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Future PT and Bus Systems and Sustainable Urban Development

Project - Da Nang/VN - KfW/ALMEC

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Content:

1. Summary

Integration of Urban and Transportation Development and integration of all modes of transportation are the most important as well as the most difficult issues aiming at economic, social and ecological sustainability of both urban and transportation investment. Integration covers the structure scale of networks and land use (0,5-10 km) as well as the design scale for traffic, public space and built-up environment (10-500 m).

Integration considerations lead to three major strategic items of a sustainable system:

- To discern between small scale high quality Urbanity (Highest density, mix of functions, and public street network) and small scale Sprawl (lacking these qualities).
- To integrate high performance PT systems into Urbanity networks, and offer not more than basic PT service within Sprawl networks.
- To integrate PMC policy by avoiding area wide PMC subsidies and introducing special regulations to maintain mobility advantages in Urbanity areas.

This general agenda will require consequences for many further advanced planning details different from usual planning and design standards.

Objectives and plans for sustainable urban and transportation development require and allow certain specific characteristics to justify bus investment in Da Nang. To improve this development, integration should be a continuing task for all next steps of the project. Instruments could be developing design standards, assessment and monitoring, case studies, architectural and urban design competitions, and vocational training for responsible experts and executives in planning and real estate investment, concerning integration proceedings, standards and tools.

2. Sustainability by Integration of Urban and Transportation Planning

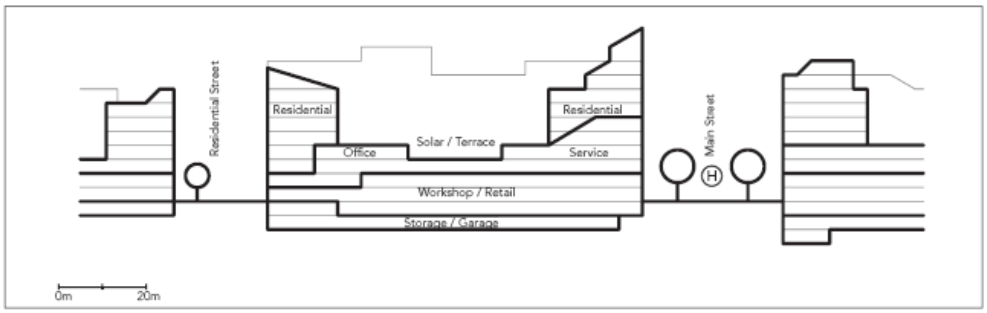
The Da Nang bus project is meant to serve the aim of sustainable urban development. Many measures, e.g. alternatives for fuel, operation or infrastructures, are valuable and reach an improvement factor of maybe 1.5 up to at most 2.0, and sometimes there remain questions about definition of sustainability. Integration of urban and transportation planning offers potentials of factor 10-50 concerning undoubted indicators of economic, social and ecological sustainability. Therefore this advanced approach will be the main focus. It has been developed in the author's research group and although not yet very common promises convincing application results.

2.1 Urbanity and Sprawl: Density, Mix of Functions, Public Streets

To avoid misunderstandings at first we explain how we use the terms "Urbanity" and "Sprawl". Both terms here are used at a small scale of settlement units covering pedestrian distance to a PT stop (500m x 500m).

Urbanity is precondition and indicator for large amounts of PT passengers by highest density (200-1000 R+E/ha). Urbanity provides balanced PT passenger load (and thus efficiency!) all day and week long all directions by small scale mix of functions (always including 30% – 70% residential). And urbanity provides safe and comfortable access and waiting by well designed and maintained traffic calmed public street space. Dense and mixed urbanity desperately needs public urban space especially on the cities ground floor: for buildings with attractive ground floor utilisation; for open street space for mixed use like walking, cycling, driving networks; for street trade, delivery and parking; for green, leisure and playgrounds; and for all unpredictable and spontaneous performances of urbanity. Urbanity in this sense has a long historical tradition in Europe and Asia. Especially it allows and encourages traditional and new forms of Vietnamese urban design and street life.

Abstract illustration of an urban unit



Sectional view of an urban unit

01.2009 H.-H. von Winning, D. Stepner

Urban Units: Abstract and Example Barcelona

“Sprawl” lacks at least one of the qualities of urbanity: it has low density, mono-functional built environment and technical street space. Mere residential, commercial, CBD, retail, education, leisure or other mono-functional areas (or centres) usually are parts of sprawl and do not provide enough PT passengers. The idea of sprawl was meant to separate early industrial zones for reasons of better health conditions in early 20th century in Europe and the US. It included full motorization and highly subsidized PMC systems. Sprawl settlement still is a very common topos in early anglo-saxon influenced planning and investment discussions and proceedings. But it is proven well enough, that sprawl causes highest consumptions of energy and raw materials, and is far from sustainability – at least in societies aiming at high differentiation, variety and cooperation. Sprawl does not resemble either European, Asian and Vietnamese urban traditions.

The Da Nang urban development will include areas of urbanity as well as areas of sprawl. Both Types are existing now, and both types may be part of the future land use pattern. The expected fast city growth process may include de-urbanisation, or re-urbanisation of existing built-up areas, as well as new urbanised or sprawl areas. Many existing urban and rural areas, as well as some advertised international developer’s projects show the Vietnamese tradition for density, mix of functions and public streets. This can be taken as a strong attitude and a good chance to avoid sprawl and to prefer urbanity.

At this time of the study it does not matter if urban development offers present passengers or just origins and destinations as subject of choice: both can be taken as an indicator for potential future passengers. Bigger scale land use plans will be asked for the situation of urban units within sprawl areas rather than for their functional zoning. Some points within functional zoned areas may be developed into urban units as highly specialised polyvalent points of urbanity. But this has to be guided by additional strict regulations.

2.2 Mobility: Choice of Options, Cost and Benefit, Efficiency

PT success usually is proven by traffic performance, measured e.g. by pax x km or tons x km. For an operating company this may be a suitable indicator. But for passengers or citizens this only counts traffic as expenditure (time, money, energy etc.) to reach destinations. The original aim of transportation is differentiation of life: to increase the choice of destinations or options for as many origins resp. citizens as possible. Then the amount of opportunities, the number of different accessible persons or places may be aggregated to describe real mobility, to count and compare potential connections of different urban-and-transportation-systems. If this reveals less pax x km or less expense of time, money, energy etc., or more opportunities within reach with the same expense, then the urban/transportation system should be called more efficient and/or sustainable.

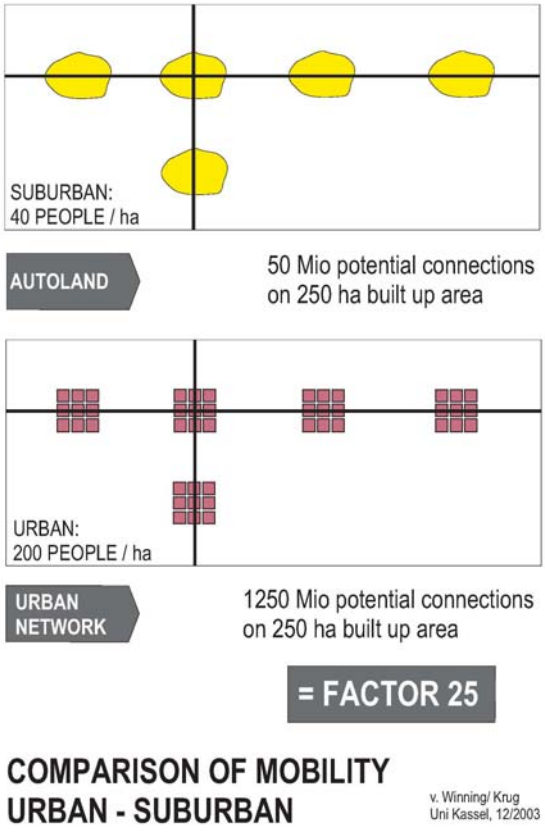
Different from other indicators, this just compares cost and benefit ratios, and sustainability here means the same as efficiency. And different from other indicators (e.g. ecological like biodiversity) it indicates economic as well as ecological sustainability – here are no contradictions between these objectives.

Of course to measure both cost (incl. all direct, external, social, environmental etc. cost and damage) and benefit (choice of options) has a lot of very difficult methodological problems. Questionable variants e.g. would be estimations of time value, cost relations between station and routes, or between real estate, infrastructure and operation, or between adequate interest, depreciation and maintenance cost.

2.3 Factor 25 for Mobility Efficiency in Urban Networks

But experiments have revealed some evidence, that the benefit variant “urban structure” by far seems to have the most important influence on efficiency. As an indicator for the number of possible origins and destinations around a stop or station, it varies most and behaves widely ceteris paribus without further interaction. Also it is not too complicated for quantitative estimation from easily accessible data. It will be valid at least for bus systems on existing or future urban and street networks within a certain range of “normal” size and quality. This is why for practical use integration of urban and transportation structure is a suitable method to assess, monitor and improve sustainable urban development.

The following figure compares the mobility (or efficiency, or sustainability) of a bus connected network of Urbanity units (“Urban Network”) with one of suburban Sprawl (“Autoland”) units. Assumed sprawl at 40 people/ha and urbanity at 200 people/ha, Urban networks provide 25 times more mobility. Other assumptions (like existing density in some parts of Da Nang of 400 and more people/ha) will boost the factor to 100. At the same time, mono-functional sprawl may even host less than 20 people per ha. And all on top, if



Sustainability of Urban and Sprawl Units

there is Sprawl and Urbanity bus stops along the same line, there will be a huge transfer of quality: from urbanity passengers stopping many times, to sprawl passengers benefiting from access to urbanity.

As future density is very difficult to prognosticate and also is subject of planning and politics, factor 25 is a rough but rather conservative average figure to be used for application.

2.4 Discerning Different Bus Service Levels for Urbanity and Sprawl

The extreme difference between Urbanity and Sprawl in mobility caused by bus investment would mean a huge subsidy for Sprawl, if the bus system would serve the sprawl with equal or similar quality. Differentiation of level of service to balance sustainability is necessary not to discriminate urban citizens. It may be reached by different headways, investment in stations or IT infrastructure, prices and fares, or source of credit and capital. The dimension of the difference has to be crucial: factor 25 would mean e.g. for headway ten minutes in Urbanity, or two hours in Sprawl.

The exact measures may be defined later. But to be able to decide about feasibility it is necessary to discern between areas of two different levels of service:

- High Performance Bus service connecting Urban Networks
- Basic Bus service connecting Sprawl Networks

It is easy to understand that to improve sustainability, the geometry and characteristics of bus systems as well as of the urban development should be respected from the very beginning and will require continuing adaptions of both transport and land use pattern.

3. Urbanity Bus: High Performance Specifications

3.1 Multi-Nodal, De-central Quasi-Endless Urban Network

Bus networks should follow the type of (quasi-) endless grids with more equivalent multi-directed nodes rather than tree shaped centre-oriented hierarchical types. Grid intervals should add direct pedestrian access (500m-1000m). Lines should be as long and straight as possible, because any line endings and detours cut back efficiency.

All streets should provide green light priority for busses from all directions. Therefore the maximum of bus headway should be about 5 minutes (=max. two articulated busses as group x 100 passengers x 12 = 2.400 pas/h) per direction. This is not too much and also allows more traffic calmed and integrated street design for smaller driveways with mix use lanes. It also allows chances for crossing the street at junctions and in course for pedestrians and all other modes. Flyovers would not be necessary, that also would separate urban connections, disturb public space design, and impede interchange between rectangular PT directions. More equivalent medium capacity lines are more adequate to multi-central urban structures than trunk and feeder bus systems.

Many line crossings allow many interchanges at most suitable stops without detours. Regional and long distance busses should have several bus stops along their way throughout the city of Da Nang. These bus stops should connect the travellers with the urban bus network at several casual roadside stops close to urban bus stations.

3.2 Highest Performance without Exclusive Bus Space

Highest bus performance means straight lines without detours or bends at stops, shortest stopping time by efficient low floor platforms, and no delay by congestion or red lights. A usual attitude is to claim more space: exclusive lanes for bus operation, or exclusive walking or waiting space for passengers. But exclusive space contradicts the qualities of urbanity and public space as the most important precondition of bus efficiency. This is why

speed and comfort should be achieved by straight driveway, management and priority, but not by separating dedicated lanes, platforms and other mono functional space. Busses and passengers could and should use general public driving and pedestrian space.

3.3 Priority on City Streets or Multiple-Lane Boulevards

Street design is depending on many other tasks of the street: bus traffic may take place in pedestrian zones, traffic calmed, or main streets with two, four or more lanes. Mixed used lanes with motorbike and PMC traffic are accepted behind queue-leading, undisturbed and non-delayed busses. So use of scarce space is more efficient. It will leave better chances for pedestrian crossing and will help for boulevard design: in small historical streets or in streets with more or less traffic. Bus leadership also will be confirmed by stops without bays or overtaking opportunities.

Dedicated lanes must be provided only at a few less sensitive sections, where PMC congestion is to be located and managed. This should take place outside urban units and distant from bus stops. Bus driveways also in the course of stops and stations should be direct, straight and without small scale bending, for better passenger comfort and for continuing priority. Combined with curb-side stops the mixed bus track preferably mostly will take place on the right side of the driveway. Wireless green demand at traffic light avoids delay at junctions during or outside peak times.

3.4 Bus Caps, Shelters, Interchange Stations

Bus stop design should use curb stops at right sidewalks. The demand for waiting space for passengers is very different during time. Integrated into general public pedestrian sidewalk space sufficient space can be provided in peak hours without spoiling space in weak hours. Dedicated platforms (middle or roadside) usually would be too small in few peak minutes, and bleak, vast and empty most of the time when not used for bus purpose. Of course the waiting area must be kept free from parking vehicles. 18cm tyre protecting (“Kassel”-) curbs help for that. Besides, they are a good design and functional compromise for some low floor busses, and for pedestrians to cross this step within public space.

Bus caps situated in straight bus approach position are comfortable for passengers; they avoid dangerous gaps for em- and disembarking persons; and they save time and money for passengers and operators. The curb must be positioned as close to the middle axis of the street, as pre-justified by existing other stationary use along the roadside (Parking or other, in reality, not in Theory!). This position also provides sufficient space for waiting passengers: wider than other parts of the sidewalk and flexible. Most platform curbs should offer about 36m length for two articulated busses.

Bus bays cannot be accepted at all within sustainable bus systems.

Weather protection, light, information boards, benches and other equipment should not be designed, installed and operated exclusively for and from bus use. All this should be integrated part of the general public space. Design and function should be part of neighbouring buildings. Windshields or advertising panels should not stand alone in public space.

Avoiding separate space (like dedicated bus lanes or passenger waiting areas) is especially important at stops for more than one line: These are points of even higher accessibility and therefore the more Urbanity and public space is needed: to feed and take ad-

Integrated Urban Bus Stop Weather Roof

vantage of the more busses there. Many (interchange) stations along Da Nang main streets today look empty and bare, but in fact have a lot of potential to be subject of intense urban development towards attractive boulevards.

At crossing and parallel lines interchange along sidewalks is quite acceptable for most interchange relations. To avoid crossing streets for interchanging passengers totally often has severe disadvantages: busses have longer ways and more left turns, and waiting islands are isolated and not integrated into general public space.

Bus service and maintenance facilities together with overnight parking areas usually need a lot of space hardly to be integrated in urban public space or high rise buildings. Therefore the location of service and bus parking areas should be chosen rather somewhere in the sprawl. This also means, service and parking should be separated from interchange or long distance bus stations, that quite well fit in existing or future urbanity environment.

4. Sprawl Bus: Low Sustainability, Basic Service

Some bus strategies aim at total area covering and even preferring to connect rural as well as suburban people to what from this point of view may be called “centres”. As described above, the efficiency and sustainability of these connections is much worse than those of urban networks, because they provide access only for and to very few people around sprawl stations. It should be well respected that subsidised bus connections from and to suburban areas would tend to be a mighty force towards more sprawl settlement, thus severely threatening overall bus efficiency and sustainable urban development.

Anyhow for some reasons, e.g. social politics, some basic bus service should be offered for sprawl, too. But this should be paid and credited for only on a very basic level, like 2 hrs headway without night service, no station infrastructure, perhaps less comfortable busses, and high cost adequate fares. In some cases this service can be offered by the same lines, that may be split into urban sections and stops, and suburban sections and stops, served e.g. by every 10^{th} or 20^{th} bus course.

Decisions about this topic may have consequences on the type of busses. Vehicle design should provide low-floor, level, or one step boarding. Fast boarding fosters fast travel times and economic and ecological operation. This also includes smooth acceleration and engine rotation control, and low engine power in favour of less emissions and more passenger comfort. For intermediate periods the amount of low floor busses gradually will increase; so no platforms should be higher than lowest possible floor busses in the long run (= 18 cm curb, which also is the maximum to stay compatible to urban space design and function). Right side bus doors exits are sufficient, as there must be no provision for left door exits or higher platforms. Within the range of the city, passenger comfort and driveline techniques should be designed for trips of up to one hour and 10 km, travel speed of 25 km/h and top speeds of 60 km/h. More distant urban or suburban destinations may require some busses with different drivelines and top speeds of 80 km/h.

This strategy does not exclude the surrounding districts and communities of Da Nang from advanced development. The exclusion affects sprawl parts of all districts and communities. On the other hand, also small communities and rural districts have the chance for (small scale but real urban) urbanity development, which would give them the chance to be part of the high performance urban (bus) network even in some distance to Da Nang city. At the same time, remaining sprawl parts of both city and rural districts and communities may develop in different directions, but with low mobility.

5. Sustainable Bus Service: Some Da Nang Feedbacks

The considerations explained above may lead to feedbacks in the course of further detailing of the bus networks, design of bus infrastructure, land use patterns, and urban design. Also there are some flanking measures necessary and recommended.

5.1 Rethinking Suburban Zoned Areas

The detailing of the zoned areas of the actual Da Nang Master plan could propose some modifications to improve sustainability. At some few selected locations at possible bus stops urbanity concentrations could be planned and constructed – 10.000 – 20.000 people within 500x500m in dense, mixed use urban units with public street networks. Some functions, e.g. resettlement dwelling, university campus, commercial offices and others should be planned and constructed to fill up present semi-urban areas to convert them into dense urban units, respecting complementary use for mixed functions. Detailed examinations will reveal sufficient real estate reserves within the urban areas.

The only zones that necessarily have to be sprawl are some of the big industrial areas and plants. They need giant ground floor light constructions with a lot of heavy truck and forklift operating space. They cause emissions and traffic not compatible with other use.

Their demand for personal traffic only has few very high peaks. And probably they will be depreciated and out of use within not much more than ten years. These specifications do not justify long term infrastructure investment, do not allow integration into urban units, and would not feed constant high performance bus services. Here special peak bus services should be offered, in addition to regular urban bus schedules and networks, and either in close cooperation with or as complete company services.

Also discussions should be launched to locate bigger and growing parts of industry separated from the big plants into urban units, where much higher accessibility and mobility for persons can be provided. Some parts of companies, e.g. research, administration or customer's service etc., may benefit more from integration into urbanity and public transportation than from vast space and close vicinity to their conveyer belts. When aimed at high level employees and executives, the alternative of an attractive urban working environment on the long run is much more charming and sustainable than industrial areas meant to turn into "grey-fields" within a decade.

5.2 The Main Street Network: Urbanity or Sprawl

The one very special character of Da Nang main streets discussed here is the very high capacity for future motorised traffic. The dimension is a capacity of roughly 3000 or more PMC-units per hour, on two lanes or more each direction, with some extensions at junctions.

Mere Automotive Highways sometimes also have higher driving speeds and/or multi-level junctions/flyovers, and in general are optimised for free motorised traffic. But these have severe disadvantages for all other urban functions. For sprawl areas car-oriented streets may be acceptable: houses and people keep and should keep distance because of danger, bad environmental conditions, and prohibited crossing facilities, and also in favour of easy motorised traffic flow. This fractionises and separates built-up areas, enlarges distances and so reduces sustainable non-motorised or PT mobility. For dense, mixed and public urbanity areas, these streets are not acceptable at all, because they severely destroy urbanity. As sustainable high performance bus traffic is dependant on urbanity at least around bus stops, bus traffic on mere automotive highways is contradictory.

But these main streets in Da Nang can be redesigned as Boulevards: very high capacity streets in an urban adapted way. "Main Street" may as well include a lot of other specifications: limited driving speeds, space saving and urban adapted driving design, high share of two-wheelers, high share of busses or streetcars, mix of national/regional/urban through and access traffic, wide sidewalks and high share of pedestrians, good pedestrian crossing facilities. New or existing adjoining buildings/lots may get orientation and representation to and access from the main street. They perform urban structure/design as public space, green and environmental qualities, limited noise and pollution, and others. To achieve this, there have to be minor restrictions for speeds and easy traffic flow, which has to follow bus speed and rhythm. But there is no limit for capacity as number of vehicles per peak hour. On the contrary, also technical capacity per lane is highest at about 30-50 km/h after starting at traffic lights. Boulevards do offer the best precondition for sustainable high performance bus traffic: Straight oriented and easy understandable network, bus stops at junctions, constant priority at traffic lights, comfortable and safe waiting areas on wide sidewalks with attractive buildings, comfortable and safe access and interchange via sidewalks and pedestrian crossings from the whole area; and the

most important quality: very dense mixed and public urban development within 300m around the bus stops to provide and serve as many passengers as possible.

The Da Nang Main Street Network will consist of the two types. The wide public owned space provided for all Main Streets is a very good precondition to be used for Boulevard design including urbanity development. Examples are Nguyen Tat Thanh, Dien Bien Phu, Ngo Quien, Truong Chinh (NHA1) and several others. Some of them in many ways show the Vietnamese tradition to orientate houses to the street, which can be taken as a strong attitude within built-up areas to avoid mere Automotive Highways and to prefer Boulevards. Only in some cases or sections in future they may be used for distance and high speed automotive design. The design principle may change between the two types along the same street, according to the cities decision either for urbanity or for sprawl development along certain sections of the street. As far as known from the development plans, the outlines of Da Nangs main street network still include all options to be developed into Boulevards necessary to fulfil the objective to be part of a sustainable bus system (which Automotive Highways do not).

5.3 The Motor Bike

Under certain circumstances the decision for the motorbike can be accepted as a transportation mode of high efficiency. These circumstances are

- Very cooperative and smooth driving behaviour with moderate speeds and accelerations prove a deep attitude to urban lifestyles. If only a low percentage of bikers would change their behaviour towards competition (e.g. by speeding or overtaking), total mobility may decrease seriously.
- Technical standards (4-stroke engines, swept volume limits) help for moderate traffic performance and rather low environmental impact. Only enforcing these standards (e.g. by electronic speed and acceleration control, and stronger emission standards) could keep free MB driving acceptable.
- The actual total amount of vehicles on the streets keeps traffic fluent. More traffic demand fulfilled by motorbikes and especially by more private cars will cause severe congestion and will cause an extreme break down of mobility of all traffic modes.

So, up to a certain performance and number of driving and parking vehicles, sustainable urban development can accept a high use of motorbikes close to the actual share. Installing a high performance bus system for the growing transportation demand seems to be the only way to keep motorbike traffic fluent and efficient. To compete with motorbike use, two traveller segments should be focussed as potential bus passengers. The first group are those with higher comfort and efficiency demand; they like rain protection, or comfortable phoning or reading during travel time in the bus. The second group are those who are too young, too poor, too old or too disabled to use a motorbike. Those should be offered personal fare subsidies by the city (not by the bus company!).

Even competing with the advantages of motorbikes there seems to be no doubt about the feasibility of the proposed bus system. Its size is just about basic. Even 100 busses each carrying 100 passengers would just replace some 10.000 motorbikes in peak hour. These figures have to be compared with a Da Nang of more than 1 Mio inhabitants (more than every 4th of them owning a motorbike): So nuances of dimensions can be dealt with later.

5.4 Private Motor Car Policy: The Singapore Way

One key for sustainable urban and transportation development in general and especially for a successful bus system is the national and municipal legal and financial framework for PMC traffic. PMC policy is the most crucial factor for the demand for and amount of PMC traffic, for the chances, performance and success of non motorised and public transportation, for overall mobility of people as described above, for the standard of urban environment, and for people's decisions for urban or sprawl settlement.

The private motor cars' individual advantages are so overwhelming, that the demand for ownership and use will exceed any dimension compatible with urbanity. As mentioned, high quality and sustainable urbanity desperately needs any qm especially in the city's ground floor for buildings and public space, and cars simply need to much space for driving and parking. Physically there is no way to meet the demand for more than a certain limited amount of cars in the city acceptable in public streets. In the past, most countries and sometimes cities too, moreover have fostered and subsidized PMC traffic, e.g. by tax reductibility, by garage obligations in building codes, by free or cheap use of public streets for driving or parking, and others.

In the last years more and more countries and cities start concrete measures to limit car traffic, to save energy and money for people, to improve urban environment, and to provide highest mobility for cultural, social, economic and ecological progress - towards a sustainable urban development. Some important measures are parking regulations: general interdiction of long term parking on city's public and private ground floor space and license only for short term parking; providing underground garages in urban master plans close to main streets; encouraging private investors to built them and offer them for everybody's use at high cost covering parking fees; and high parking fees everywhere as an interim measure. Also there might be driving regulations like strict speed limits at 30 km/h for wide areas of the city to harmonise traffic with busses and motorcycles; this also could be achieved technically by obligatory electronic on-board devices. Also there should be infrastructure measures on public streets like traffic calming and boulevard design. The most promising field is road pricing – starting with inner city tolls, and proceeding to area-covering satellite-organized automatic encashment with different prices according to sensitivity and congestion times and spaces, for all vehicles, streets and parking facilities.

It should be emphasized that these measures are not restrictions of PMC traffic, but rather regulations and lack of subsidies. And they also are suitable to serve the remaining PMC traffic. Whereas cities with supposed "free" car use remain stuck in congestion including busses, bikes, motorbikes and cars, cities with strict regulations can benefit from fluent traffic in all modes. The remaining amount of cars will be more than sufficient to serve those city functions that are car dependent and cannot be substituted by other urban modes of transportation.

The most advanced program worldwide is done by the city of Singapore. Singapore has been testing, conducting, monitoring and improving its system for decades. It has been gained highest economic benefits from PMC regulations, that include highest fees, taxes and tolls for PMC. Many specifications can be visited, learned and adapted from there.

This study cannot give detailed information on this subject, which is one of the most important parts within all serious initiatives for sustainable urban and transportation development. To approve sustainability of the Da Nang bus project it is necessary to get at least some general consents by the city towards regulating PMC traffic.

6. Further Proceedings

So far this Feasibility Study has revealed potentials and chances for improvement during further project work. Some controversies about aspects of sustainability by integration of urban and transportation development need to be reduced. This partly is due to the fact that it is not possible to sufficiently and finally discuss these within the given time and working time resources. Urban and transportation integration are always continuing tasks for public planning departments and for all sectoral and spatial planning instruments, projects and programmes.

The next steps of the Da Nang Bus project should increase to integrate aspects of sustainable urban development, on the basis of the preliminary sketches of the FS. One instrument should be a design atlas, as a general guideline for the architectural and urban design of bus stops and their environment. Some areas with complicated surrounding urban development should be detailed through urban and traffic design master plans and continuing external consulting, e.g. along present main streets to be future boulevards. Some very special situations, realms and tasks should be subject of (international) architectural and urban and traffic design competitions, e.g. the Opera Place.

The degree of sustainability by integration achieved in different stages of the project should be subject of continuing monitoring, assessment and improvement procedures. As shown in the attached Figure “Comparison of Mobility of Urban and Suburban”, an urbanity bus line is better than the sprawl line by factor 25. Using this indicators and figures, and knowing the future degree of urbanity around stations, it is possible to estimate and compare the efficiency and sustainability of bus stations, bus lines, and bus networks in combination with urban development. From the present point of view the results of this assessment may be the following conclusions and recommendations:

- Modification of kind and degree of urbanity around certain stations, e.g. by suggesting additional urban densification, complementary functions, and public street design.
- Modification of geometry of bus network, e.g. by indicating suburban lines, avoiding detours, and avoiding concentrations of too many driving or stopping busses.
- Modification of level of service and investment for sprawl lines or parts of lines, e.g. by less headway, building and IT-priority, and number and situation of stations.
- Modification of fares or funding for sprawl bus, e.g. special prices, subsidies or credits, depending on political priorities of different acting organisations

Another helpful initiative would be to launch vocational trainings in sustainable urban and transportation development. The target group should be experts and executives in planning, civil and transportation engineering, and real estate investment. The training units should concern proceedings, standards and tools. It might be practical also to open the courses for scholars from outside Da Nang, but to develop a joint programme together with interested personalities and faculties in Da Nang or Ha Noi University.

Objectives of sustainable urban development require and allow certain specific characteristics and measures to justify bus investment in Da Nang. The feasibility can be stated under provision of some further efforts and more detailed evidence of the issues and interrelations described.