# INTEGRATED QUALITY MANAGEMENT FOR URBAN TRANSPORT SYSTEMS

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## ABSTRACT

In our societies, in many areas of production and services quality management procedures are already well established. They became important elements of a successful business management. In traffic and transport such approaches to quality management came up only quite late with increasing privatization and market-orientation. Meanwhile, several instruments of quality management have been established. Nevertheless, a comprehensive and integrated quality management for urban transport systems has not been developed yet.

This contribution describes the objectives of such a comprehensive quality management and the related basic methods. The different perspectives of road users, transport system operators, and the society on the quality are analysed. The application of quality management for products and processes in the urban transport system is drafted. Therefore, a modular approach is developed. It covers the planning, implementation, and operation of the transport infrastructure. Several development needs are identified, which addresses procedures and tools of quality management for different systems, criteria to describe the quality, demanded levels of quality, procedures to measure and monitor quality, a quality management handbook, a formal certification, and of course appropriate resources. The contribution aims to draw a comprehensive picture on how such quality management system for urban traffic should look like, and which problems must be expected on the way towards its implementation.

*Keywords: urban transport, quality management, performance measurement, urban transport policy*

## 1. MOTIVATION AND GOALS

Our transport infrastructure is an important locational factor which contributes significantly to the attractiveness of our cities and regions. Because of that, it is a priority task for our societies to ensure the functionality of the transport network and its high quality.

In our societies, in many areas of production and services quality management procedures are already well established. They became important elements of a successful business management. In traffic and transport, such approaches to quality management came up only quite late with increasing privatization and market-orientation. But even in road traffic, which is not shaped by market-oriented supplier-customer-relationships, we already have quite many approaches to ensure the quality. In the case of Germany, comprehensive guidelines and normative regulations exist for many matters of road design and traffic control, especially with regard to traffic safety in the design stage and also during operation. Also in other countries, such as Japan or USA, several instruments of quality management have been established, although they are partly named differently (e.g. performance measurement). All of this contributes to a common understanding of quality and to a high quality.

But the efforts to reach a high quality generally are still marked too much by isolated approaches and reaction on pressing deficiencies, intuition and individual knowledge, limitation of available resources, and limitation by available methods and procedures. Instead, by reasons of efficiency, the existing efforts to ensure quality must be brought together to a comprehensive systematic approach of quality management.

Such an integrated approach, which had been drafted by Boltze (2005), was elaborated at the Institute of Transport Planning and Traffic Engineering, Technische Universitaet Darmstadt (Boltze and Jentsch, 2009; Jentsch, 2009). This project was funded by the German Research Foundation (DFG).

In this context, the term “integration” includes different dimensions:

- quality management steps: the approach includes all steps of quality management, not only the standardization of processes or measurements.
- means of transport: the approach considers all means of urban transport.
- stakeholders: the approach does not only focus on the operators interests, but on those of all stakeholders who have requirements to the transport system.
- life cycle: the approach refers to planning, realization, and operation of the transport system.
- fields of impact: the approach considers all fields of impact, e. g., traffic flow, safety, environment.
- processes: the quality management integrates the existing processes, completes them, and links them.

With this integrated approach, firstly the efficiency of the processes will increase and the results will improve. This enhanced quality of the transport system will increase the customers’ satisfaction and therefore the attractiveness of the city for citizens and business.
The systematic, continuous documentation of quality and quality management itself will also assist a fact-based discussion about the transport system, necessary actions, and priorities. It can also prove the sustainability of the city’s administration and help to control public-private partnership results.

# 2. INTRODUCTION TO QUALITY MANAGEMENT

During the last decades, many concepts and models of quality management have been established, e. g. ISO 9000-9004, Six Sigma, European Foundation for Quality Management (EFQM), Balanced Scorecard, Performance Measurement. All of them have been enhanced based on the experiences in application. Mostly, there is no clear definition of the concepts, the focus is different in each application. The concepts have many similarities and links.

The ISO 9000-9004 standard can be regarded as the most established standard and the only one which is clearly defined. The current version of this standard contains three parts: ISO 9000 explains the fundamentals and defines the specific terms, ISO 9001 sets requirements and is the base for certification, ISO 9004 are guidelines for performance improvements and is directly linked to ISO 9001.

The current version of this standard is the result of several revisions. On the one hand, compared with earlier versions, it is much more limited to the requirements which are really necessary, which decreased the related efforts in paper work a lot. On the other hand, it is open for any kind of organization aiming for quality, independent of the kind of products.

ISO 9000 defines quality as the “degree to which a set of inherent characteristics fulfils requirements”. Therefore, quality is always connected to requirements and not only a loose description of performance. And, as a degree, it is itself uncommitted and measurable. Based on that, quality management is defined as “coordinated activities to direct and control […] with regard to quality.”

According to ISO 9000, the steps to develop and implement a quality management can be listed as:

1. determining the interested parties and their needs and expectations,
2. establishing a quality policy and quality objectives,
3. specifying and applying processes necessary to attain the quality objectives,
4. specifying and applying methods and processes to measure, document and monitor the quality of the processes and products,
5. specifying and applying processes to prevent nonconformities and to eliminate their causes,
6. establishing a process for continual improvement of the quality management system,
7. determining responsibilities and providing the resources necessary to attain the quality objectives.

# 3. STATE-OF-THE-ART OF QUALITY MANAGEMENT IN TRAFFIC AND TRANSPORT

With the comprehensive set of standards and guidelines which is available at least in the developed countries, there is already a good base for a quality management. It includes the functional description of the design and the construction of traffic facilities, such as streets, traffic signals, signs etc. The Highway Capacity Manual (TRB, 2000) or the German

Guidelines for Traffic Signals (FGSV, 1992) can be mentioned as examples. The standards and guidelines already include processes to check quality, but this focuses on road construction and on the quality objective safety in terms of safety audits or safety management. Furthermore, a comprehensive set of standards for the maintenance of electronic equipment is available. For the field of traffic management, there are barely obligatory standards.

Regarding single traffic modes as a whole, most activities can be found in public transport, fostered by the separation of the contracting entity and the service provider as determined in the European regulation (EC) No 1370/2007.

Legal standards do only exist in a few areas. In the case of environment, thresholds and general ways of reaction are regulated in the European Directive 2008/50/EC for air quality and Directive 2002/49/EC for environmental noise, and in their national compilations. Concerning traffic safety, usually the general responsibilities are determined by law.

An approach which is applied in many countries and includes many aspects of a quality management is the “performance measurement”. Unlike quality management, performance measurement is not described in international standards. Therefore, the observed approaches are very different in objectives, content, comprehensiveness, and formal determination. The existing applications are “grown systems” which have been adapted to changing requirements. The terms are also not unique. Performance measurement, performance-based planning, and performance-based management are often used with more or less the same meaning.

Comprehensive approaches of performance management are common e. g. in the USA, in Canada, Japan, or New Zealand (FHWA, 2004). In the USA, performance measurement is implemented in the states all over the country, whereas different developments occurred as a reaction to changing political pressures (Bremmer et al., 2005).

As an example, the US State of Washington can be mentioned, which can be regarded as a leader in this field. Every quarter of the year, the DOT publishes a performance report, called “Grey Notebook”, based on the so called “performance journalism” (Bremmer and Bryan, 2008).

In Japan, performance measurement is nationally coordinated and more closely linked to the basic concepts of quality management.

In summary it can be stated, that performance measurement includes many aspects of quality management, but it is mostly focused on results and not closely linked to the processes behind them. And it misses the orientation on clearly defined requirements. Performance measurement is commonly implemented on state level or national level, but seldom for urban transport.

In the Germany, the Hessian Road Authority (Hessische Strassen- und Verkehrsverwaltung) implemented a statewide quality management including all subordinated agencies. On urban level, the City of Zurich (Switzerland) implemented a quality management system for their traffic control which is ISO 9001 certified.

The state-of-the-art analysis proves an effect which occurs often with the implementation of quality management systems: well-known approaches which are not yet applied for different reasons (budget, resources, conviction) can be established with the quality management system. Examples are “before-after studies”, project management, and safety audits.

The existing applications of quality management and related approaches reveal that these systems normally focus on the design of processes or on parts of the system as a result, but they do not combine both perspectives. They also show the importance to consider the customers view. In the USA, the ISO 9000 oriented quality management applications were abolished because of the lack of that view. With the performance management the converse occurred.

A concept for an integrated quality management for urban transport does not yet exist.

# 4. URBAN TRANSPORT AS AN ITEM OF QUALITY MANAGEMENT

The general applicability of quality management on traffic and transport is already proven by the various number of standards, guidelines, research projects, and field applications. But urban transport as a whole is a notably complex item of quality management. Important characteristics of urban transport are

- the quantity and interactions of the traffic modes,
- the quantity of interested parties and their opinions and interactions,
- the quantity of normative regulations (national laws and state laws, local constitutions, standards and guidelines ...),
- the resulting quantity of requirements, which are often incompatible,
- the quantity of processes and the complexity of their interrelations,
- the quantity of restrictions for the realization of measures (spatial, financial, ecological...),
- the uniqueness of the transport systems and therefore the individuality of the measures, and
- the major influence of the users on fundamental characteristics of the transport system.

We must also consider that – in contrary to commercial goods – the demand for urban transport systems allows conclusions on the quality of the system only to some extent.

Figure 1 faces the “interested parties“ of a quality management as listed in ISO 9004 with the stakeholders in urban transport. Each party is represented, but the allocation is ambiguous. This becomes apparent in the example of the general public, which is not only the “effected society” as mentioned in ISO 9004, but a main customer for the municipality and − as taxpayers − also the owner of the system.

The ISO 9000 standard distinguishes between the product categories “hardware”, “software” and “services”. These terms have to be understood as an abstract item. All these categories are represented in urban transport. The physical transport system as the streets, the traffic signals, the signs, and the parking facilities are the “hardware”. This infrastructure is "organized“ by the “software”, which can be a traffic signal’s software in the closer meaning, but e.g. also the static traffic regulations or the public transport schedule. Examples for services are traffic information or schedule information and ticketing.

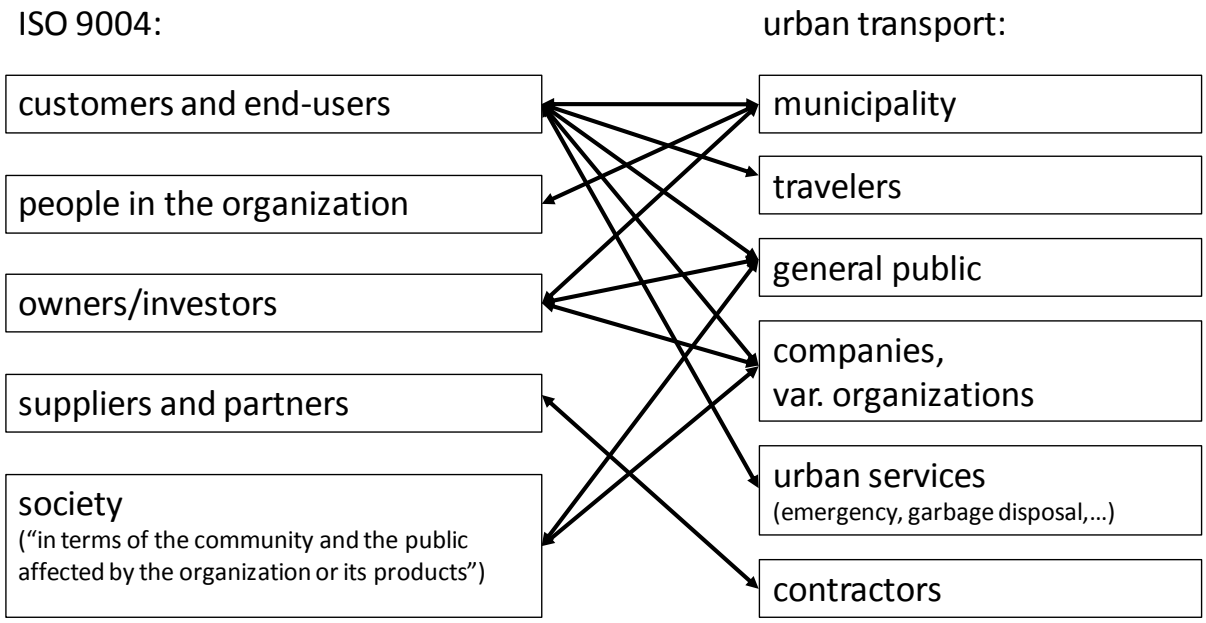


Figure 1 – Stakeholder analysis

The core of quality management is the analysis of the processes and their interdependencies. In urban transport, this system of processes is very complex. The municipality is in charge of planning, realizing, and operating the transport system as the basic process categories (see Figure 2). The operation is a fundamental difference to industrial production in which quality management is already established, because the product is not sold to the customer, but it is permanently operated while it is used by the customer. This situation is a challenge, because the use by customers can be influenced only in a limited way. On the other hand, it is an opportunity, because it allows an ongoing adaption and optimization of the system.

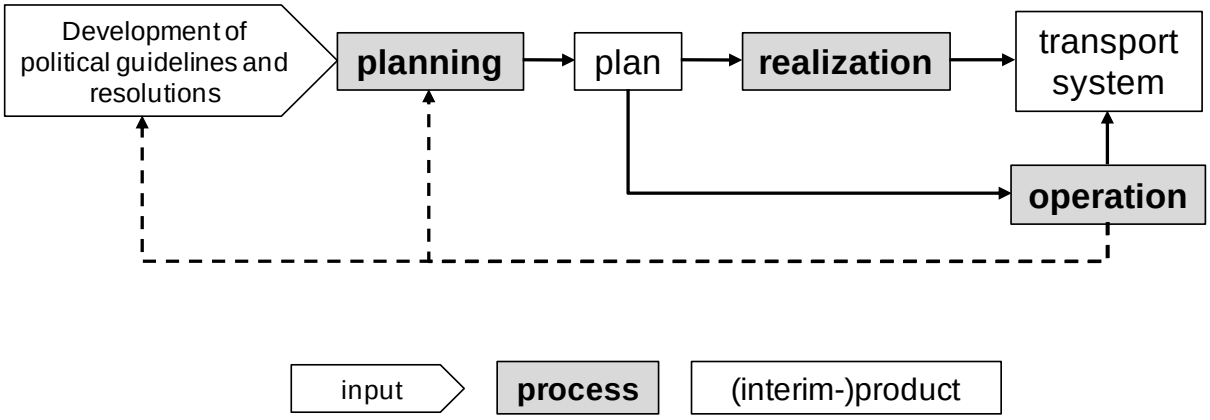


Figure 2 – Life cycle phases as base for the quality-related processes in urban transport

These process categories have to be detailed in the analysis. Planning can be separated in the different planning levels, beginning with the master planning, development planning and detailed planning and design of the system elements of the transport system. For realization, there are different ways such as construction, buying, or implementation. Operation can be

distinguished into basic operation, maintenance, traffic management, and observation. Finally, every single process such as urban transport master planning, street design, road construction, or traffic signal operation has to be identified.

In this analysis, the different roles of the municipality have to be considered. The tasks can be an in-house effort or awarded to private companies. These roles have to be differentiated in the quality management.

We must also consider that the products and processes in the overall concept cannot be regarded as isolated, but as closely interconnected elements. Forms of interconnection are:

- intermodality,
- overlapping of spatial requirements, and
- overlapping of the impacts.

# 5. OVERALL STRUCTURE OF A QUALITY MANAGEMENT FOR URBAN TRANSPORT SYSTEMS

The overall approach for quality management requires a modular structure. Modules are basically independent quality management elements which could be applied self-contained. This offers the following advantages:

- step-by-step implementation of the quality management system,
- better handling,
- separated responsibilities and decision-making authority on all levels,
- integration into existing administrational structure,
- easy adaption to changing requirements.

To fulfill the requirement of a comprehensive, integrated approach, the sum of all modules must include all dimensions of integration (quality management steps, means of transport, stakeholder, life cycle, fields of impact, processes).

Following the process-oriented approach of a modern, ISO 9000-oriented quality management, the processes provide the basic elements of the modular structure. Consequently, these process-oriented modules are called “basic modules”. To deduce the basic elements, the process categories are opposed to the system elements considered as the products. This matrix (see Figure 3) leads to nearly 90 basic elements which represent the core processes in urban transport.

With this separation into independent elements based on processes, an overview on an higher level is not possible. Nevertheless, this is necessary for the quality assessment of system-wide interactions in the transport system and the resulting decisions. For reporting quality to third parties, a pure collection of basic modules is also not optimal. For these purposes, superordinate modules have to be added to the modular structure. Especially the traffic-related characteristics of the transport system are influenced by several processes.

| | | | processes | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | planning | | | realization | operation | | | |
| | | | master planning | development planning | detailed planning | | basic operation | maintenance | traffic manamagement | observation |
| products (transporation system) | „hardware" | streets | | | | | | | | |
| | | traffic signals | | | | | | | | |
| | | pt vehicles | | | | | | | | |
| | | … | | | | | | | | |
| | „software" | traffic control | | | | | | | | |
| | | guidance | | | | | | | | |
| | | schedule | | | | | | | | |
| | | … | | | | | | | | |
| | services | traffic info | | | | | | | | |
| | | schedule info | | | | | | | | |
| | | ticket distribution | | | | | | | | |
| | | … | | | | | | | | |

Figure 3 – Matrix structure to deduce the basic modules

Accordingly, the perception of the transport system by the customers is not related to one process only. Hence, in addition, superordinate modules have to be defined with the following objectives:

- to gain additional perspectives and dimensions,
- to identify interactions on higher levels,
- to coordinate and to prioritize actions,
- to inform political bodies,
- to inform the general public.

The superordinate modules deal with the results of multiple processes and not with single processes or products themselves. But the deduced actions have an impact on the processes. The modules are based on the basic modules, e. g. for the acquisition of requirements and parameters. Superordinate modules are derived by the criteria shown in Figure 4.

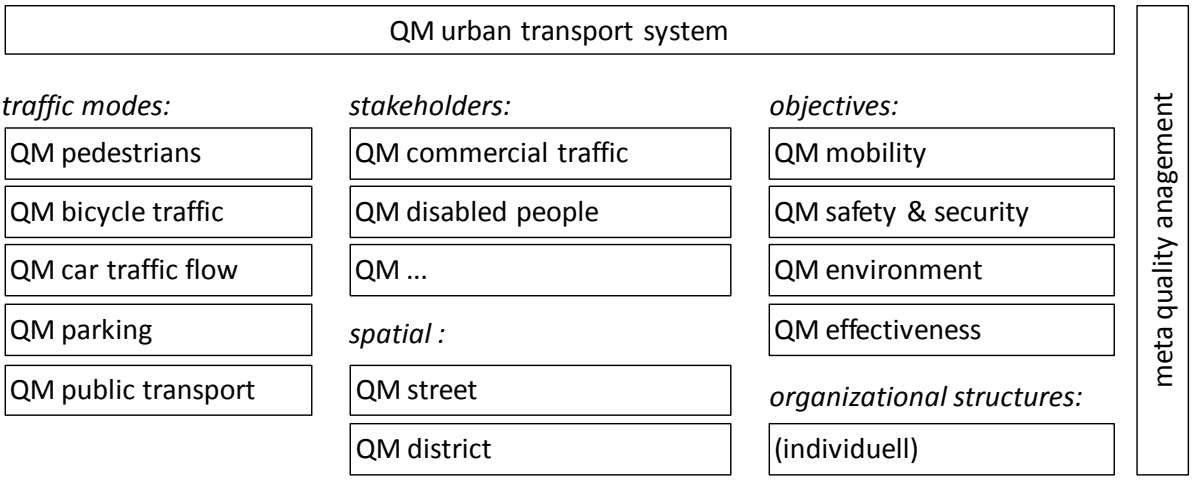


Figure 4 – Superordinate modules

# 6. SPECIFICATION OF BASIC MODULES

For each basic module, all steps for a quality management have to be elaborated in a way that the quality management can be completely and continuously conducted based on theses specifications. The factual base for the specifications are:

- legal requirements,
- standards,
- research results, and
- experience-based knowledge.

The documentation can be elaborated as a quality manual with the corresponding documents, e. g. process descriptions.

In the following, the main content which has to be elaborated for each step of each module is described.

## 6.1 Determining the interested parties and their needs and expectations

The involved parties have already been described generally. For each basic module it has to be identified, which parties have to be considered and what their roles are. In some cases, the determination of the considered parties leads to a focus for the process. As an example: in dynamic traffic management it has to be decided if it should focus on individual motorized traffic only, on all motorized traffic including public transport, or on all modes of traffic including non-motorized.

Concerning the requirements, the legal requirements have to be collected first. Also the standards have to be considered, which are not as binding as a law, but which represent the state-of-the-art.

The identification of customer requirements is more difficult, but they should be considered necessarily. To identify the customers' requirements, basically surveys are the appropriate method. Customer surveys are currently established in public transport (e.g. Sträubli et al.,

2006; Krietemeyer and Wergles, 2006; Theissen, 2005; Suckrow et al., 2008), where the idea and term of a customer is much more established than in individual transport.

In customer surveys, synergies have to be used. Combined surveys for several modules are not only a matter of economy, but also a factual need. Normally, the customers don't realize the processes themselves, but the characteristics of the transport system, which are mostly influenced by several processes. Due to this product-oriented perception, the inquiries should not be related to processes, but to the results. From the results of the inquiries, the requirements can be derived for the basic modules as well as for the superordinate modules. Further synergetic effects appear, if the customer satisfaction is also included in the survey.

## 6.2 Establishing a quality policy and quality objectives

According ISO 9000, the establishment of a quality policy and quality objectives aim at determining the desired results and the focus for directing the organization. In this process, the quality policy offers the framework for the determination and the assessment of the quality objectives. The term of a "vision" or "mission", which is common in transport planning, can be compared with the quality policy. The statements of the quality policy should base on the quality management principles and could include statements about the following items:

- traffic-related objectives (e.g. punctuality of public transport services, minimization of congestion),
- consideration of specific parties (e.g. accessibility for disabled),
- process characteristic (e.g. meeting deadlines), or
- further focused items of quality (e.g. environment-friendliness).

Based on the quality policy, the quality objectives have to be defined. They have to be based on existing goal concepts, if available. Quality objectives should be measurable to allow to check to which extent they are fulfilled. Deriving the measures for the objectives is part of the specification of the quality management processes.

## 6.3 Specifying and applying processes necessary to attain the quality objectives

The base for this step is a in-depth process analysis. The process which is item of the respective basic module has to be divided into sub-processes. The aim is the elaboration and application of process descriptions (procedures for the productions processes) which document how a process has to be conducted. The objective of a process description is that a qualified employee can conduct a conforming process independently in a way that quality objectives are attained. The process descriptions include

- the objective of the process,
- the scope of the project description,
- the roles and responsibilities,
- the input,
- the work steps,

- the results, and
- the customers and suppliers.

The description of the work steps, which is the core of the specification, includes mainly the factual guidance for the conduction and

- the resources to be used (e.g. standards, software, data sources),
- required internal coordination,
- required external coordination,
- tests and checking procedures, and
- requirements and standards for the documentation.

The process description should be easy understandable by using a compact, clear presentation (tables, lists, diagrams).

In the case of urban transport, the potential of detailed process descriptions varies highly due to the different character of the processes. This leads to different requirements for the qualification of the person in charge. While the acceptance of an implemented traffic signal can be described quite precisely, the process of a transport master plan cannot be specified to that level of detail. Nevertheless, it is the objective of the process description to specify the procedure as precisely as possible. When appropriate, alternative actions have to be depicted.

## 6.4 Specifying and applying methods and process to measure, document, and monitor the quality of the processes and products

The objective of this step is the elaboration and application of processes for checking production processes and products. Checking is defined as the evaluation if the requirements are fulfilled. The outline of these descriptions correlates basically to those of the production processes. In addition, the trigger has to be defined, which determines when the process has to be conducted. The checking can also be integrated in the production process descriptions. The specification of checking procedures has to consider the following steps:

- selection of a checking method,
- selection of criteria and measures which are available and appropriate to measure of the objectives are attained,
- setting up rules for data capture and calculation,
- determination of requirement levels,
- definition of triggers, and
- setting requirements for the documentation of the results.

Measures are necessary to evaluate the quality of products (e. g. waiting time at traffic signals) as well as processes (e. g. duration for the planning of a traffic signal).

## 6.5 Specifying and applying processes to prevent nonconformities and to eliminate their causes

If the monitoring of the quality of processes and products shows that requirements are not fulfilled, processes to eliminate these deficiencies have to be initiated. Following the process-oriented approach, not only the deficient product has to be regarded, but also the process behind the product has to be adapted to avoid further nonconformities.

This requirement is in conflict with the following problem in urban transport:

- The limited financial and personal resources constrain the scope of action to change processes.
- Due to the complex interactions of processes in urban transport, the quality-related characteristics can only partly be changed by adapting only one process.
- Due to the interactions in the transport system, actions which improve the quality in one area may decrease the quality in another area.

Of course, these problems must not lead to ignoring the deficiencies. Instead, they force to use a systematical analysis of possible actions and a transparent decision on how to deal with the deficiency.

Basically, process descriptions have to be elaborated and applied also for the processes to eliminate nonconformities. The descriptions include objectives, scopes, responsibilities, inputs, work steps and results including resources, internal and external coordination, tests and checking procedures, and standards for documentation.

Depending on the processes and characteristics with their different complexity, the level of detail for the description of processes to eliminate nonconformities varies significantly. The spectrum reaches from clearly defined procedures with indication of necessary resources (e.g. in the case of a traffic light breakdown) to lists of actions and recommendations for their selection and application in complex problems (e.g. frequent congestion on a arterial road).

Particularly in the case of complex problems, single actions are often not sufficient. Here, a coordinated bundle of actions is necessary. A simple process description as a reaction is barely possible because of the high level of complexity of the depiction of actions. Therefore, a “knowledge database” might be set up, according to Reusswig (2005). In such database, the actions are allocated to the problems. By a permanent updating, the state-of-the-art is always documented.

## 6.6 Establishing a process for continual improvement of the quality management system

Continual improvement can be ensured by two approaches:

- The establishment and evaluation of an user feedback system, and
- a periodical management review for the quality management system of each basic module.

The user feedback system includes two elements (Reusswig and Jentsch, 2009): With the continuous feedback, the staff can suggest improvement opportunities induced by any current reason. In the periodical feedback, the staff assesses the quality management system.

A periodical management review of the quality management system is required in ISO 9001 to “ensure its continuing suitability, adequacy and effectiveness”. In this procedure

- the existing requirements,
- the quality policy and quality objectives,
- the process descriptions of the production processes and the quality management processes, and
- the content of the documentations

have to be scrutinized in cooperation with the persons in charge for the process. This includes the general proceedings as well as details such as the selection of measures or the requirement levels.

The results of the review are adaptations for the quality management system including the resource planning.

### 6.7 Determining responsibilities and providing the resources necessary to attain the quality objectives

Responsibilities have to be defined for production processes and quality management processes, and for the whole module, as well. For some processes, institutional responsibilities are determined by law.

The provision of resources also includes both kinds of processes. During the implementation of the quality management, the resources for the quality management processes are perceived as additional effort, while the resources for the production processes appear obligatory. But considering the limited resources, this is a critical process which is an important contribution to transparency concerning desired and achievable quality.

Resources does not only address the number of staff, but also their individual competences, awareness and training, the budget, technical infrastructure and the working environment.

## 7. SPECIFICATION OF SUPERORDINATE MODULES

The emphasis of the superordinate modules differs according to the different criteria they are derived from. Unlike the basic modules, the processes are not in the focus. The modules for the organizational structures are directly based on the basic modules. The superordinate modules developed for different traffic modes, stakeholders, objectives, and spatial aggregations represent different views on the transport system, and consequently, they are product-focused. But by the deduction of actions to improve, the modules are linked to the processes. These links can be very complex, because the problems have to be solved by improvements in several processes in different responsibilities.

In the following, the basic differences and amendments for the specification of superordinate modules compared to the basic modules are described.

The survey on **customer requirements** will especially include items of superordinate modules, because these modules are related to this perspective. A comparative survey of different system elements which includes the assessment of importance and satisfaction can help in setting priorities (Blees et al., 2003).

The **quality policy and quality objectives** will be more product-oriented. A critical point is the overlapping character of these modules, which involve several organizational units and areas of responsibility. This makes it more difficult to reach consensus.

The **specification of production processes** is not a topic for the superordinate modules. But it is an essential task to analyze which processes are influencing the particular item. The process descriptions of the relevant basic modules have to be checked if they are appropriate to attain the quality goals of the superordinate modules.

For the **specification of checking procedures**, the aim should be to utilize the results of the basic modules as far as possible. This increases the efficiency. If necessary, the procedures of the basic modules should be extended. The criteria and measures of the basic modules have to be filtered to select representative and meaningful “lead measures” or “lead criteria”.

Objectives and procedures in the development of **processes to eliminate nonconformities** vary depending on the kind of module. For the organizational modules, the results of the basic modules are aggregated on the different hierarchical levels. In this process, also the recommendations for actions are forwarded if they cannot be implemented on the lower level. On the appropriate level, the actions have to be initiated.

By allocating the responsibility for the modules for the traffic modes and stakeholders to the unit with the core competence, actions can be launched in the module. For the further planning, assessment, and implementation of the actions, it has to be checked if the full strategy can be allocated to one unit in charge. Three cases have to be distinguished:

- The strategy can be allocated completely to the unit in charge of the module: Further planning, assessment, and implementation of the actions and documentation can be done in this unit.
- The strategy can completely be allocated to another unit: further planning, assessment and implementation of the actions and documentation can be assigned to that unit. Status and results have to be communicated to the unit in charge.
- The strategy has to be implemented by different units: the responsibility is transferred to the module “urban transport system”.

For the modules regarding specific objectives, the procedure is the same, but the deduction of action is more complex.

The module „urban transport system“ has a coordinating role. “Overlapping strategies” initiated by other modules have to be ordered, activities have to be coordinated, priorities have to be set. The actions have to be documented and communicated.

It is important to make sure that no parallel structures and redundant responsibilities occur in the development, assessment, and implementation of actions.

The **determination of responsibilities** can be more complicated than in the basic modules, because they are linked to several areas of responsibility. For highest efficiency and acceptance, the unit with the most influence on the item of the module should be responsible.

The **provision of resources** firstly has to be done for the quality monitoring in the area of the module and coordinative tasks. The development and implementation of actions is a task of the basic modules, where the resources have to be allocated. But these allocations of resources should be checked by the superordinate modules.

# 8. RECOMMENDATIONS FOR IMPEMENTING THE QUALITY MANAGEMENT SYSTEM

The basic task for the implementation of a comprehensive, integrated quality management for urban transport is the specification and application of all quality management modules in the way described above.

If possible, the introduction of a quality management should be supported by the political bodies of the city and the high level representatives of the administration. This ensures the necessary resources during the introduction. This commitment would be a foundation for a systematic introduction of the overall approach.

In reality, this requirement may limit the implementation, because such commitment cannot always be expected for various reasons (e.g. budget restraints, lacking belief). In these cases, a successful pro-active start of a single unit may help to convince and force others to react.

Main aspects for the implementation are:

- individual adaption of the concept,
- step-by-step implementation,
- integration of processes (quality management process should integrate existing procedures and complement them),
- involving the staff,
- coordination by a quality representative,
- installation of a complaint management,
- software assistance.

# 9. FURTHER DEVELOPMENT

The concept introduced in this paper was validated and evaluated in two case studies and an expert workshop. The structure proved to be complete and applicable. The various interfaces are manageable. The evaluation of the approach was positive, so it should be strived for the application.

But the effort for the implementation will be considerable because the status of application in practice is low, so far. Main obstructions will be the lack of human resources and the lack of political awareness. Thus, the implementation process will last several years. To further

develop and establish the concept of quality management for urban transport systems, the following actions are necessary:

- consolidation of existing process-oriented and product-oriented quality management approaches,
- elaboration of a “practical guideline“ for application,
- enhancement and completion of the general module specifications which were elaborated in this study and compilation of „sample quality manuals“,
- conduction of pilot projects,
- certification of implemented quality management systems,
- integration of the political bodies,
- development of a benchmarking system for urban transport,
- establishment of a forum for quality management for urban transport.

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