Should Planning-Support Tools rely on Public Participation or on Expert´s Judgments?

Antônio Nélson RODRIGUES DA SILVA, Renata Cardoso MAGAGNIN, Léa Cristina LUCAS DE SOUZA

Antônio Nélson Rodrigues da Silva, University of São Paulo, School of Engineering of São Carlos, Department of Transportation, Av. Trabalhador São-carlense, 400, 13566-590, São Carlos, SP, Brazil, anelson@sc.usp.br
Renata Cardoso Magagnin, São Paulo State University, Department of Architecture, Urbanism and Landscape Architecture, Facultyof Architecture, Arts and Communication, Av. Luis Edmundo C. Coube, 14-01, 17033-360, Bauru, SP, Brazil, magagnin@faac.unesp.br
Léa Cristina Lucas de Souza, São Paulo State University, Department of Architecture, Urbanism and Landscape Architecture, Faculty of Architecture, Arts and Communication, Av. Luis Edmundo C. Coube, 14-01, 17033-360, Bauru, SP, Brazil, leacrist@faac.unesp.br

1 INTRODUCTION

The fast and somehow chaotic urban growth process faced by many cities around the world demands the adoption of new planning methods to ensure a sustainable growth process, meant to improve the overall community quality of life. For that reason, many research teams are nowadays working on the development and adjustment of techniques for getting a stronger community participation in the planning process.

The participation of the community in the planning process can make the discussion about urban problems more comprehensive and effective, and in theory it can legitimate both the decision-making and decision-taking processes. That means that the solutions of urban issues would rely not only on politicians and planners, but also on the community affected by the decisions. Therefore, participative planning should be able to drive the development of a city for reaching sustainable development and to improve the community quality of life through an organized process. That is one of the reasons why most of the new planning support tools currently under development worldwide are in one way or another including public participation channels in the planning process. However, there is no evidence that community is always tuned with the planning requirements and, above all, constraints. Many factors (e.g., social and cultural) and the knowledge gap between the common citizens and the experts are likely to generate distinct planning alternatives and priorities. As a consequence, the overall planning process can take different directions depending on the judgments it is based upon.

In order to evaluate the impact of the different points of view assumed by regular citizens or by experts on a planning initiative, we built an experiment using PLANUTS, a Decision Support System developed for sustainable mobility planning in Brazil. Given the internal structure of the system, five Categories were considered for analyses: Transport and Environment, Transport Management, Transport Infrastructure, Transport Planning, and Socio-economic Aspects of Transport. Each one of the Categories was divided in Themes, which were further subdivided into Indicators (close to one-hundred). Categories and Themes were then evaluated by the two groups, one of experts and the other one formed by common citizens, in order to identify their relative weights and to look for differences in their evaluations.

2 METHODOLOGY

We have compared the results of the evaluations carried out by two groups of users with the Scale of Points, which is the the multicriteria analysis technique adopted in PLANUTS. The first group was formed by three experts, while the second group was formed by three community members. The selection of the groups was based on the following aspects: i) the experts were individuals involved in the development of systems for urban mobility planning, ii) the community members were individuals with different levels of knowledge about urban mobility issues, about computational tools, and with different technical and cultural backgrounds.

As shown in Figure 1, the five-points scale was the alternative adopted in PLANUTS for the evaluation of urban mobility aspects. That was as an attempt to keep the evaluation process as simple as possible, given that in a participatory planning process one can expect to have users with different backgrounds and distinct levels of knowledge about the urban mobility aspects being evaluated. The evaluation process of PLANUTS is available in Internet. The entire system is constituted by four modules for the evaluation of urban mobility aspects through Categories, Themes, and Indicators, as earlier proposed by Costa (2003). In the experiment designed for the present study, only the first module of PLANUTS was considered. That module allows the identification of the most important Categories and Themes for urban mobility planning, according to the evaluators. This is done in two phases: the first one only for Categories, and the second one for Themes.

Figure 1: Five-points evaluation scale used in PLANUTS

Considering the characteristics of the evaluations and the essentially qualitative nature of the analyses we planned to conduct with their outcomes, we choose to analyze the results using non-parametric statistical methods. Two aspects were particularly interesting for our study: the intensity of agreement among evaluators and the degree of similarity of the ranks obtained with the two methods. So, we needed statistical methods that could be used to evaluate the data correlation or the level of agreement in the judgments. Thus, we selected Kendall's Correlation Agreement Coefficient to compare the level of agreement in the evaluations of the two groups, and Kendall's Correlation Ranking Method to check if the final results of both groups were similar in terms of ranking.

3 ANALYSIS OF THE RESULTS

As a first step of the analyses, the evaluation results were used to calculate the mean values of the weights found for Categories and Themes by each group. The weights found for Categories and Themes per evaluator in each group and the mean and standard deviation values are shown in Table 1. The information contained in Table 1 made possible to identify the results (or weights) per evaluator and per group that are within an interval considered as acceptable. We defined that interval as one standard deviation to each side of the mean value obtained per criterion. Therefore, the values in dark gray cells in Table 1 are below that interval, while (light) gray cells are associated with values above that interval. The other values of Table 1 (in the non-colored cells) are within the specified interval.

An analysis of the Categories in Table 1 showed that the evaluations were quite homogeneous in both groups. In Group I, 73 % of the values are within the interval predefined as acceptable. The weights outside the interval are balanced below and above it. In the individual analysis of the evaluators, only evaluator 'A' had all results within the acceptable interval. Group II had the same number of evaluations outside the acceptable interval (27 %), but they were spread in the three evaluators.

A similar analysis was also done for the Themes, in which the evaluations were more heterogeneous. The main points observed were: i) 34 % of the values in Group I are ouside the acceptable interval (17 % below and 17 % above it); ii) 25 % of the values in Group II are ouside the acceptable interval (10 % below and 15 % above it). A more detailed analysis was done per evaluator, as follows of Group I:

- Evaluator 'A' had 80 % of the results within the acceptable interval against 20 % of the weights outside the same interval (10 % above it and 10 % below it).
- Evaluator 'B' had half of the results within the acceptable interval. The weights outside the same interval were balanced (25 % above it and 25 % below it).
- Evaluator C had 66 % of the results within the acceptable interval against 34 % of the weights outside the same interval.
- A similar analysis was also done for Group II, as follows:
- Evaluator 'D' had 55 % of the results within the acceptable interval against 45 % of the weights outside the same interval (25 % above it and 20 % below it).
- Evaluator 'E' had 80 % of the results within the acceptable interval against 20 % of the weights outside the same interval (15 % above it and 5 % below it).
- Evaluator 'F' had 90 % of the results within the acceptable interval. The weights outside the same interval were balanced (5 % above it and 5 % below it).

The analysis per evaluator allowed a comparison of the results found for each criterion in both Groups. When looking to all values outside the acceptable interval in Table 1, for instance, only a few criteria had weights in the same relative position (evaluators B and E for Urban Population and C and D for Costs, for example). That analysis approach focusing only on the mean and standard deviation values, however, was not enough for checking the intensity of agreement among evaluators within the Groups and the degree of

similarity of the ranks derived from the weights found by the two Groups. This was done with the specific methods discussed in the following subsections.

CRITERIA		GROUP I			GROUP II			MEAN	STD DEV
		A	B	C	D	E	F		
CATEGORIES									
TRANSPORT AND ENVIRONMENT		0.211	0.200	0.238	0.208	0.158	0.227	0.207	0.028
TRANSPORT MANAGEMENT		0.158	0.150	0.190	0.167	0.211	0.227	0.184	0.031
TRANSPORT INFRASTRUCTURE		0.158	0.150	0.143	0.208	0.158	0.136	0.159	0.026
TRANSPORT PLANNING		0.263	0.250	0.238	0.208	0.263	0.182	0.234	0.033
SOCIOECONOMIC ASPECTS OF TRANSPORT		0.211	0.250	0.190	0.208	0.211	0.227	0.216	0.020
THEMES									
TRANSPORT AND ENVIRONMENT	ENERGY	0.188	0.200	0.313	0.235	0.214	0.167	0.219	0.051
	ENVIRONMENTAL IMPACTS	0.313	0.333	0.250	0.235	0.286	0.278	0.282	0.037
	AIR QUALITY	0.250	0.267	0.188	0.294	0.286	0.278	0.260	0.039
	NOISE	0.250	0.200	0.250	0.235	0.214	0.278	0.238	0.028
TRANSPORT MANAGEMENT	ECONOMIC STRATEGIES	0.231	0.333	0.231	0.313	0.250	0.278	0.273	0.043
	MONITORING	0.308	0.167	0.308	0.188	0.188	0.222	0.230	0.063
	MOBILIDADE URBANA	0.231	0.250	0.231	0.188	0.250	0.222	0.229	0.023
	NEW TECHNOLOGIES	0.231	0.250	0.231	0.313	0.313	0.278	0.269	0.038
TRANSPORT INFRASTRUCTURE	FLEET	0.188	0.250	0.231	0.118	0.214	0.222	0.204	0.047
	ROADWAY SYSTEM	0.313	0.375	0.308	0.294	0.286	0.278	0.309	0.035
	TRANSPORT SERVICES	0.250	0.250	0.231	0.294	0.286	0.278	0.265	0.025
	TRAFFIC	0.250	0.125	0.231	0.294	0.214	0.222	0.223	0.056
TRANSPORT PLANNING	URBAN ACCESSIBILITY	0.278	0.294	0.250	0.222	0.364	0.333	0.290	0.052
	URBAN GROWTH	0.278	0.294	0.250	0.278	0.273	0.267	0.273	0.015
	URBAN POPULATION	0.222	0.176	0.250	0.222	0.182	0.200	0.209	0.028
	TRIPS	0.222	0.235	0.250	0.278	0.182	0.200	0.228	0.035
SOCIOECONOMIC ASPECTS OF TRANSPORT	COSTS	0.188	0.222	0.250	0.250	0.200	0.211	0.220	0.026
	SOCIOECONOMIC IMPACTS	0.250	0.222	0.250	0.250	0.267	0.263	0.250	0.016
	ROAD SAFETY	0.313	0.278	0.250	0.250	0.267	0.263	0.270	0.023
	PUBLIC TRANSPORT	0.250	0.278	0.250	0.250	0.267	0.263	0.260	0.012

Table 1: Weights found for the Categories and Themes per evaluator and per Group

3.1 The Agreement within Groups

The Kendall's Correlation Agreement Coefficient makes possible to compare the intensity of the agreement observed in multiple sets of data, based on their ranking. The correlation coefficient (W) produced with the method varies from zero to one. The interpretation of the coefficient values is straightforward: zero indicates no correlation, one indicates total correlation, and the values in between show the intensity of the relationship as they approach zero (low correlation) or one (strong correlation). The application of the method in our study was done to verify the intensity of agreement among evaluators in each one of the Groups. The results of the application of Kendall's Correlation Agreement Method for Categories and Themes are shown in Table 2.

In the case of the Categories, the results in Table 2 showed a strong agreement of the evaluators in the group of experts (W = 0.846). Conversely, that agreement was not so strong in the Group of community members (W = 0.235). The W values for the Themes shown in Table 2 were calculated within the Categories. The Categories with the strongest agreement were: Transport Planning, for Group I; and Transport and Environment, Transport Management, Transport Infrastructure, and Socioeconomic Aspects of Transport, for Group II. The agreement was evident in the Theme Transport Management for Group I (W = 0.867) On the other hand, the same Theme had a very low coefficient for Group II (W = 0.144). That difference in the value of W reflects the distinct points of view of experts and community members regarding the aspects of transport management in the city.

3.2 The Similarity of the Results Obtained

The Kendall's Correlation Ranking Method made possible to check if the final results of both methods were similar in terms of ranking. The correlation coefficient (τ) produced with the method is in the interval $-1 \leq \tau$

≤1. The interpretation of the coefficient values is direct: zero indicates no correlation, and one (either positive or negative) indicates total correlation. Positive values indicate a direct relationship while negative values show an inverse relationship. The application of the method in our study was done to verify how similar are the results obtained by the different groups in terms of ranking. The data used in the calculation and the results obtained are displayed in Table 3. The analyses of the results show a perfect positive correlation in the case of the Categories ($\tau = 1.000$), but a relatively low value for the Themes ($\tau = 0.471$).

CRITERIA		RANKING						W (Kendall's Coefficient)	
		GROUP I			GROUP II			GROUP I	GROUP II
		A	B	C	D	E	F		
CATEGORIES									
TRANSPORT AND ENVIRONMENT		2	3	1	1	4	1	0.846	0.235
TRANSPORT MANAGEMENT		4	4	3	5	2	1		
TRANSPORT INFRASTRUCTURE		4	4	5	1	4	5		
TRANSPORT PLANNING		1	1	1	1	1	4		
SOCIOECONOMIC ASPECTS OF TRANSPORT		2	1	3	1	2	1		
THEMES									
TRANSPORT AND ENVIRONMENT	ENERGY	4	3	1	2	3	4	0.333	0.623
	ENVIRONMENTAL IMPACTS	1	1	2	2	1	1		
	AIR QUALITY	2	2	4	1	1	1		
	NOISE	2	3	2	4	3	1		
TRANSPORT MANAGEMENT	ECONOMIC STRATEGIES	2	1	2	1	2	1	0.144	0.867
	MONITORING	1	4	1	3	4	3		
	MOBILIDADE URBANA	2	2	2	3	2	3		
	NEW TECHNOLOGIES	2	2	2	1	1	1		
TRANSPORT INFRASTRUCTURE	FLEET	4	2	2	4	3	3	0.792	0.818
	ROADWAY SYSTEM	1	1	1	1	1	1		
	TRANSPORT SERVICES	2	2	2	1	1	1		
	TRAFFIC	2	4	2	1	3	3		
TRANSPORT PLANNING	URBAN ACCESSIBILITY	1	1	1	3	1	1	0.647	0.462
	URBAN GROWTH	1	1	1	1	2	2		
	URBAN POPULATION	3	4	1	3	3	3		
	TRIPS	3	3	1	1	3	3		
SOCIOECONOMIC ASPECTS OF TRANSPORT	COSTS	4	3	1	1	4	4	0.569	0.667
	SOCIOECONOMIC IMPACTS	2	3	1	1	1	1		
	ROAD SAFETY	1	1	1	1	1	1		
	PUBLIC TRANSPORT	2	1	1	1	1	1		

Table 2: Kendall's Correlation Agreement Coefficient (W) for Categories and Themes

4 CONCLUSIONS

The main conclusions drawn from the application of the non-parametric statistical methods for comparing the results of the evaluation carried out by the groups of experts and of community members were:

- The application of the Kendall's Correlation Agreement Method indicated a considerable difference in the evaluations conducted within the two Groups. While the group of experts agreed in the analysis of Categories, they did not agree in the evaluation of the Themes. It happened exactly the opposite in the evaluations of the community members.
- Through the Kendall's Correlation Ranking Method we observed a positive correlation of the results obtained by the two Groups for both Categories and Themes related to urban mobility. In the case of the Categories, there was a perfect correlation. In the case of the Themes, however, the value of the correlation coefficient found suggests a reasonable difference in the points of view of the two Groups.

In an overall comparison of the results obtained in the evaluations of the different Groups, we found that our system apparently should not rely only on the judgements of experts, given the differences in the judgments expressed by the two groups. However, as the experiment involved only small groups of both experts and community members, further analyses with larger groups and with other methods of analysis are needed.

CRITERIA		FINALWEIGHTS		RANKING		τ (Kendall's Coefficient)
		GROUP I	GROUP II	GROUP I	GROUP II	
CATEGORIES						
TRANSPORT AND ENVIRONMENT		0.217	0.200	2	3	1.000
TRANSPORT MANAGEMENT		0.167	0.200	4	3	
TRANSPORT INFRASTRUCTURE		0.150	0.169	5	5	
TRANSPORT PLANNING		0.250	0.215	1	1	
SOCIOECONOMIC ASPECTS OF TRANSPORT		0.217	0.215	2	1	
THEMES						
TRANSPORT AND ENVIRONMENT	ENERGY	0.051	0.213	9	18	0.471
	ENVIRONMENTAL IMPACTS	0.065	0.277	3	9	
	AIR QUALITY	0.051	0.298	9	4	
	NOISE	0.051	0.255	9	10	
TRANSPORT MANAGEMENT	ECONOMIC STRATEGIES	0.044	0.280	14	5	
	MONITORING	0.044	0.263	15	19	
	MOBILIDADE URBANA	0.039	0.289	16	16	
	NEW TECHNOLOGIES	0.039	0.395	16	2	
TRANSPORT INFRASTRUCTURE	FLEET	0.032	0.243	19	20	
	ROADWAY SYSTEM	0.049	0.378	12	12	
	TRANSPORT SERVICES	0.036	0.378	18	12	
	TRAFFIC	0.032	0.324	19	17	
TRANSPORT PLANNING	URBAN ACCESSIBILITY	0.069	0.295	1	1	
	URBAN GROWTH	0.069	0.273	1	3	
	URBAN POPULATION	0.054	0.205	7	15	
	TRIPS	0.059	0.227	5	11	
SOCIOECONOMIC ASPECTS OF TRANSPORT	COSTS	0.048	0.222	13	14	
	SOCIOECONOMIC IMPACTS	0.052	0.259	8	6	
	ROAD SAFETY	0.060	0.259	4	6	
	PUBLIC TRANSPORT	0.056	0.259	6	6	

Table 3: Input data and results of the calculation of the Kendall's correlation ranking method for Categories and Themes

5 ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the Brazilian agencies CAPES (Post-Graduate Federal Agency), FAPESP (Foundation for the Promotion of Science of the State of São Paulo), and CNPq (Brazilian National Council for Scientific and Technological Development), which have supported our efforts for the development of this work in different ways and periods.

6 REFERENCES

ABDI, H.: The Kendall Rank Correlation Coefficient. URL: http://www.utdallas.edu/~herve/Abdi-KendallCorrelation2007-pretty.pdf

COSTA, M.S.: Sustainable Urban Mobility: a Comparative Study and the Bases for a Management System in Brazil and Portugal. MSc Thesis, University of São Paulo, São Carlos, SP, Brazil, 2003.

CRAIG, J.W.; HARRIS, T.M.; & WEINER, D.: Community participation and Geographic Information Systems; Taylor and Francis. London and New York, 2002.

MAGAGNIN, R.C.; RODRIGUES, D.S.; RAMOS, R.A.R. & SILVA, A.N.R. da.: A Spatial Decision Support System for Participative Planning. In: CUPUM 05 - Computers in Urban Planning and Urban Management. Londres: CASA - Centre of Advanced Spatial Analysis - University College London, 2005.

SILVA, A.N.; RAMOS, R.A.R.; SOUZA, L.C.L.; RODRIGUES, D.S. & MENDES, J.F.G.: SIG: Uma plataforma para introdução de técnicas emergentes no planejamento urbano, regional e de transportes: uma ferramenta 3D para análise ambiental urbana, avaliação multicritério, redes neurais artificiais; São Carlos; SP; Ed. dos autores, 2004.