

A Hierarchical Model to Evaluate Public Transport's Supply Quality

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Abstract There are several elements of supply quality in public transportation. These elements are often referred, but only some of them are mentioned at a time, and regularly some confusion can be discovered in this topic. In order to get a clear and complex image, we constructed a hierarchical model to elaborate all elements of a public transport system. This model has been tested on a Japanese city's bus transport system. The gained results are introduced shortly in the paper.

Keywords: hierarchical structure, AHP (Analytic Hierarchy Process), supply quality elements

1. Introduction

In many countries in the world, the low utilization of public vehicles is a crucial problem. There are many disadvantages of this phenomenon, such as heavy traffic on the roads, increasing number of accidents, CO₂ emission, parking problems, declining revenues for the public transport companies. While the costs of these companies are increasing, the loss is growing simultaneously, and the government has to spend much for financing this debt.

So for the government (and for the public transport company as well) the aim is to motivate people shifting from cars to buses, trams and other public vehicles.

One way of the motivation can be easily determined: to cut fares, but as mentioned above, there has been already huge loss for the public transport companies, and – at least in a short-run – this measure would increase this loss. On the other hand, the revision of costs may be a useful tool for the public companies [1].

Apparently there is only one way left to increase the utilization: to raise the supply quality of public transportation.

For this, the following steps are advisable to take:

- Decrease the dissatisfaction of passengers and non-passengers.

- Make public transport more attractive for non-passengers.
- Consider all 3 participants' (passengers, company, government) aspect [7].
- Synchronize different objectives (getting high service level, run effectively, maintain service level while restrict spending).

Integrating the mentioned criteria, we constructed a hierarchical model that can be used for the evaluation and analysis of all elements of public transportation. This specific model has been made for the elaboration of a city's public bus transport system, but with some minor modification, it can be extended for every kind of public transport.

2. The structure of the model

The model can be considered not only for static analysis of the certain system, but also for a dynamic evaluation that is able to highlight directly the sensitive points and may hint for necessary developments [4].

Another advantage is that all 3 participants can make judgments of the elements so the results are comparable [8] and the differences can be easily determined.

For the static analysis, a simple questionnaire can be applied, e.g. the evaluators should give points from 1 to 10 for the different elements (minding the hierarchy!). By this, we get a clear picture, how satisfied they are with the segments of public transport.

For the dynamic analysis, the necessity of development should be asked by the questionnaire. E.g.: How important is it from your point of view to develop this element of public supply?

The necessity of development embodies the importance of the element and the satisfaction level as well [5].

The constructed model is shown in Figure 1.:

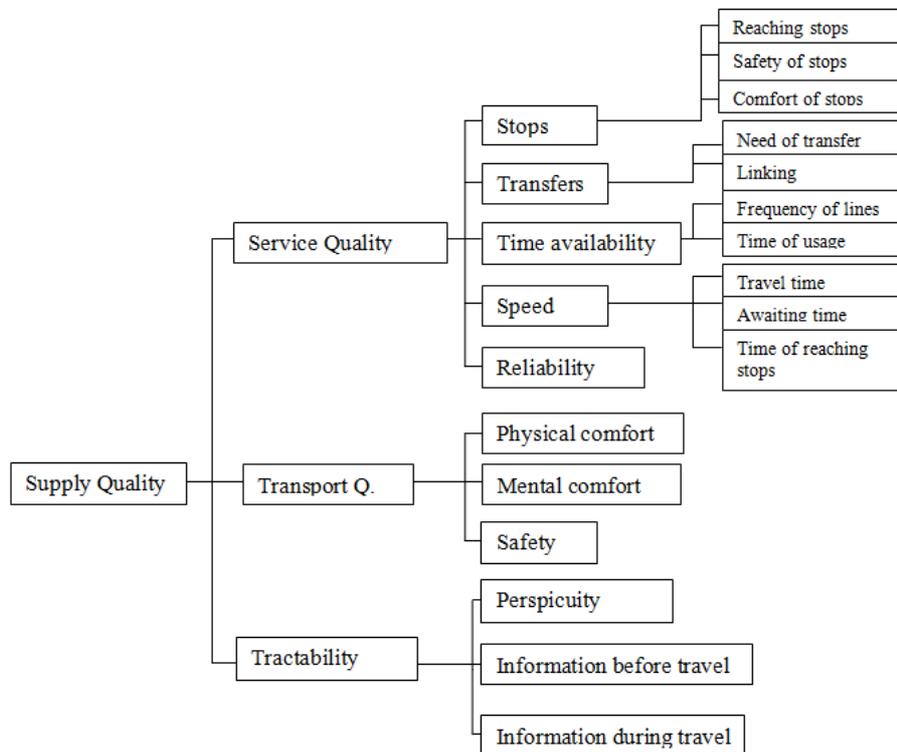


Figure1. The Hierarchical Structure of Public Bus Transport (Source: own exhibition)

Maybe the segment of “mental quality” should be explained in detail. We integrated all issues in this element that reflect the mental feelings of the passenger during the journey, such as the politeness of the driver, the image inside the vehicle, and so on.

We have tested this model on a Japanese city’s (Yurihonjo) bus transportation system and got some very promising results. From company managers and governmental officials no remarks had been received that the model should have been amended or some elements should have been left out. There were some points (e.g. the frequency of lines and perspicuity) that showed totally different opinions from the passenger side and the governmental/company side.

3. Results of a preliminary study

A previous study was made to evaluate the situation of Yurihonjo’s bus transport. The characteristics were the followings:

- 29.556 evaluators were asked out of the total population of 50.000, so the preliminary survey can be regarded as representative.

- It was made by a consultant company, so it included only statistical analysis and did not use more complex methodology.
- The survey was made in March, 2010, so it contained fresh and relevant information.
- Only the passenger side was asked.
- Reasons of dissatisfaction with public bus transport mentioned were:
 1. Bad time availability. (Not convenient frequency of lines) 64%
 2. Fare is too high 27%
 3. Long distance to and from stops 26%
 4. Connection to train not convenient 16%
 5. Limited time of usage 12%

45% responded to use more public bus transport if the mentioned issues are improved. That means 13.500 possible new users or more time users, although it includes the claim of lower fares as well [2], not only the development of supply quality [1] [3] [4] [5].

Highlighting the crucial points of the supply and simultaneously synthesizing the 3 different aspects of the participants' point of view may help significantly to improve the utilization of public vehicles.

4. Results of the test phase of the constructed model

The characteristics of the conducted survey based on the hierarchical model were the followings:

- 30 university students, 9 office workers and 2 research experts (who were involved in the previous survey, so had enormous information about passengers' opinion) were asked for the passenger side
- 3 company managers and 3 government officials (in the relevant field) were asked for the company and for the government side
- The survey was made in June, 2010, and analyzed in July 2010.
- Questionnaires were made for the evaluation that contained questions based on the hierarchy (Figure 1.). For the static elaboration the element had to be evaluated in a scale of 1-10, 1 was absolutely dissatisfied, 10 was absolutely satisfied. For the dynamic elaboration, the Analytic Hierarchy Process (AHP) was applied [6]. Because of this, pairwise comparisons had to be made by the evaluators for all the elements of the model, considering the hierarchy levels. For the 1.st level the following questions were asked: "Compare the importance of improvement for the service quality and transport quality element of the model! Compare the importance of improvement for the service quality and tractability elements! Compare the importance of improvement for the transport quality and tractability elements!" For the 2nd, and 3rd level the

same structure was constructed. In order to simplify and reduce the number of questions we applied matrices to embody the pairwise comparisons.

- During the AHP process we examined the consistency of answers, so applied a filter [2] to analyze only the logical and consequent answers of the evaluators.

By this process, the gained results are the followings:

The passenger side mentioned the greatest need of improvement in the segment of service quality. The tractability got in the second place and the transport quality development is not significant at all for the public bus users. On the contrary, government and company side evaluated transport quality as the most important issue to improve. This result shows the very common problem of public transport, company managers think that the most important way of getting more passengers is to change the vehicles to new ones. The gained results show the opposite, government and company experts should concentrate on the elements of service quality.

For the 2nd level, users mentioned the stops and transfers as the two most sensitive points of the system. Company managers seemed to realize these claims; although they mentioned the improvement of speed as well (the passengers were totally satisfied with this element). The government officers were not so aware of the users' point of view; they think that the speed is the most important for them, and the physical comfort of the journey. This issue reached the last position for the passenger's side.

For the 3rd level users mentioned the distance to and from stops as the most inevitable issue to improve. Company managers thought that the frequency of lines should be improved for the first time, and it is partly true, because in the case of some lines it was declared very clearly by the passenger evaluators. But in the case of other lines, the frequency of lines is totally satisfying for the users. That means that a thorough analysis should be made to shed light on the lines which should be more frequented by buses and the ones which should not. The government mentioned the travel time as the most crucial point, but the other sides' evaluation did not verify this.

Based on the gained results it can be stated that:

- The model is suitable to evaluate the opinions of different participants of public transport.
- The introduced hierarchy embodies all important elements of public bus transport's supply.
- There are discrepancies among the visions of public transport of different participants; users, company managers, government officials.
- These contradictions should be eliminated by synthesizing the different opinions and creating a common image on the necessary improvements.
- Specifically for the examined city: the most urgent step is to replace the stops with the consideration of passengers' claims. The most crucial point is the distance to and from stops, so this distance can be reduced by the replacing process. It may be expensive but surely will bring more users and will produce profit in the long-term. Another inevitable issue is to revise the frequency of every line and alter it in some cases.

5. References

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