solutions for the managed institution, as well as for all the users. In this context, a decision support system can be very useful.

3.2 Quality of Life in Campus - QlC Evaluation model

As in a small city, the liveability in a university campus is conditioned by many factors, such as the environmental conditions, mobility, accessibility to services and work places, and social conditions. Then, it is understandable that a university campus can be seen as an urban space. This idea is reinforced when considering the definition of a city given by Merlin (1994): "a reunion of men, in a favourable localisation, to drive collective activities, a place for people, goods, capitals, ideas and information exchange, being simultaneously a framework, a motor and the result of human activities" (free translation). For that reason, the methodology exposed by Mendes (2004) and implemented in several previous works of the author (Mendes, 1999; Mendes, 2000; Mendes, 2004) was adopted for the Evaluation of the Quality of Life in University Campuses. With the necessary adaptations, the following steps were proposed as a framework for the QlC Evaluation model:

a. To identify the dimensions to be considered in the evaluation of the QlC;
b. To establish a system of weights for the dimensions, through direct inquiry to the users, groups of interest or decision-makers;
c. To identify/build the set of indicators that characterises each one of the dimensions considered. This process is based essentially in the judgement of the investigator about the relevance of the indicators, since its adoption is usually conditioned by the availability of information;
d. To establish a scoring scale for the evaluation of the indicators, properly normalised, allowing its aggregation;
e. To establish a system of weights for the indicators. The weights attributed to the several indicators, inside each dimension, should be based essentially in the judgement of the investigator, due to the specificity of the indicators;
f. To establish the indicator aggregation rules, inside each dimension;
g. To establish the dimension aggregation rules.

3.2.1 Indicators

The choice of indicators depends on definitions (which are context dependent); their representation at a given moment and over time; measurement techniques; their compatibility and predictive accuracy; and their purpose, which is related to the objectives and priorities of those who use them. They are also affected by the kinds of information that are available or that can be obtained, the pertinence of that information, and its level of abstraction in relation to concrete themes or subjects (OECD, 1997).

As the objective was to evaluate and monitor Quality of Life on campus, five dimensions were identified as appropriate for the study (Rodrigues, Ramos, et al., 2005): Environment, Mobility and Parking, Safety, Urban Space, and Services. Then, those dimensions were characterised by the construction of a list of relevant indicators for each one. This step was the result of the consultation of reference bibliography and works developed in this field, and the interaction with elements of decision and management organs of the campus chosen as case of study. The availability of information also worked as a constraint in this search. As the list was getting longer, the introduction of an intermediate grouping level was considered adequate: themes were introduced as dimensions sub-items, creating smaller groups of indicators (Table 1, adapted from Rodrigues, 2008). This structure brings some benefits: when searching and selecting indicators, it allows us to better define the extent of this task, defining sub-contexts of quality of life intended to be characterised; when using those indicators in the evaluation, it is possible to reflect this structure in the indicators selection, combination and even weights assignment operations. Table 2 (adapted from Rodrigues, 2008) shows the indicators of one dimension grouped by themes.

Table 1. QlC Evaluation - list of Dimensions and Themes

QlC Dimensions	***Themes***
(1) Environment	(1.1) Environmental noise, (1.2) Air quality, (1.3) Waste management
(2) Mobility and parking	(2.1) Campus accessibility level, (2.2) Campus accessibility level for handicapped people, (2.3) Internal road network, (2.4) Internal pedestrian network, (2.5) Pedestrian accessibility ratio, (2.6) Handicapped people accessibility ratio, (2.7) Parking offer, (2.8) Public transport, (2.9) Service level of the axis campus-city
(3) Safety	(3.1) Crimes in campus, (3.2) Campus surveillance, (3.3) Fire fighting, (3.4) Evacuation exercises
(4) Urban space	(4.1) Functional zoning, (4.2) Urban furniture, (4.3) Internal signalling, (4.4) Campus works
(5) Support services	(5.1) Food and drinks, (5.2) Shopping, (5.3) Services, (5.4) Leisure and culture, (5.5) Sports

Table 2. Support Services dimension indicators grouped by themes

Themes	***Indicators***
(5.1) Food and drinks	(5.1.1)Bar capacity (clients zone); (5.1.2) 5.1.1 per 1000 users; (5.1.3) Restaurant capacity (clients zone); (5.1.4) 5.1.3 per 1000 users; (5.1.5) Number of vending-machines; (5.1.6) 5.1.5 1000 users
(5.2) Shopping	(5.2.1) Area of newspapers and magazines kiosks; (5.2.2) 5.2.1 per 1000 users; (5.2.3) Area of bookstore; (5.2.4) per 1000 users; (5.2.5) Area of other shops; (5.2.6) per 1000 users
(5.3) Services	(5.3.1) Area of travel agency; (5.3.2) 5.3.1 per 1000 users; (5.3.3)Area of banks; (5.3.4) 5.3.3 per 1000 users; (5.3.5) Number of ATM; (5.3.6) 5.3.5 per 1000 users; (5.3.7) Number of public phones; (5.3.8) 5.3.7 per 1000 users; (5.3.9) Medical Support; (5.3.10) Percentage of wireless network coverage; (5.3.11) Area of other services; (5.3.12) 5.3.11 per 1000 users
(5.4) Leisure and culture	(5.4.1) Number of places in auditorium (with capacity superior to 100 places); (5.4.2) 5.4.1 per 1000 users; (5.4.3) Number of cultural events by year; (5.4.4) 5.4.3 per 1000 users; (5.4.5) Number of sport events by year; (5.4.6) 5.4.5 per 1000 users
(5.5) Sports	(5.5.1) Area of indoor sports facilities; (5.5.2) per 1000 users; (5.5.3) Area of outdoor sports facilities; (5.5.4) 5.5.3 per 1000 users; (5.5.5) Number of available sport modalities; (5.5.6) Number of registered practising users; (5.5.7) Percentage of registered practising users

3.2.2 Global QlC index

To get a global QlC index, it is necessary to find a way to combine the meaning of the indicators values. The calculation of the global QlC will reflect the grouping structure adopted for indicators. It means that indicators are combined at the theme level, themes indexes are combined at the dimension level, and finally, the global index results from the dimensions indexes combination.

Denoting the standardised value of an indicator *i* of a theme *t* by x_i^t, and w_i^t as its weight, a theme QlC index (S_t) is given by equation (1):

$$S_t = \sum_i^{n_t} w_i^t x_i^t \tag{1}$$

Equation (1) is essentially a Weighted Linear Combination, one of the aggregation procedures available in the context of multicriteria evaluation (Voogd, 1983).

A very important component of a multicriteria evaluation model concerns the priorities attached to the various criteria, i.e. the values of the weights w_i^t in equation (1). The objective of developing weights is to quantify the relative importance of criteria to one another, in terms of their contribution to an overall index. Among many methods to derive weights established and used by different authors, two are most commonly used (Mendes, 2000): the n-points scale (originally seven-points scale, as introduced by Osgood et al. (1957)); and a more complex method called Pairwise Comparisons, which was developed by Saaty (1977) in the context of a decision making process known as Analytical Hierarchy Process (AHP).

Using the same approach as for the calculation of the themes indexes, a dimension QlC index (S_d) can be calculated by equation (2), where w_t^d denotes a theme weight and S_t^d a theme QlC index (see equation 1):

$$S_d = \sum_t^{n_d} w_t^d S_t^d \tag{2}$$

Finally, the global QlC index (*S*) is achieved by equation (3), where S_d is a dimension QlC index (see equation 2) and w_d its respective weight:

$$S = \sum_d^{n} w_d S_d \tag{3}$$

Because of different scales upon which indicators are measured, it is necessary to standardise them before aggregation. Using indicators values of a year considered as a reference, the standardisation of indicators submitted to the evaluation process is the result of the comparison between them. So, the values of the reference year work as a standard value (100). The values of the year to be evaluated are compared to those, using the standard value

(100) to convert them in a standardise value that reflects its evolution. For instance, when an indicator has a positive contribution to QlC (i.e. its value increase also means a QlC improvement), we can say that an indicator as evolve positively in QlC contribution, when its standardised value is greater than 100. If an indicator is classified as having a negative contribution, then its standardised value will be greater than 100 (positive evolution) when its value is smaller than the one from the base year.

To avoid that standardisation could result in virtually infinite values, a limit value to positive contribution should be established. This limit value represents a value that indicates when a maximum positive contribution is achieved, i.e. the standardisation of any value greater than the limit will result in a same standardised value for the limit.

3.3 QlC System structure

A system containing four major components was idealised (Figure 1). These components are a database subsystem, a models subsystem, a reports creator and an interface with the community.

The database subsystem includes a database (DB) that stores all the relevant data for the problem, as well as their description (metadata). All data accesses are made through a DataBase Management System (DBMS). These operations can be creation / insertion, updating or query. The models database subsystem is dedicated to the management, maintenance and operation of models. For such, it integrates a models base (MB) for its storage. As referred for data, there is also a models management system that manages the access process to the models base (MMS). It also allows the creation of new models when using any appropriate tool or programming language. Furthermore, it provides the possibility to interconnect models with proper connections to the data base. The reports creator collects all the necessary procedures and tools for reports creation. It allows us to produce documents of synthesis, analysis and comparative synthesis, which can present the information in tabulate or graphical form, improving its perception and interpretation.

The interface with the community is a subsystem that allows, in a transparent manner, the interaction and operation with the remaining subsystems. Users can participate in the process and take advantages of the available functions, without however being required extended computer skills. For that reason the interface should be based on a well known working environment and with which computer users are more familiarised: the internet browser was elected. Also with the aim to turn interaction with the system as simple as possible, users should only be asked to do basic actions, such as inserting values, selecting items or clicking on buttons to initiate new actions, tasks that are very common when using a web browser.

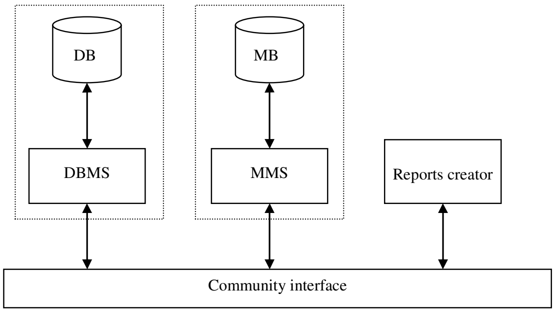

Figure 1. Components of the QlC System structure

All the information flows between the several subsystems will not be much perceptible to the user, given that his interaction with the system is established and orientated by the interface. However, these flows exist. The models subsystem queries for data the database subsystem to feed its models. The database subsystem will receive all information that is intended to be stored. The reports creator consults the database and, eventually, the models base to gather all necessary data in reports construction. While administering and orientating all steps given by the users, the interface has the role to start actions or operations that lead to the appearance of these flows. It has also the task of directing these flows between the several subsystems, in order to guarantee expected results (for example, to store new values or to supply a user with results).

In the next two subsections, two recommendations in system implementation are made: to include wizards to simplify users' actions; and also to enable users to navigate freely through the available information. These two aspects can greatly contribute to the success of a system.

3.3.1 Wizards

A wizard is a way of interaction that guides the user through a process. This guidance is done providing, in sequence, some steps that the user should follow, with the aim to reach the end of the process, simplifying actions to be taken and also reducing as much as possible user's interventions. The adoption of wizards is considered appropriated in order to turn the system more appealing and accessible to users, for it is a way to promote community's participation. On the other hand, the appliance of this type of interface also aims to minimise mistakes when gathering useful and essential information that would result in incorrect subsequent analyses.

Due to the fact that the collection of individual evaluations from members of the academic community is a critical process of the system, the construction of a wizard that will guide participants through the evaluation steps is considered essential to attain the expected results.

3.3.2 Non-standard processes

The non-standard processes will allow users to freely consult and collect information, i.e. without having to follow any wizard instruction. A user who accesses to the system will be able to explore all the available resources, without having to follow previous defined steps and iterations. So, navigation must be simplified. The use of menus and options integrated in a global structure can globally transform more intuitive and simple accesses. Keeping that in mind, providing the campus QlC current state, through the consultation of values referring to the eligible indicators in evaluation of the quality of life variation, will certainly improve the information function of system. Besides that, this description can include several maps that illustrate some indicators, namely when an indicator is represented by none discreet values (for example, areas).

4. A CASE STUDY: UNIVERSITY OF MINHO CAMPUS

The methodology presented in the previous section was implemented and tested as a case study developed at the Gualtar Campus of the University of Minho, Braga, Portugal. The Campus is located in a peripheral area of the city of Braga, and occupies an area of twelve hectares. The community of the Campus has about 13100 users, being 12000 students, 800 professors and lecturers (teachers) and 300 staff employees. The buildings support academic activities, congregate Schools and Institutes, three Classroom Complexes and several buildings for services, such as the Library, the Computational Centre, the Academic Services, the Sports Complex, etc.

4.1 Indicators, themes and dimensions weights

During the process of individual evaluation of quality of life, all data inserted by the users are stored by the system. One of these data is the weight assigned by each user to indicators, themes and dimensions (section 3.2). The quality of life variation evaluation by groups of users depends on the system ability to process this information: weights must be derived for the evaluation by group. For each group, this task consists in, gathering all data associated to the group. It is then possible to calculate a weight for each indicator, theme and dimension. It is done by calculating the average of the weights assigned by the users belonging to the same group. Due to the fact that participants had the possibility to select only some indicators to carry out their evaluations, we considered that the evaluation by groups would be done with the whole set of indicators. For that reason, to all unselected items in individual evaluations a weight of 0 was assigned.

Table 3 shows the weights obtained for the dimensions and for each users group. These values correspond to the participation of 45 students, 8 teachers and 10 members of the administrative staff. This panel of participants intended to represent the different groups of users existing in the academic community, namely in this phase of system test. So, the Community value is the aggregation of the previous three values, proportional to their relative importance. It can also be observed that the several groups have assigned different levels to the dimensions.

Table 3. Dimension weights by users groups

	Students	Teachers	Staffs	Community
Environment	0.206	0.206	0.218	0.208
Parking and mobility	0.197	0.212	0.194	0.198
Safety	0.206	0.230	0.218	0.211
Urban space	0.181	0.164	0.181	0.179
Support services	0.210	0.188	0.190	0.204

4.2 QlC evaluation scenario

Evaluating the QlC variation that occurred in the last two years will result in information with a limited contribution to campus planning and management. In fact, as actions already took place, only conclusions of what went right or wrong can be the result of that type of analysis. However, if a set of hypothetical actions and measures is submitted to a comparative evaluation, effects on quality of life can be measured before its implementation. Even more, several scenarios can be evaluated, using the same reference year, to find which one better performs in QlC improvement.

To validate the model and the system, a set of members of the academic community was invited to individually evaluate the quality of life variation between the base year of 2006 and a scenario for 2007. Each campus user had to choose the indicators that he wanted to consider, and had to assign them weights that would be applied in further calculations.

Data referring to the year 2006 served as a base for the creation of the above mentioned scenario, i.e. new values were assigned to some indicators whereas the remainder, which were considered unchanged, maintained the same previous value (equal to the base year). Updating the value of an indicator did not simply result from an act of insertion of a new value, but from the consideration of possible events or interventions on the campus. This assumption can lead to the change of several indicators values that could be affected by a particular event. For instance, if we consider the possibility of planting more trees, the scenario will reflect this action by the assignment of new values to indicators like the, number of trees and the number of trees by hectare. In that way, a scenario year intends to represent possible interventions on the campus that could provoke a quality of life variation, updating affected indicators values.

The scenario for 2007 resulted from considering the possibility:

i) of installing a new recycling container to improve actual coverage (to reduce the distances) of the campus. It implies the assignment of a new value to indicators total number of recycling containers and total number of recycling containers per hectare;

ii) of increasing to 14 the number of daily buses running between the campus and the city centre, from 8am to 8pm;

iii) of installing 6 new exterior fire hydrants to reinforce the existent net. The affected indicators are a number of exterior fire hydrants, a number of exterior fire hydrants per hectare and a number of exterior fire hydrants per 1000 m2 of construction (implantation);

iv) of planting 50 new trees, trying to improve the physical and natural environment of the campus, the indicators total number of trees and total number of trees per hectare received values that reflect this changing;

v) of constructing the new building announced in the UMDicas newspaper (published by the university social services), which will include a new sports complex, a cardio-fitness room and a medical centre; it affects several indicators, distributed on more than one dimension. With an area of approximately 782 m^2, this value was added to the existent value for area of indoor sports equipment, leading consequently to a new value for the area of indoor sports equipment per 1000 users. Due to the fact that a part (179 m^2) of the new facility will occupy a portion of space devoted to the practice of outdoor sports, this will have an impact on subsequent indicators, the outdoor sports equipment area and the outdoor sports equipment per 1000 users area. If until now the dimension support services, and its theme sports, were only a target of a closer look, that kind of intervention on the campus also has an impact on the dimension urban space, namely on the functional zoning theme. So, there is an increase of the built area, as for implantation, as for pavements. Consequently, the value of other indicators must be re-calculated, as long as they are directly related with the previous ones. In this situation, we found the built area (pavements) per user, the built area percentage and the construction rate;

vi) of installing another Automatic Teller Machine (ATM), that would improve the coverage of this type of equipments, namely in the sports complex where the offered services require payments;

vii) of increasing the medical support to 10 hours, making it available from Monday to Friday, even for short periods of 2 hours;

viii) of improving the wireless network coverage, especially outside buildings that for now is only available indirectly (only when in range of inside buildings network coverage).

4.3 QlC evaluation results

The last step of the quality of life variation evaluation process consists in calculating indexes for each group. This task implies the application of the weights previously referred. Table 4 shows indexes obtained for each campus user group.

Table 4. Quality of life variation indexes by group

Group	**Index**
Students	107.4
Teachers	108.0
Staff	107.7
Community	107.5

As it can be seen in table 4, the implementation of the evaluated scenario would origin a positive variation of the quality of life for all the groups, i.e. the obtained indexes are all higher than 100 (base value). Presented values do not differ much. This can be justified by the fact that users did assign weights in a quite similar manner. Even short, the biggest difference is found between the students index and teachers one. This gap happened because the teacher group took some different options when assigning weights in comparison to the remaining groups.

Using the scenario previously described, Table 5 shows how the variation of each affected indicators is numerically translated by the normalisation process. Only these indicators are shown, although the remainders were unchanged, i.e., their normalised value is equal to 100 (reference value).

The system also provides graphical results. Charts show the quality of life variation by dimension. With that kind of representation, it is possible to observe how each dimension has contributed to final indexes. For example, Figure 3 shows that Environment dimension got a higher value, more than

100 for each group. It means that the QlC variation is always positive, i.e., in any case, this dimension contributed positively to the global index. Looking at the results of each group, we can also see that they were not quite similar, because only the value for the Teachers group is different.

Table 5. Scenario indicators normalised values

Total number of recycling containers	133
Total number of recycling containers, per hectare	135
Number of daily buses running between the campus and the city centre (8am to 8pm)	121
Number of exterior fire hydrants	143
Number of exterior fire hydrants, per hectare	142
Number of exterior fire hydrants, per 1000 m2 of construction (implantation)	140
Built area (implantation)	98
Built area (pavements)	99
Built area (pavements), per user	99
Percentage of built area	96
Number of trees	108
Number of trees, per hectare	107
Number of ATM	120
Number of ATM, per 1000 users	118
Percentage of wireless network coverage	167
Medical support	250
Area of indoor sports facilities	122
Area of indoor sports facilities, per 1000 users	122
Area of outdoor sports facilities	92
Area of outdoor sports facilities, per 1000 users	92

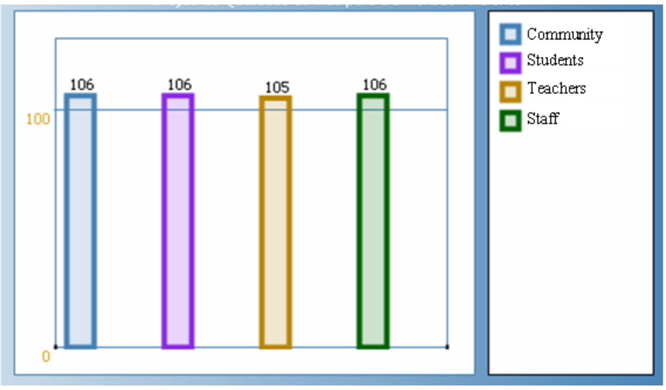

Figure 2. Quality of life variation for the Environment Dimension

Analysing the other dimensions graphs - see Rodrigues (2008), the differences between groups' indexes values, when they exist, were never higher than one positive point. When comparing those values the reference indexes (100), the dimension urban space and the dimension mobility and parking presented a variation which was not higher than one point. The others revealed a more significant variation with a difference of five, six or seven points. However, the dimension safety got results that are beyond those, presenting a variation of twenty-two points for teachers and twenty-three for the other groups.

5. CONCLUSIONS

Basically, the presented model aims to determine a global index of the Quality of Life in Campus (QlC) variation, comparing different moments in time. Comparing directly a set of indicators, this index allows us to evaluate how QlC has evolved in general terms. If results are analysed at the indicator level, i.e. studying the variations of each indicator, it is possible to identify which ones have contributed more significantly to QlC variation trend. That kind of analysis can also be conducted to a theme level, as well as to a dimension level. In other words, the system's outputs can be used to analyse the quality of life variation profile.

To collect necessary data, a database subsystem was designed to store all the relevant information related to individual evaluations. The participation of a set of students, teachers and staffs was crucial. Gathering information and opinions was helpful and it allowed us to validate its functionality.

Thanks to the storage of individual participations, the calculation process of QlC variation indexes by users groups became possible. On the other hand, the impact of future interventions on QlC can also be measured through the evaluation of scenarios. Providing these functions, the system can effectively work as a decision support tool for campus planning and management, when searching for solutions that meet users needs. Furthermore, as the community involvement is important, a special attention was given to the system's interface design. All required actions were kept as simple as possible and a user-friendly interface was developed, using web browsers as working environment.

By using a base year when calculating general indexes of QlC variation it was possible to collect information that would be useful for temporal analysis. So, it is possible to compare several years to a common base year, showing obtained indexes and allowing the search for a tendency. For a time period where data of different years are available, a QlC variation evaluation can be carried out using successively each year as a base year. The variation will be calculated when comparing to the first following year in the chronological order. Indexes refer to comparisons of pairs of years that cover the whole studied period.

The system also has an informative function, allowing users to build up their own ad-hoc analysis. Information, that was unavailable or was available but diffuse, can now be accessed. A user can go through the database and access the whole available information related to the indicators. As long as it was required the item or items were better understood graphically, maps were created using a geographical information system, improving the readability of the information.

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