Hanoi Public Transport—Transformation by Management Using Action Research and Behavior Setting Theory

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Abstract: After the economic reforms in Vietnam, the number of motorbikes surged while public transport lost its passengers. No funds for investment available TRAMOC (Transport Management and Operation Centre), the Transport Management and Operation Center started the experiment of transforming Hanoi Public Transport by management based on action research, introducing some interventions, which had shown to be effective in Europe. Phase I of the experimental approach was carried out with the smallest company that operated Line 32. The number of daily passengers surged from 1,700 to 8,000. In Phase II, the experiment was extended to the whole net. In 2001, there were 35,000 passengers per day, in 2010, there were 1 million; this is an increase of 3,000%. The result surpassed by far the expectations. The key for understanding the surprising results is the mode choice. 53% of the users are riders by choice; they have access to a car or motorbike. Simulation of the decisions as rational choice based on time needed for trips was proved to be quite accurate. Behavior was analyzed in the frame of behavior setting theory, which brings together urban structure and the design of the transport system. Success with introducing public transport needs a self-reliant leadership, which works with people in their real life situation. An urban transport system is part of the organized behavior of the people, who make use of the technical opportunities offered.

Key words: Public transport, management of public transport, action research, behavior setting, mobility, mode CHOICE in transport, urban structure and public transport, trips, modal split.

1. Introduction

In 1986, Vietnam replaced the socialist system of centralized planning by the new, market oriented economic system. Fig. 1 shows the growth rates of motorbikes and of passengers of public transport between 1986, the year of economic reforms, and 2010. After the reform, public transport lost its passengers.

This article is about the year 2000, when the impressive increase in ridership started. An outside observer called it the miracle of Hanoi. In fact, it was a big success of behavior change by management. In 1998 on recommendation by a Swedish expert, Hans Orn, a new institution was created, the TRAMOC (Transport Management and Operation Centre), with a small team of Vietnamese, appointed by the City

(Hanoi Peoples Committee). The task of this office was to regulate public transport in European style. I had the privilege to join TRAMOC late in 1999 as in-house expert, employed by the city of Hanoi with financial support from CIM, an agency of the German ministry of economic cooperation.

The steep decline of passengers stabilized around 1998 on a very low level. After the experiment started, the numbers climbed up. After Phase II was implemented, the numbers exploded and continued to grow always a little above the growth of motorbikes. Note however, that the growth is still very strong around 20%.

Hanoi means “between the waters”. It was founded one thousand years ago, as the seat of the imperial court and an adjacent settlement for artisans, traders and the officials of the court. Transport was mostly by boat. In

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the 19th century, it became the capital of French Indochina. The French built a railroad, a railroad station and a tramway. They also built the first bridge crossing the red river for mixed use of trains and road traffic. Designed by Gustave Eiffel, it is a landmark of Hanoi. After independence of Vietnam in 1954, Hanoi became the capital of the now Socialist Republic of Vietnam. A road bridge and eventually a third bridge with two levels, one for trains and one for cars were added.

After 1986, Motorbikes slowly replaced the bicycle. Buses replaced the electric streetcar. Trains that had only at grade crossings with the roads could not anymore enter the city. Three state-owned bus companies were transporting around 35,000 passengers per day with 350 buses in a city of three million. The smallest company, which originated from the abandoned streetcar, had 14 old buses, a gift from France. It transported 1,700 passengers per day on one line, the now famous No. 32. This small company became the model for our simple experiment, which went viral, transforming urban transport in Hanoi.

Fig. 1 shows the dramatic changes, which took place after the start of the experiment (see also Fig. 8 for

number of passengers on Line 32.)

The growth rate of GDP (gross domestic product) in Hanoi was in these years around 14%. After an initial high growth of motorbikes after the reform, the growth slowed down, but remained always a bit higher than the growth rate of GDP. For growth of public transport, after a big jump in 2004, it also returned to a “moderate” growth, but still above the growth rate of motorbikes.

2. The Objective: Improve Mobility by Public Transport

The task of TRAMOC was to organize the public transport, which was the buses. In a wider sense, this was to maintain and improve the mobility of the people of Hanoi. The policy of Hanoi was to achieve a model split of 30% for public transport.

The basic unit for transportation research is the trip, defined as the movement from the Origin O to a point of Destination D. The term trip is not as precise as it looks. If a parent brings the child to school, before proceeding to the place of work, this counts as two trips. One should call it a trip with two legs. Furthermore, in the course of the day, most people want to return in the evening to their place of origin, which practically makes

Fig. 1 Growth rates of public transport and motorbikes.

a trip a return trip, which counts as two trips.

In all big cities, there are several modes of transport available that can be used to move around and reach different destinations. Modes can be walking, using the bicycle, a motor bike, the car or some sort of Public Transport, which includes the Taxi and in Hanoi the Motorbike Taxi, called “xe om”.

Mode choice refers not just to the trip, but to a chain of trips. Outside the world of transport planners people usually think of return trips including some in-between stops. The in-between stops are the purpose of the roundtrip. Modal split refers to the share a mode of transport has in the total of transport movements. It may refer to trips or to distances travelled. The target for sustainable transport is usually a share for 30% of non-motorized (cycling and walking) and 30% of public transport. This objective refers to trips. Depending on the methodology frequently, distances are measured instead. There is some confusion in international comparisons and in defining targets for planning of transport systems.

The task assigned to TRAMOC involved a modal shift for improving mobility. Mobility means that people can make any desired number of trips during the course of the day. Forcing people to walk, instead of using a motorized vehicle, would improve sustainability, but limit their mobility.

As Enrique Penalosa, who had transformed the urban transport of Bogotá, while he was mayor stated, the aim is “to construct a city that reflects socialist values: a different city, with more social justice...” [1]. Population growth forces people to live in ever-larger cities. As distances become longer, mechanized transport is unavoidable. As roads become congested the poor suffer most. Public transport is necessary.

Officially, the modal split for public transport in Hanoi was 10%. This was a political statement, not based on empirical evidence. There was a fleet of old, dilapidated buses. In 2000, they were running mostly empty. Bicycles were disappearing and there was a surge of motorbikes (Fig. 1). What to do with great

ambitions, when no funds are available?

3. A Note on Theory and Its Background

There is nothing as practical as a good theory [2]. With no funds available, what always can be done is a self-experiment [3]. I did walk to my office, used the motorbike, the xe om^b, the taxi and the bus. To give the result in short, the bus was a terrible experience, completely unpredictable, when it would arrive. Walking the 2 km was an ordeal, as sidewalks were rotten and often blocked by parking cars and motorbikes, using the taxi and xe om involved long discussions with the respective drivers who tried to charge high prices. The bicycle was uncomfortable in dense traffic, otherwise satisfying. The motorbike was the most convenient way. Therefore, I did as most Hanoians do, used the motorbike with my assistant serving as driver. Even on rainy days, this was the only acceptable mode of transport.

In Europe, there was already in the 1960s the debate to find affordable ways to reconstruct public transport, as the only viable solution to avoid the collapse of urban mobility. The car is no solution in densely built-up cities. Effective and low cost solutions were service of public transport in fixed intervals. Standing out is Switzerland, where between cities and inside cities an integrated time schedule has been introduced. Another successful approach was a transit pass. You pay once and can use any public transport vehicle for a given time (hours, days, a month or a year).¹

3.1 The City as a System

The city is a human habitat or ecological niche [4]. It is a complex system, made up of many components, of physical structures as well as communication, functional relationships, knowledge and economic transactions. It provides the humans with all the

¹In most large cities, there are several public transport systems: the underground, at grade streetcars, trains offered by the national railroad, buses of various kinds. Each used to issue its own tickets. Creating tickets for use on any mode (in Germany called Verkehrsverbund) was a success.

necessities of life and survival. There is struggle, competition and also cooperation. A system is a set of interacting, interdependent components, which are also systems, forming a complex/intricate whole.² The “whole” refers to the requirement of stability of each unit in an ever-changing environment. This is achieved by feedback and feed-forward loops. There appears to be a not-material organizing nucleus hidden in all the interactions. Transport is a very important component, keeping this system of systems together. It is often compared to the circulatory system in the body.

3.2 Deductive Reasoning

By convention, planning is applied logic. The premises, such as “mobility is good and necessary for the life of a city” leads to the conclusion, that roads and rail systems support mobility and are therefore necessary. Planning the transportation system involves designing the infrastructure, based on assumptions of demand, considering the available technology of the time and finally calculating the cost of the project. A financial plan, calculating the assumed income by fares and economic benefits to the economy of the city, is the climax of such a plan. It has to work out; financial and economic benefits must be greater than the cost calculated. It ends with a plea to the political leadership: do as we, the planners tell you, find the necessary funds and the city will flourish. There are many assumptions, such as the belief, that people will behave as planners assume.

3.3 Inductive Reasoning

Inductive reasoning takes the opposite path. Its basis is systematic observation of real life events and extracting laws, if possible by empirical testing. A lot of data are collected. In practice, inductive reasoning is used to support the assumptions of deductive reasoning. The dimensions of a technical building, such as a road, can be based on observations of road capacity, the inductive way or it can be deduced based on technical

assumptions. There are manuals, which serve as normative basis for planning. So transport planning somehow has a scientific basis. Unfortunately, behavior of complex systems, as interaction and autoregulation defy the scientific method.

A different approach is to study traffic by observation of behavior. In order to be objective, measurements and reports should be independent from the observer and they should be replicable. Observable is, for instance, a road, with traffic lights, the cars moving along and stopping, as ever the traffic lights change their color. Pedestrians crossing the street, whenever there is a gap in the flow of cars. As the researcher observes the intersections and interactions, he notices that there are recurring patterns of behavior.³ Returning the next day, he observes different cars and different people crossing the street, but the recurring patterns of behavior are there again. He notes down, that traffic lights and gaps in the flow of traffic are causes for the resulting behavior. He assumes that this is the result of learning and imitation. Going more into detail, he discovers that there are physical conditions involved. The driver applies the brakes, which cause the car to slow down, etc. He may be interested, what causes the traffic lights to change color and may ask himself, who invented the traffic lights and how it happened, that drivers are learning, when they have to apply the brakes and how the pedestrians learned that changing traffic lights would cause the drivers to stop and offer them a chance to cross the streets. As he tries to understand all of this perfect fit of perception and adapted action, the people taking the correct action at the right time, he discovers that traffic is movement while patterns of behavior are stable. One can extract rules for behavior and admire the engineers and the teacher of drivers or the parents of children, that they were teaching each traffic participants the rules, which

³The term originates from the study of animal behavior. Konrad Lorentz [19] popularized “fixed action pattern” as instinctive responses in the presence of identifiable stimuli. The patterns of behavior, as Barker used it, is observable behavior without knowing the content or reasoning of the acting human being, but it is learned behavior.

²<http://www.merriam-webster.com/dictionary/system>.

coordinate the different forms of behavior. This is a little example that the life in a city has created rules of behavior. They are not in the nature of human beings, but rather a second nature, learned and enforced by the conditions of life in the city. One step further, rules are necessary. To drive on the right hand side of the road (or the left if one is in Britain) is no law of nature. That it has to be settled the one or the other way is inherent to the logic of coexistence of many vehicles and persons moving in the same place. This is a condition for the survival in the city.

Now I return to the neutral observer. Suddenly he discovers that he has to stop his observations and cross the street in a hurry, as somewhere, he has an appointment with his girlfriend. He will observe the rules and follow the patterns of behavior. There is however a new dimension. He gets annoyed, because he has to wait long for crossing the street and he gets scared, as a car is fast approaching him, only in the last second avoiding running him over. He arrives at the meeting point a little bit late and his girlfriend is already angry. He excuses himself and tries to explain to his girlfriend the bad traffic conditions.

Let me call this part “a milieu experience”. Before, he was studying a system objectively, but by joining the game, becoming a part of the system, he experiences the system not as an object of scientific research, but as a milieu, in which he himself has to act and will create reactions. All this he does in order to survive and to save his friendship. Milieu and system are the same and yet fundamentally different, because of the perspective. Observation is objective, experiencing and living in a milieu is necessarily subjective, colored by emotions and particularly attached to the personal goals or purposes of behavior.

In studying or in planning a traffic system, one should be aware that it has to function, but that the functioning system is milieu for many people

Not enough passengers for buses in a city of more than 3 million? Evidently, the people were doing fine on their motorbikes. Why should one introduce a new urban transportation system at high cost? Time spent in

traffic is lost for other activities. There is a huge economic implication, as people stuck in transport jams can neither produce nor consume. It exhausts the energy of everybody; it is a health hazard and limits market access. Cars use too much space for operating and parking (Fig. 9). They immobilize the people and create a very visible form of urban poverty. Traffic jams are a form of daily conflict between the citizens. This conflict must be mitigated.

But if the people will not use the transport offered to them, such as the existing bus-services? The challenge is not just to introduce a new technology; it is to introduce a transportation system that is accessible and acceptable for all people, involving people it changes their behaviour.

The Hanoi Peoples Committee wanted a rail system. This is laudable, but very expensive and inefficient. In no city of the developing world are rail systems accessible for more than 10% of the population [1]. Can the bus service be a functioning alternative system?

I was not really at a theoretical crossroad. There just was no possibility to carry out a systematic study and there were no funds to implement any plan. I had the results of the URFS (urban rail feasibility study)⁴ and the conclusion that neither an urban rail nor an elevated bus lane would attract sufficient customers to make the project economically feasible. I also had the result of my own experiment with the conclusion, that only the motorbike was an acceptable mode of transport. For the well established procedures, the gates were closed. I had no other choice than to start an experiment to change the situation by management. The administrative unit responsible for transport management was TRAMOC, part of an urban administration, which had evolved during 45 years of socialism and was petrified in the thinking of a planned

⁴At the time of the author's arrival, a feasibility study (URFS) had just been completed. This study, funded by the German government, made plans for an elevated railroad, above the existing at grade national railroad, and it designed an elevated bus-line.

economy. There were plenty of foreign advisors running around and telling the Vietnamese, that they would have to replace socialism by a market economy. I did not believe that the market can create an efficient public transport system. So he told his colleagues that there is no law of nature that socialism must lead to mismanagement. Keep the socialist system and improve the management! There I was in my element [5]. The key question was, how do people chose their mode of transport and how can this be influenced [6]?

If there are several modes of transport, people may have a choice.

3.4 The Key Question: Mode Choice

What is determining the mode choice? A superficial answer would be that they use for their trip the fastest or the cheapest mode. Consumer decisions are more complicated. In the following section, mode choice is analyzed from the point of views of individual decisions taking place in a complex system or rather a maze, where millions of people have to find their ways. The mobility of a person is to visit several destinations in the course of a day not as a series of trips, each based on a separate decision, but as a chain of trips, organizing all his trips according to preferences. The utility of a motorbike is to be seen in the context of this chain. If the person starts the day in the morning on the motorbike, he has to bring it back home in the evening. If he chooses the bus in the morning, he has to consider how to return in the evening. If there are no buses in the evening, he has to use the motorbike also in the morning. Whatever mode of transport he uses, each choice is influencing the other choices. There are some trips which may be unconnected. The person may drive to the office, but walk from the office to the restaurant. After returning on foot from the restaurant, he has to drive home again. All trips are return trips, but there may be trips nested inside such a return trip. This is not the only interdependence. When travelling with his car, the person may visit a supermarket, where he finds a parking lot. If on the other hand, he is walking, he may

choose a small neighborhood shop, which is somewhere along his path and do his shopping there.

These everyday decisions are plausible to anyone who lives in a city. Walking, using a bike, a motorbike or a car offers a maximum of flexibility in organizing the daily trips. Public transport has constraints. In order to be attractive, it should not be conceived on a basis of lines, but as a net which connects to all kinds of trips and destinations.

Is the decision based on time spent or on cost involved? What does the customer attribute to the trip he is about to make?

(1) Decisions based on time must be translated into the question: do I now have the time. The bus may be faster than the bike and therefore the preferred mode of transport, but if I have to wait for 30 minutes for the bus, the bike is faster, because I can start right away. There are many variations to this question. Taking the car involves uncertainty about the time required to find a parking lot, the bike again may be better, if the person is short in time;

(b) Decisions based on cost are also tricky. The own car may appear cheaper than public transport. If the car owner would include cost for parking in town, the insurance and tax and depreciation plus the risk of paying a fine, all broken down to the single trip, using the car may be more expensive. Using this deficit in cost attribution, the introduction of monthly passes changes the calculus again, as once the passes are purchased, each trip for itself is a free ride.

Considering all this, it appears most appropriate to base mode choice on the factor time, excluding the expensive mode taxis.

This heroic simplification allows to calculate a rational choice. There are further questions: does the traveler know the time required for a trip by the modes of transport, which he is not regularly using? If it is subjectively perceived time, does he weigh his perception of time spent for different modes the same way? There are studies, which report that waiting time is subjectively experienced to be longer than the same

time spent driving.

Using a decision model based on cost, similar problems arise. Cost using a preferred mode of transport is often underestimated; cost for the least preferred mode is overestimated [7].

For public as well as for private transport, there is also a distortion. Prices for using the transport do not reflect the cost of providing the facilities. Bus fares are political and not economic decisions. In urban transport, there is no efficient market. There are choices, but they are not rational as the underlying system does not provide realistic data and preferences and prejudice deform the interpretation of the information available.

Nevertheless in the following section, I shall present a calculation for a supposedly “rational choice”. This assumes that the traveler has a free choice and is not forced by circumstances (Table 2).

3.4.1 Definitions on “Free” and “Forced” Choice with Some Special Vietnamese Additions

Rider refers to a person using public transport.

Driver refers to a person steering a motorized vehicle, car or motorbike. However in Hanoi, frequently, an employed chauffeur drives the cars. This category we call “car with driver”. If the owner of the car drives himself, it is called in this paper “car without driver”.

Of course, this is not a driverless car, the most recent development of the car industry. A taxi would be a car with driver, but we stick for this special mode with the term taxi as a car with driver hired for a limited time.

A “forced rider” is a person using public transport, because he does not dispose of a car or a motorbike and his trip is too long for walking or using the bicycle.

A “forced driver” is a person, who is forced to use a car or motorbike, purchased or hired for the occasion, because there is no public transport available and the trip is too long for walking or using the motorbike.

The opposite would be the “rider by choice” and the “driver by choice”. The theory of choice can only apply to these categories.

3.4.2 Modes by Time and Distance Including Access Time

Fig. 2 shows the result of these calculations in Hanoi. A trip by a motorized vehicle implies several steps and calculating the time one should consider access time and time for travelling. In Fig. 2, there is the rubric “access” as starting- time required for each mode of transport.

“Bus fixed intervals” refer to the buses as organized after the reform, irregular buses to the situation, as it was before the reform.

Fig. 2 Bus in service in 2000.

Table 1 Steps of using public transport.

(a)	Walk from the home to the station	Walk
(b)	Cross the street, reach the platform, where the bus will stops and wait	Cross the street and wait
(c)	Board the bus and travel to the station, where to descend	Board and travel
(d)	To change the bus, step down on the platform, cross the street and wait for the correspondence	Descend cross the street, wait
(e)	Board the bus. Travel to the station, where to descend	Board and travel
(f)	Cross the street and walk to the point of destination	Cross the street and walk
	Steps d) and e) occur only when there is no direct line	

Average speed is for walking 4 km/h, for the bike 8 km/h, for all motorized travel 20 km/h. Only for MRT, which does not yet exist in Hanoi, an operation speed of 40 km/h is assumed.

Considering the whole procedure of using a bus as a coherent setting, there are the elements of walking, street crossing, waiting, boarding and riding the bus, each element involving some interdependence with other factors:

- Crossing the street has to be coordinated with the other road traffic,
- Waiting depends on the intervals of bus operation;
- Boarding-time depends on characteristics of the bus and the station;
- The flow of the bus is synchronized with the other road traffic, changing lane, deceleration and acceleration of the bus.

3.4.3 Steps of a Trip and Access Time

A trip contains at least 7 steps as shown in Table 1 for public transport.

Steps (a) and (f) involve walking; distance depends on station spacing and placement. Sidewalks should be in good condition. An advantage is, if the bus station is right in front of an important destination, for instance, a school.

Steps (d) and (e) are eliminated, if there is a direct line, but it is impossible to connect all stations by direct lines to avoid changing the bus.

Steps (c) and (e) involve boarding the bus. This is not simple. Usually it means climbing down from the platform to the pavement, then making a huge stride to get on the first step of the bus. If there are many people who want to board, this delays bus operation.

Using a car or motorbike, there are the steps walking

to the parking, riding, searching a parking lot and walking to the point of destination.

Access to public transport as well as to private vehicles requires time. This can be called T_{access} . Then the time for a trip T_{trip} is

$$T_{trip} = T_{access} + T_{ride}$$

where:

T_{ride} is the time needed to move from the point of boarding to the point of disembarking;

T_{ride} depends on the distance between station of origin and station of destination and the speed of the bus, or if this should be the case of the urban rail, metro, streetcar. The speed of a bus in mixed traffic is more or less equal to the speed of other vehicles using the road. In Hanoi, this is about 20 km/h. In the congested roads of other cities, it may be as low as 8 km/h, for instance, Paris. In order to improve this, one needs dedicated lanes or rails on their own infrastructure. Maximum speed of buses on dedicated lanes is 35 km/h;⁵

T_{access} in Hanoi on the bus service as it existed before the experiment was about 40 min.

The formula allows to compare the time needed for a trip, based on the distance and to predict mode choice dependent on distance. Fig 3 shows the results shown in Table 2 using the stochastic model of rational choice.

If two modes take exactly the same time, 50% of passengers will choose Mode A, the other 50% Mode B. If the two modes show a small difference, still 40% may take the slower mode, for instance, walk instead of using the faster motorbike.

To reduce access-time was a major feature of the experiment. The fixed intervals for bus-service reduced waiting time.

⁵Measured on the BRT in Bogota.

Fig. 1 Mode by time and distance.

3.4.4 The Problem of Aggregation

Planning cannot be based on millions of decisions. Shifting from planning to management, the focus is not to predict behavior, but to change it in a desired direction. Be aware that the results of any action may not be as desired. As Kurt Lewin put it “If you want truly to understand something, try to change it”⁶.

⁶This statement, attributed to Kurt Lewin, is frequently quoted, but actually, there is no source indicated, where he made it [20].

3.5 Abductive Reasoning: Action Research

Abductive reasoning complements the two forms of logical reasoning, deduction and induction.⁷ Abduction starts with a surprising event or observation

⁷Scientism takes the inductive methods of the natural sciences as the only source of genuine factual knowledge which alone can yield true knowledge about man and society. Leaving the scientific method leads to pragmatism. The American philosopher Charles S. Pierce (1839-1914) explored this third method of reasoning, already mentioned by Aristotle, who called it “ἐπαγωγή” in Latin abductio [21].

Table 2 Result of Surveys and traffic counts.

Type	Description	Finding	Source
Household survey	Interviews with 242 households, 2010, random but not representative	96% of households interviewed owned a motorbike car or have at least access to it. The longer the trip, the more likely are people to choose the bus or to use a car or taxi. Up to 10 km the motorbike dominates. Most trips, whatever the mode of transport, do not take more than 30 min	Ref. [16]
Passenger Interviews	1327 passengers interviewed in one bus line (No. 7) representative	53% own motorbike, only 32% have no access to a motorized vehicle	Ref. [16]
Road count, Quarter Ngoc Ha Ba Dinh District	All people leaving this quarter during 24 h. 317,951 people have been counted. The quarter is not accessible by car	The modal split was 53.31 % motorbike, 11.96% bicycle and 34. 39% pedestrian	Refs. [15, 17]
Traffic counts on main roads	Traffic recorded by camera. Results from peak hour traffic. Buses were inspected to check number of passengers	The modal split for public bus is main road (Kim Ma) 14% Chuong Duong Bridge 24.7%, Thanh Long Bridge 48.9 % including regional bus	TRAMOC, reported in Ref. [16]

and is than looking for the best explanation. The method for abduction in management is action research, which is experimental and heuristic. Simon [8] was treating the question in his book *“The Science of the Artificial”*. His main point was that a plan or design is an art. It is a product of creative imagination, but it also has to observe the constraints. That is how it becomes a science. The constraints may be physical laws.

Planning is an artful process of problem solving. In a complex situation, scientific reasoning not permitting a rational choice, action research allows a step by step approach and this way to advance the body of knowledge.

This procedure leaves the mechanistic concept of cause and effect, used all too often in transport planning in favor of understanding action as part of an evolutionary process. The city and its transport system and the concepts themselves are in a process of evolution. Every action has results, perhaps not the intended ones. Even failed intervention teaches us something and changes the knowledge [9].

My task was not scientific research and not planning a transport system. The task was to help the city of Hanoi and its agency TRAMOC to improve public transport. Action research was therefore an appropriate method. As the results were quite surprising, abductive reasoning, looking for the best explanation, is a logical next step. This is part of the aim of this paper, to show that behavior setting theory can explain the results, which have no place in the deductive/inductive method

of planning.

Lewin coined the term “action research” to refer to social action to solve problems in a controlled way [10]. Action research is problem centered, client centered, and action oriented. It involves the client system in a diagnostic, active-learning, problem-finding and problem-solving process. It is also a management method [5, 11] and an experimental approach.

Action research is a scientific method. The outcome of experimental changes has to be measured by an observable indicator, in our case the number of passengers.

Action research is not only a method; it is a philosophy. Social change does not occur out of the drawing room of some planning engineer, it happens as result of a cooperation of all actors particularly the people [11]. This takes up the work of PAR (participative action research).⁸

We did not start with a plan and the search for

⁸“Do not monopolize your knowledge nor impose arrogantly your techniques, but respect and combine your skills with the knowledge of the researched or grassroots communities, taking them as full partners and co-researchers. Do not trust elitist versions of history and science which respond to dominant interests, but be receptive to counter-narratives and try to recapture them. Do not depend solely on your culture to interpret facts, but recover local values, traits, beliefs, and arts for action by and with the research organizations. Do not impose your own ponderous scientific style for communicating results, but diffuse and share what you have learned together with the people, in a manner that is wholly understandable and even literary and pleasant, for science should not be necessarily a mystery nor a monopoly of experts and intellectuals” [20, 22].

money.⁹ We started a social movement. The success was not to be measured by financial criteria (profit), but by the number of people joining the movement, by signing up for transit passes and by using the bus.

3.6 Behavior Setting Theory

Lewin [12] considered behavior (B) as the result of the total situation, compressed in the formula:

$$B = f(P, E)$$

where, P is the person, and E the environment. Barker [13], the founder of environmental psychology was interested in the environmental part influencing the behavior. He coined the term BS (behavior setting) [14]. In his definition, a BS is a “standing pattern of behavior-and-milieu, with the milieu circumjacent and synomorphic to the behavior”. He surveyed two cities in England and the US for BS and concluded that the rules of the BS can explain 95% of the behavior of a person in the course of his daily life. There is a multitude of behavior settings in a city, but their number is finite and can therefore be studied and classified—there are classrooms and schools, restaurants, sport fields, recreation parks, etc. An activity takes place in a particular place at a given time. To get there, the person may pass through several BS, following their rules arriving at his destination to take part again in a BS, such as eating in a restaurant or working in the office. The number and types of BS make up a measurable characteristic of a city and together they are the constituents of the human habitat. The city is a structured system of behavior settings.

Synomorphy is the structural fit between the physical environment and behavior—think of climbing a stair: naturally, the movement of the body adapts to the stairs. Synomorphy also guides by design the social

interaction

Many BS take place only at certain times, so there must be a synchronization to allow the BS to function. Synchronization may also be required in the mini-cosmos, between pedestrians and cars when pedestrians are crossing a street. There are rules, which make up the cooperation and synchronization. My own addition to these basic conditions is synonymy [15]. The rules, which each participant follows, in assuming his role, must fit together. The roles complement one another. In the situation of an urban street, say in the morning, you have many people, at the same time in the same space; all want to move to different destinations. What has to emerge is the synonymy—the fit of all the rules that people in the BS follow. Modeling the physical environment and setting formal rules can initiate and facilitate.

Here, the traffic engineer should happily agree, building curbs, placing fences, painting lines on the pavement, he tries to channel behavior. The government may pass laws to regulate behavior and send the police, to enforce those rules. Attention however, not all this guarantees success. The people, who populate the BS, must be able to adapt those features in their own purposeful behavior. The trouble is that people who decide on these designs and rules are agents of different units; they want to operate a bus company, make money with building the roads and bridges, and force their rules on other people. They are usually part of another tribe, using cars, but not crossing streets on their way to school. People outside the BS may design the synomorph. Their design may help or hinder the flow of activities in the BS. Planners are very often blind to the fact, that they are making designs, which will become part of the milieu of people. Focused on the technical aspects of their plans, they ignore the behavioral aspect.

While the micro behavior follows the rules and physical conditions of a BS, observing its timing, the person executes a plan, pursues a goal and chooses whatever path is on offer by the behavior setting. A city

⁹The circumstances were not at all favorable at the moment. After a lot of engineering work URFS concluded, that there would not be sufficient passengers for the urban rail and the elevated bus-line would also not meet the cost. They further found out, that Hanoi had a sufficient number of buses (Fig. 2). This result gave the German government the argument to revoke its pledge to support Hanoi Public Transport with 40 Million DM. Generously, they financed my presence as advisor.

is an organized environment and at the same time, the eco-system in which people live and prosper. The person needs food and shelter, it needs the company of its group, needs to find partners to meet and mate. All these basic needs are woven into economic and ecological systems, which enable survival. Organizing behavior means that the person adapts to the conditions in order to reach a goal. Occasionally, the person may attempt to change the conditions for survival and may try new opportunities, if they are promising.

For the citizen, the BS makes up the totality of his milieu at any moment. The components are part of other systems. The engineer looks after the physical design and is interested in its engineering aspects, the shopkeepers want to sell goods, the administration has to organize the roads and send the police to monitor the observation of rules. There are many potential conflicts, which planners and organizers have to take into consideration.

While the BS is influencing the forms of behavior, it does not determine them. As the formula of Lewin makes clear, there is the other part, the person with its purposes, sentiments and reflections. It is the person, who acts. The planner wants to guide and push the person to act in a certain way, but the people may refuse this. There is a liberating aspect to action. People may get together and articulate their dissatisfaction, but this is not necessary. A plan that does not fit their needs and desires fails. The failure creates the condition for tumult, boycott or simply for ignoring the offer provided by the planner. The empty buses in Hanoi were an example of this quiet resistance.

4. The Method of Action Research

4.1 Step 1: Explore the Milieu by Participating in the Daily Life of the Target Group

In this case, the target group is the population of Hanoi. As mentioned above, I started to move around experiencing several modes of transport. Widening the exploration to other areas, I could not find the bus stop, he could not find out, which bus to take, and where to

get off. Finally, he would go to the terminal of my bus line. There he did find a number of buses, drivers sitting together and playing cards. Then, they would get up, three buses leaving the station one after the other. The buses were almost empty, no passengers boarding the bus on their travel through town.

4.2 Step 2: Evaluate the Situation

Public transport in Hanoi was feckless. The service was cheap, but so unreliable, that it was impossible to organize daily life using the bus. Bus stops were difficult to find and people were ignorant about the bus operation.

4.3 Step 3: Design and Implement an Experiment

I was very lucky, that I could persuade my colleagues in the office and the authorities for an experimental operation. Note here, that it is in fact easier to start an experiment than to elaborate and implement a comprehensive plan for public transport operation, which would require a big political discussion.

5. The Experiment

5.1 Phase I Experimental Model Line: Fixed Interval and Monthly Pass

TRAMOC decided that Line 32 would become an experimental model line. This line was operated by the smallest bus company, originally the operator of the streetcar in Hanoi. There was a new cooperative director, who was eager to improve his company.

The following changes would be introduced:

- Operation with fixed intervals, a bus every 10 min. This was possible with 12 buses; in fact, there were 14 buses available;
- Extend operation from 19:00 to 22:00 in the evening. The 19:00 end of service was a hangover from the socialist time, people go to work in the morning and return after work to their home and stay there;
- Offer a cheap transit pass to get loyalty to the bus line;

- A small change in the route, mainly for technical reasons. This was a lucky stroke, as the terminal then was just in front of a technical boarding school with several hundred poor students from the provinces, who had no motorbikes.

The experiment was very successful; soon we could celebrate 2,000 monthly passes sold. The buses were well occupied all day. Before the experiment, there were 1,700 passengers per day and after the experiment Phase I there were 8,000 (Fig. 9).

5.2 Phase II: Extending the Experiment to All Lines

All the bus operators supported the decision to implement Phase II to share the success of the model line.

5.2.1 Fixed Intervals for All Lines and Extension of Service Time

Service time was extended for all lines until 22:00 in the evening. Fixed intervals of 10 min were introduced, but for Line 32, a 5 min interval was arranged. Of course, we needed additional buses. We got a donation of 61—second hand buses from Ile de France.

5.2.2 Transit Passes for the Whole Net and a Fixed Period

On the model line, we had already a pass, valid for one month and any number of trips. Now we created a transit pass, valid for the whole net. This was a hit. Without any advertisement, the passes sold like hot cakes, 20,000 within two weeks. The whole team was working with great effort and enthusiasm to register the applicants, print the tickets and photos with a color printer and issue them with a stamp, which had to be paid for every month. Long lines of people were queuing up at improvised ticket offices. For an unknown reason, we were informed that the Peoples Committee wanted to stop the issuing of transit passes. In a long night, we printed the list of the 20,000 customers with name and address and submitted this book with the title “20,000 reasons to keep the monthly ticket”. This first ever mass petition in the capital of the socialist republic was a success. TRAMOC got the

permission to continue.

The transit pass was a small revolution. Before, the staff in each bus would sell the single tickets and deliver the money to the bus company, the staff keeping some of the income for themselves. Now, suddenly the tickets were sold by TRAMOC and the money collected by the sale of the registered and numbered stamps. To compensate the staff on the buses, the salary of the bus drivers and ticket collectors was doubled from the equivalent of 35\$ to about 70\$ per month. Within 3 months, the number of passes issued climbed to 100,000.

5.2.3 Introducing Better Information

Impressed by this success, additional grants could be obtained, to improve the maintenance and produce maps of the bus system (Fig. 5).

5.2.4 Interchange

As the system now relied very much on interchange, using two or more buses, attention turned to the interchange stations. Here is an example that shows the transformation of a disorganized situation into a very attractive structured behavior setting. Note that the flow of cars improved greatly by placing the bus station in the center.

5.2.5 Park and Ride

The spontaneous creation of park and ride by the people is an indicator of the success. They would drive by bike or motorbike to a bus station, leave their bike behind against a small fee, and continue their journey by bus.

5.3 Further Research on the Effects of the Experiment

Some further studies, listed below permit some further reflections on mobility in Hanoi (Table 2).

Almost all the people in the household interviews have access to a car or motorbike, which they may share with their family many trips are reported per day, the mode of transport depending on the length of the trip.

In the Quarter Ngoc Ha, located close to the center of town behind the presidential palace, only access is

Fig. 2 Increase of ridership in buses 2000~2010.

Fig. 3 Bus map.

Fig. 4 Long Bien bus stop before.

Fig. 5 Design of the interchange station.

through alleys, which are too narrow for cars. The dominant mode is the motorbike, but the share of bicycles is very high (Fig. 10).

Interviews in the bus revealed that only 32% have no access to another mode of motorized traffic. However, why do 2/3 of passengers prefer the bus to the motorbike? 53% of bus passengers claim to own a motorbike. They are riders by choice.

The results of these surveys and traffic counts, all stipulated by TRAMOC, but carried out by independent researchers, are surprising.

Fig. 6 The new interchange station.

Fig. 7 Increase of passengers Line 32.

Fig. 8 A house in Ngoc Ha.

6. Results

6.1 Increase of Passengers

The experiment launched a transformation of urban travel. Buses are present and buses are usable all day at affordable prices. The share of people using the bus increased, but the number of people using the motorbike increased as well (Fig. 1). The huge increase of passengers of course is relative to the deplorable state of public transport at the time.

6.2 Improving Mobility

There are distinct areas or orbits for the spatial movement of people:

- Short distance destinations such as small shops in the immediate neighborhood. Due to the socialist concept, kindergarten and primary schools are also in the densely built up areas in the neighborhood. Distance is $< 2,000$ m, so it can be reached by walking or by bicycle;
- Middle distance destinations, where one visits friends, health care, recreation facilities. Also most secondary schools are in this distance of $< 5,000$ m. This distance is too far for walking, but can still be accessed by bike;
- Further distance destinations, as place of work, universities, hospitals, administration, where trips of $> 5,000$ m are required;
- The bus with fixed intervals offers a solution, in particular as long as there is no MRT operating. MRT, however, will be of real value only for distances $> 10,000$ m. As of 2010, trips of this length are rare.

Based on a household survey in 2010 and on passenger counts and traffic counts as well as on the analysis of mobility in this paper, the following

conclusions were reached:

On long trips > 5,000 m, the bus with fixed intervals makes a difference. On longer trips, which are not very frequent, the older regime of busses travelling on schedule, but without fixed interval, had an important role. The new system reduces the dependence on the motorbike for middle and long trips.

6.3 Urban Structure, Trip Length and Mode Choice Are Interactive

This result is almost trivial and yet often overlooked. In Hanoi, we have a rare mixture of functioning neighborhoods that allow short trips. These neighborhoods are by lack of parking space not encouraging for driving the own car. Hanoi is an ideal setting for the combination walking, the bike, the motorbike [18] and a well organized bus system. There are many forces driving his harmony apart. On the other hand, improving the access to bus stops and interconnecting the buses by well designed interchanges will strengthen the role of the bus.

In a tumultuous environment, people will use any stick to survive. This is not a question of life and death, but of coping with conditions, some favorable and some adverse.

6.4 Behavior Setting Theory Helps to Organize the Search for Solutions and to Find Promising Ways for Experimental Change

What does behavior setting theory add? It is an approach to manage cooperation and create solutions for social interaction. The big increase of road traffic poses problems especially for people using the road in other ways than driving a car. Without intervention, they are the weakest participants in the conflict zone, very often victimized. Look at the road side. In the densely settled quarters, the front side is often used for shops (Fig. 11). Part of the business takes place on the sidewalks. Customers come to shop, leaving their bikes and motorbikes stationed. The people living in the street, who keep their two-wheelers at night inside, have to leave the house, cross the sidewalk to take the

Fig. 9 Traffic jam in 2015.

Note: Up on the road, there is a bus stop. So buses have to approach the sidewalk. Further down, the car is stationed. Buses have to move to the center. On the right side, some motorbikes are trying to cross the street. In the center of the street, there is a bus stop, which has been constructed for the future BRT, which is designed in Latin American style for buses with doors on the left side, to allow boarding from the center platform.

Table 1 Type of trip and model split calculated and observed.

Type of trip	Distance	Preferred mode	Time (min)	Modal split (%)	Trips per day and person
Short	< 2000	Walk and bike motorbike	15~30 8	50~70	2.9
Middle	2,000~5,000	Motorbike bike Bus fixed interval	12~15 20~30 30	80 5 5~10	2.3
Long	5,000~10,000	Motorbike Bus fixed interval	25~30 40~50 40	45~60 15~20 30~40	1.9
Extra long	> 10,000	Bus on schedule Motorbike car	35 40	35 15~20	Not yet many

road. The roadside therefore is a very busy part of the street in constant conflict with the moving traffic. If the bus should stop, it moves close to the curb, but has to avoid the people and their motorbikes, standing there. The BS is a self-organized creation by the users. They incorporate the setting into their behavior. In order to make this adaptation smoother, the bus should run in the center of the road, in Fig. 11, you can see a BRT station, built but not yet used. This is supposed to take the buses to the middle of the road, where it is free of the constant interference from roadside behavior. Both of the interchanges, which we constructed, we could place the station in the center of the road. Interchange of passengers can occur in a well organized area, free of motorbikes and cars. Both these stations have only few passengers coming from the adjacent street. Tens of thousands of users arrive by bus, get off and board another bus. The interesting part is, that on the remaining road-space traffic flow is much smoother, as the users of the bus system do not hinder it. These are just two examples how proper design makes movements of all traffic participants easier. It removes hurdles and obstacles for the passengers and makes the bus service more attractive and access time shorter. BS-design takes into account the interests of all participants. The realization is a proof, that little investment can achieve this.

7. A Final Remark

Why did other experts and the planners of Hanoi itself not see the opportunities of improving the bus-service?

I have explained the conditions, when we started the project. I would not have dared to forecast, that the number of passengers would multiply by 30. I was myself overwhelmed by the result. Nobody at the time would have believed such a prediction. Very important was the fact that little money was involved. When Ile de France and Hanoi approached the EU for support under its ASIA-URBS¹⁰ program, a plan had to be drawn up. The advantage was that we had already some success to show. Furthermore, the EU allows in these programs the applicants to propose their own actions and formulate their own objectives. The whole design of the log frame of the EU is in the spirit of Action Research. World Bank and other donors require big plans and base their decisions on recommendations of international consultants. TRAMOC could profit from some World Bank funds to visit successful Bus schemes; in Curitiba, we could meet Jaime Lerner and in Bogota, Enrique Penalosa, who also came to visit us in Hanoi. We also could organize a study tour to New Delhi, to meet the charismatic project manager, Shridaran, who had realized the extraordinary success of Delhi Metro. Lerner, when he invented the BRT¹¹ in Curitiba, was mayor. Penalosa was running for mayor, when he worked out the plan for BRT there. He implemented it, after he was elected. Shridaran had a reputation of working miracles, when New Delhi asked him to assume the charge of building the Metro. He

¹⁰ASIA-URBS is program of grants by the European Union and designated for cities in Asia. It is open on application, awarded by the merit of the application of cities and NGOs.

¹¹Bus rapid transit, a bus system that has similar capacity and speed and is sharing the qualities of MRT but operated by buses instead of railcars or trains.

could impose his conditions on the government of New Delhi and of the Indian Union, to save the city after decennials of useless planning and frustrated efforts.

These people are strong leaders and they are convinced about the necessity of a well-organized public transport to save their city. For technical problems, one can call on experts, but the leadership must define the objective. I asked Jaime Lerner, to what he attributes his success. He told me, that he studied in Paris. Then he visited the first pedestrian zone in Munich. When he became mayor of Curitiba as young and promising urban planner, he wanted to create a pedestrian zone as in Munich and a transport system, like the Metro Paris. By lack of funds, he invented the BRT, somewhat a Metro on rubber wheels. Then he added, “I was lucky, that we did not have the money to invite foreign experts. So we had to do it ourselves with our own resources”.

As I mentioned in the beginning of this paper, the government of Vietnam and the peoples committee of Hanoi wanted to have public transport, but they lacked the financial means. There had been consultants to sketch out systems, but project costs were out of reach for the city. I had the great luck to meet the general director of Public Works in Hanoi, Pham Quoc Truong. Somehow, he had confidence in me. It was he, who got all the necessary decisions approved by the Peoples Committee. Without budget and with a small organization we could start the experiment without big public and political attention. It was the success of the experiment with Line 32 which created a favorable environment. Alain Lesaux, in charge of international affairs of Ile de France was trying to introduce a new system of decentralized cooperation, so he managed to obtain funds from Ile de France and from the European Union. With him, there was no need for long discussions. We both had the background of Public Transport in Paris and agreed that small actors must succeed in small projects. Convinced, that public transport is the only way to keep a big city alive, we only had to show, that this is possible.

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