Harry Timmermans, Tom Bellemans and Soora Rasouli:

A Microsimulation Model for the Evaluation of Transport Policies: Development and Application of ALBATROSS

Baekjin Lee(hereafter 'Lee'): *Would you introduce yourself? What is your major research subject?*

Harry Timmermans(hereafter 'Timmermans'): My name is Harry Timmermans. I am from Eindhoven University of Technology in the Netherlands. The research projects that I am working on are primarily related to activity based modeling and travel forecasting. Most of these belong to the field of transportation, but also urban planning or different components of urban planning – such as retailing, tourism.

Tom Bellemans(hereafter 'Bellemans'): I'm Tom Bellemans from Hasselt University. I'm doing an associate tutor in transportation research institute in the university. I'm mainly working on transportation behavior model.

Soora Rasouli(hereafter 'Rasouli'): I'm Soora Rasouli. I'm doing a Ph.D in Eindhoven University on a complex model of travel forecasting focusing on uncertainty of these models.

Lee: *I heard that you visited several countries and attended seminars recently. Could you tell me what these seminars were for?*

Timmermans: Most of them were related to activity based modeling. I participated in these seminars for general interest. But the other components were related to the major European project - uncertainty in complex models.

Lee: *Could you explain ALBATROSS project briefly?*

Timmermans: ALBATROSS project started in 1998 for Dutch Ministry of transportation. Actually,

Netherlands was one of the first countries working with tour based models that were somewhat similar to nowadays' activity based models. However, their existing models were too limited. For instance, there were no constraints. They could not deal with households and also other policy domains. Thus, the link between urban planning and transportation planning was not very strongly developed.

They needed a more integrated approach to transportation modeling that could address specific issues such as the effects of opening hours on travel. They had the special program for research activities that look at the potential of new developments - that could be technology, new models, or new data collection.

Seoyeon Yoon(hereafter 'Yoon'): *Could you explain your FEATHERS projects?*

Bellemans: FEATHERS(Forecasting Evolutionary Activity-Travel of Household and their Environmental Repercussions) project was stared within Flemish research project funded by the Flemish government. It was implemented by two consecutive projects.

The first one's primary work was on FEATHERS, we also work together with people from Eindhoven University. In order to set up the system which could simulate activity based modeling and model, we used the ALBATROSS model from Eindhoven University. The main reason that I focused on ALBATROSS is that we want to do policy evaluation such as 'what's the impact of certain transportation or traffic management policies'. That's the reason the ministry justified the choice for the activity base modeling. Activity based models have this behavior component which allows for modeling the behavioral impacts of these policies on transportation fields. The second project was an application dimension, expanding the model to other policy domains - not only transportation domains, but also domains like traffic safety, emissions, human heath, etc.

Lee: *Could you explain your research topic, uncertainty?*

Rasouli: My Ph.D project is a part of a very big European project which consists of 6 different organizations in Europe. It was 4 years of long project. Two key groups of this research are from England and Germany. And four of the others are taking care of case studies. Each of these 4 groups is working on a specific model - Eindhoven university is working on transportation model(ALBATROSS), the group in Oslo is working on air quality model. Fera in UK is working on land-use response to climate and economic change.

So, first of all, we need to give all the details to the key groups, to give them the ability to put all these models into the web and chain them together on the web. So the first one year of that project was just gathering data, giving data to them and getting familiar with the functionality of other models. After that, we needed to expand the existing model to be able to take into account uncertainty. At that moment, ALBATROSS didn't cover any

component for considering uncertainty. So, I started my research expanding ALBATROSS.

Lee: Recently, many people got lots of interest in Activity based model. What do you think about the reason that people have interests in activity based model?

Timmermans: Maybe I should start saying that there is quite some variation. Now, especially the Americans are picking up very fast the development and applications of Activity based models. One of the reasons I think TRB organization has been very active in promoting Activity based models: very active task force, several conferences that were focused on the application of activity based model, training workshops, etc.

Otherwise, I think much of this increasing interest was deeply related to the increasing computing power. This means that we can simulate individuals. And I think this really creates new opportunities. Today, these opportunities are not only related to transportation issues. Indeed you can simulate from aggregate distributions all the way down to individual paths. We don't need assignment modules anymore. We can directly get information about people due to the emergence of GPS data, and other kinds of new data. So, we no longer have to rely on traditional data. I'm pretty sure that the next breakthrough in this whole sequence.

Because it is micro-simulation, it's much easier to deal with social problems such as health and emissions. You can attach all these kinds of indicators that are fairly different, especially for integrated policies. Thus, indicators from transportation, urban planning and health etc. come together. Integrated models have become important, linking environmental policies, urban policies and socio-economic policies in one big model system.

Bellemans: You can also see that governments started to ask questions which can not be answered by the traditional modeling tool. For example, in Netherlands, we have a similar experience in problems of social exclusion of specific sub-groups of population. If you want to assess of the impacts of certain policy measures or certain policies on these particular groups, or perhaps on other application domains, this integrated model which are the way to find of answer to those kinds of the questions – I think part of popularity, increase of interest is due to the fact that some of the questions which remain un-answered can get the answer with the support of the model. I think this is the one of the reason.

Yoon: *There are many Activity Based Model models that are being developed and each of them has their own assumptions or different ways of modeling behavior or travel pattern. What do you think is the major distinction of ALBATROSS from the other models?*

Timmermans: I think that much of the existing models like AMOS or the models in California which other consultants are using, are kinds of extensions of simple discreet choice models such as the nested logit. Often these model systems consist of a set of largely independent sub-models. These are integrated using a simulation

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Most existing models are primarily based on the random utility theory, and assume a simple mathematical expression. ALBATROSS was motivated to avoid such limitations. While other models have one utility functions, ALBATROSS identifies heuristics for various kinds of contextual situations. This creates much flexibility. It uses a decision tree representation. So, I would argue that it's more integrated. It has more flexibility in terms of specifications of conditions that influence choices.

Albatross attempts to have robust parameters. I always have been concerned with model that estimate choice parameters from observed patterns and claim these parameters reflect behavior. I always give the following example: if you have a spatial structure with certain density, we fit the utility function. Does this reflect behavioral sensitivity to distance? I claim it does not. If behavior remains the same, but density changes, the estimated utility function will also change. Thus estimated utility functions reflect the specific configuration of opportunities. We need a model system that separates spatial context from behavior in a better way. There are also other differences related to constraints. Most activity based models do not include any constraints, at least not at the estimation stage. That means there is no mechanism where constraints interact with the estimated utility function.

Lee: Is Feather system based on the ALBATROSS or new one?

Bellemans: The data we look at Feather system was basically software lab used in other groups. So, we can benefit from that we can possibly get all of data for any studying area. But, apart from that, of course, main component of activity based model was schedule. FETHERS are able to plug-in different schedules, but the main schedule we have calibrated to the Flemish situations which we use was actually slightly modified version of ALBATROSS schedule.

Basically we don't look at FEATHERS as the Activity based model, but it could be used to do investigate in regard to the Activity based model. So, if we set up some kinds of discreet choice based experiment, we also do it with FEATHERs. Actually, we want to have as much of reprocessing and the data management separated from the actual scheduler. The idea that isolates form the actual scheduling component as much as possible was the reason to develop the FEATHERS. This were related to the concept of 'transferability'. Applying the model to new study area, at different geographical resolutions becomes easier due to the fact that what you have this data structures. In this reason, we currently use ALBATROSS scheduler as the core scheduler.

Timmermans: So, in the ALBATROSS software, much of this was hard-coded. But that was fine because it was developed only for the Dutch Ministry. They didn't want the flexibility that we are talking about. And that

means that you have to start to thinking about data structure, and modular organization of the software.

Lee: What's the meaning of considering uncertainty in transportation model?

Rasouli: I think that is mostly related to policy makers decision. If they don't consider uncertainty and just rely on the deterministic model results; consider input as a fixed input or run the model once and get one result - then they might face some problems in later stages. For example, if they intend to design infrastructure based on the model result, it might be very over design or under design. I will give you an example, in ALBATROSS, two types of speed is used; free floating and peak hour speed. But, we know that it is not what usually happens in real world. That free floating speed and also peak hour speed is not constant. They change from day to day, week to week and month to month. Considering this kind of variability will lead you to capture the reality better.

Lee: As far as I know, there are several type of uncertainty - data collection, model. But I think the most important one which brings the highest impact is that uncertainty from the policy decision. That's why we always get the problem. That's always be the obstacles to make more exact results.

Rasouli: One of our researches has been done considering uncertainty at the individual level. When we run ALBATROSS several times, the trajectory of people are different in each run because of the random seed and probabilistic decision trees. If someone would argue that what is the benefit of uncertainty analysis at the individual level? The answer would be improving the model based on the result of this analysis. If the uncertainty is too high, then we could say that the decision trees don't work properly and some more influential variables are required to be added in the decision trees or so on.

Yoon: So, after all, if there is any easy way to separate impact of policy and uncertainty of the model, what would you recommend to do that?

Rasouli: We need to separate the uncertainty in terms of input/model uncertainty and uncertainty comes from different scenarios or policies. As far as the model in use is able to do that, the differentiation between shares of each uncertainty sources is more obvious for policy makers which subsequently result in more reliable decisions.

Lee: Could you explain national, regional, urban planning using ALBATROSS or FEATHERS? Could you explain on practical perspective?

Bellemans: I'd like to say one [illegible] currently working on. It's not the strictly planned project, but it related them. It is a research project of evaluating impacts of light trail in the context of city development. The

purpose of this project is to identify of the impact of this light-trail on the transportation system which might be different depending on the long-term evolution in terms of land-use development. Like long-term scenarios, we have to develop set of different options. One of the major assumptions is light-trail will play on the role in each of these options. That is an example of urban application of this Activity based model in this context.

Lee: *When we try to introduce new transport system, such as LRT - first time to introduce and we don't know the current activity. How can we apply ALBATROSS in this situation?*

Timmermans: The problem is that the data used for estimating the model could not reflect this transport mode. To account for that, we have developed an approach which we applied to congestion pricing. We use stated adaptation experiments to predict change in the skeleton of activity-travel patterns. The decision tables are then used to schedule the activities and travel.

What we do was using the outcomes of the Stated-adaptation models to predict seed anchor points in scheduling process. And based on that, the ALBATROSS system is applied for any secondary effect.

Yoon: *Do you know any comparison between different models?*

Timmermans: Not that many. We did compare to ALBATROSS with PCATS, famous Japanese system. Prof. Fujii helped us. We also compared it to a Nested logit structure. ALBATROSS came out best one in terms of reproducing the data. Also, we have a before & after situation and we can predict the effect of policy.

Lee: *Do you have any experience to apply FEATHER system or the comparison to other nations?*

Bellemans: No, we didn't compare it with other models.

Timmermans: I'd like to say that a fair comparison is very difficult. Just a simple example, the original model system in PCATS assumes that some activities are fixed, thus that is not predicted. But, in ALBATROSS nothing is fixed. So, what to do?

Yoon: *I think Activity based model structure and model depend a lot on different cultural or local situation of the countries. For example, Southern California does not really consider transit seriously in their model. But in Korean situation, we are experiencing big changes. Slow growth, aging problem, and decreasing population. What is the biggest strength of Activity based model in such situations compare to other models?*

Timmermans: I'm not sure if it is necessarily related in that sense to the policy issues. I think it depends on higher sensitivity to all kinds of mechanisms that may people decide how to organize activity and travel in time

and space. Plus, as indicated some models do not depended directly on spatial formations of facility location. To some extent, I think human behavior has some regularity. Indeed, Activity based model should also apply and perform better for those policies. Sometimes the concept of activity based modeling has been misunderstood. For example, they are talking about the limitations of the current state are due to the economic crisis. But, what I'm talking about is the behavioural mechanism I'm not talking about the outcomes.

Lee: *Until now, Korea has experienced rapid development. All economics growth and population increase. But now, we started to decline - decline in everything. Every time we try to construct one - new road, new towns- but, everything is started to decline. Once we tried to apply conventional modeling, it would be difficult to find the reason to develop new one. So, I think we try to step up management stage. What do you think about the implications of ALBATROSS, Activity based approach in this situation of rapid social changes.*

Timmermans: What you describe would be the situation that less people go to work. The ALBATROSS system is a process model that starts by simulating 'whether the people will get to work or not'. That could reflect the economic situation.

I think that is exactly one of the strength of activity based models. Traditional four step model could not make this approach because it does not have the relationship, connections of the effects of work on the other activities.

Bellemans: Basically, the only thing that you are firmly depending on is that your model reflects the fundamental process. And there is the assumption is not broken by the scenario or evolution that you want to assess. you can simulate the impacts.

Timmermans: But there are also fundamental limitations because activity-based models are dealing with the typical day. That's the reason why we need to consider dynamic models, the next generation.

Lee: *Do you have any idea about that? Because I think these kinds of social change problem would also be the uncertainty.*

Rasouli: Yeah, There're other Ph.D projects that I know were quite interesting. This project considers the whole life-span of people - they moved their house-place and its pattern, lower-level life style, when people divorce, when people got child, etc.

Lee: *So far, we have the regulations to evaluate the new project investment. There is a manual based on four step model. This works like the regulations. Even a private company try to check travel demand on the project they use the one otherwise the government don't believe that. And KOTI provide the standard database of our*

nation. This is standard one, but all model have to use this data. But still, in the practical point of view, Activity based model has a little difficulty to apply. Do you have any opinion to clear this obstacle in the practical part in the database?

Timmermans: I think we should realize that in terms of data requirements, traditional 4 step models and activity based models are very similar. The one big difference is constraints. Because traditional four-step model are not considering these.

As for travel behavior data, the only condition is that you need data that allows you to say something about the dependency between activity and travel. So, if the travel survey may include 'how often do you go shopping', ' how often do you work', then you cannot estimate the dependency. At least one needs a sequence of activities and travel during the day. Most modern travel surveys thus suffice.

In case of Korea, I think you should know why Activity based models would not be possible. You don't need all the data. You don't need more data. Actually, based on the seminar that I attended yesterday, I could not understand why they would think other data to develop an activity based model.

Lee: *Any other comments?*

Timmermans: This is my second time in Korea. I think that people are slowly becoming more open minded about activity based models. When I first visited Korea, it seemed that people were thinking 'okay, that is a different world'. Now, they seemed a little bit hesitant to try. I think this is the right time to build an activity-based model and compare it with a traditional model. And also, let people know the potential of activity based models - wide spectrum of different of policy domains, integrated approach. I think what you need is more training, open workshops and seminars.

Rasouli: This is my first visit and actually, it was very valuable time for me to know what's going on in my research area in other parts of the world.

Bellemans: I'm happy to be here with you. I'd like to note that you should firstly take in-detail comparison between this micro-scope model and traditional 4 step model. I think Activity based model could tell you more than four-step model especially, in policy field. Thank you.