ROAD ASSET MANAGEMENT (RAM) IN SWEDEN

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ABSTRACT

Road administrators must allocate their budgets across a number of areas including maintenance of the road network, improvements and additions and support to road users. To ensure that the best possible decisions are made, a Road Asset Management (RAM) approach is required including the provision of proper supporting tools. The RAM is defined as:

- An integrated, systematic, business improvement approach based upon the evaluation of the road network from both a technical (preservation) and functional (use) perspective.
- Management of the road network including use, operation, maintenance and development through improvements or construction of new roads.

The aim of the RAM is to maximise the long term benefits for road owners and road users through external efficiency by achieving the best balance between the different goals set and internal efficiency by achieving these goals in the most cost effective manner.

RAM requires a holistic view to be taken of the road network taking into account the following perspectives:

- Network use, operation, maintenance and new construction
- The various infrastructure elements (roads, bridges, tunnels, street furniture, verges and landscaped areas)
- Specific actions against roads, traffic and road users
- Time dimension (present state and future needs)
- The interests of the road owner, road users and wider society which includes residents and tax payers.
- The positive and negative effects of the road network, which includes for example the movement of freight and people, but also their environmental impact and impact of accidents.
- The present and future needs of the road administration.

An integrated set of tools for RAM is called a Road Management System (RMS). The examples given in the presentation are based upon the current practice of the Swedish Road Administration (SRA).

1. SWEDISH ROAD NETWORK

The introduction of a RAM approach needs to be adjusted to meet the specific pre-requisites of each country or road administration in order to avoid potential problems and will allow those available opportunities to be taken.

1.1. Sweden

Sweden covers some 450 000 km2 and has a population of 9 million people. The distance from the south to north is nearly 2 000 km. In the south, the climate is “European” and the country is quite densely populated. The industrial structure is well-developed and diversified, with well established freight and commuter movements. In the north, above the Arctic Circle, the climate is harsh with long and severe winters and the country is sparsely populated. The distances between centres of population and industry are great so reliable vehicles and roads are a necessity all year round. The timber industry is of primary importance in this area.

1.2. Swedish road network

The road network hierarchy in Sweden exists at three levels:

- State roads, of which there are 98 000 km which carry 69% of all traffic, represent the backbone of the road network. The traffic intensity varies from 100 000 vehicles/day on urban motorways to a few vehicles/day on rural gravel roads. About 80 000 km of these roads are paved.
- Municipal streets and roads make up 39 000 km of the road network, carrying 27% of all traffic, these are complimentary to the state roads and exist primarily in urban areas. They are used particularly by public transport.
- Private roads, of which there are approximately 284 000 km carry 4% of all traffic. These form a capillary type network and are located mostly in rural areas. They are owned by private companies, housing associations or individuals. About 25% of them receive state grants to permit public traffic use.

The state roads are classified according to the type of traffic use; national, regional and local. There are big differences in traffic volumes on the roads, the percentage distribution is shown in the following table:

Table 1 - Road length per traffic class

Traffic AADT	<500	500-1000	1-2000	2-4000	4-8000	8-12000	>12000
% of length	60	14	10	8	5	1,5	1,5

1.3. Swedish Road Administration (SRA)

The SRA is controlled by the parliament and the government, together with other interested parties within the transport sector and receives from them transport policy, annual directives and a budget. The overall aim of the transport policy is to ensure a socio-economically efficient transport system that is sustainable in the long term for individuals and industry throughout the country. This high level goal is supported by six complementary goals linked to accessibility of the transport system, transport quality, traffic safety, good environmental practice, regional development and sexual equality. Interim goals are established to deal with specific needs.

The SRA has four main responsibilities:

- Sector responsibilities: The SRA represents the state in the development of the road transport system. The SRA monitors this development, co-ordinates common activities to achieve the goals and stimulates other parties to contribute to the process.
- Public authority responsibilities: SRA draws up and enforces regulations for vehicles, driving licenses, road traffic environment, commercial traffic and also manages state subsidies.
- National road management: The SRA manages and develops the state road network.

- Road construction: The SRA has separate units for road maintenance and construction, road design and ferry operations. These are commissioned by SRA or other organisations and companies in competition with private companies to deliver required services.

Sweden's annual national road management budget is approximately $2 billion. It is currently divided equally between maintenance and investments (new construction and improvements). However the future trends suggest that investment will decrease, whilst the maintenance budget remains constant.

2. ROAD ASSET MANAGEMENT (RAM)

Common definitions of RAM are quite vague. For successful communication to take place throughout the organization and onward to stakeholders a clear definition is required.

2.1. Task of Road Network Management

A road network administrator is usually responsible for keeping the network available for present users, maintaining it for future users and developing it to adapt to changes in the patterns of use. Current use also requires some type of road user support.

The road owner and road users have a number of different objectives and preferences that often are contradictory and different from an individual to another one.

Resources obtained for the road network management task should be used to achieve the different goals identified in a balanced and effective way taking into account the long-term perspective.

The national road administration is sometimes obliged to support other road administrations for example those responsible for municipal or private networks. They also play a significant role in broader transportation matters such as legislation and regulation, vehicle registration and driving licenses. This wider road transport sector responsibility brings another dimension to the task of management adding to its complexity.

There is no single method to solve the complicated problem. However, a systematic approach makes it easier to find acceptable and coherent solutions and to adapt them to changing conditions and needs. The concept of Road Asset Management represents such a systematic approach.

2.2. Objectives of the Road Asset Management

The objectives of RAM is to maximise the long time benefits for road owners and/or road users through external effectiveness (best balance between different goals) and through internal effectiveness (achievement of goals to the long-term lowest costs).

2.3. Definition of the Road Asset Management

The RAM within the SRA is defined as:

- An integrated, systematic, business improvement approach based upon evaluation of a road network from technical and functional perspective (preservation and use).
- Management of roads covering use, operation, maintenance and development through improvement or construction of new roads.

The RAM is not the same as road capital value assessment, but it does include this task.

2.4. Perspectives

The RAM process requires a holistic view of the road network to be taken, covering the various different perspectives. The RAM covers (see figure 1 below):

- Use of the road network together with road user support and all types of road works enabling the use: operations, maintenance, improvements and the construction of new roads. The road works types are strictly defined by the SRA. Operations are road works with short lifetime, less than one year in length. Maintenance works are road works aimed at upkeep or restoration of the road condition with a lifetime of more than one year. Improvements are road works executed for a permanent functional enhancement of the existing road network infrastructure.
- All road network components: roads including drainage systems, bridges, tunnels, roadside furniture and verges / landscaped areas.
- All types of activities directed towards road traffic, road users, residents along the roads, concerned public and private organizations etc.
- The time dimension (present and future needs).
- The interests of different stakeholders: road owner, different types of road users and the wider society (residents, tax payers, environmental protection, etc.)
- Positive effects of the road transport (transport benefits) and negative effects (accidents, emissions, energy consumption etc.).
- Markets for road works, road and transport consulting services, road and transport research and development.
- Present road network administration and its development as an important part of society.

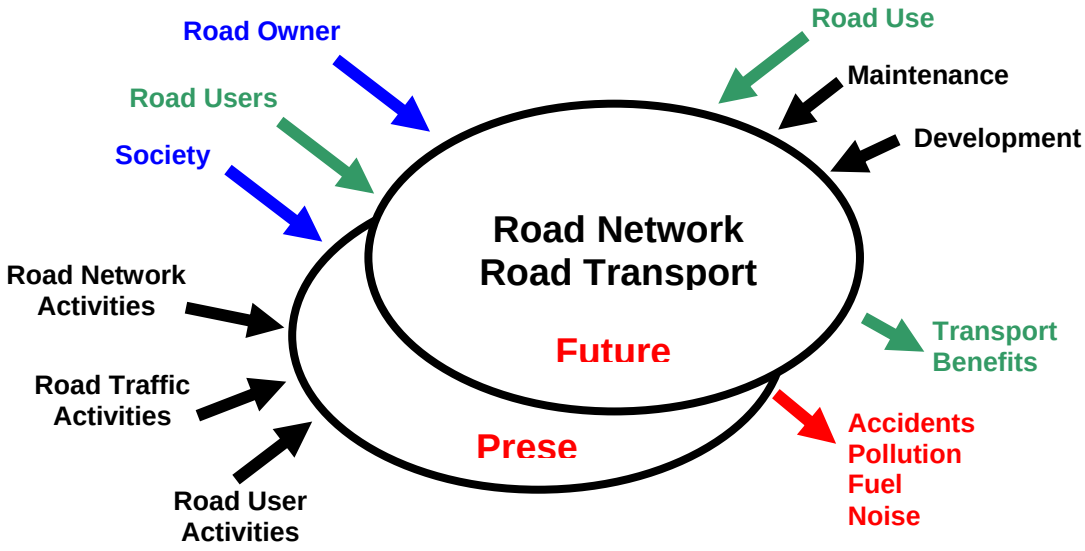

Figure 1 – Perspectives of Road Asset Management

In order to make well-informed decisions it is necessary to systematically follow-up on all of the aspects mentioned above and regularly analyze the available data. For the purposes of maintenance it is most important to monitor the road network condition and to consider this in conjunction with the cost of road works. Estimation of the impact of road traffic and comparison with road user demand is also essential. Another very important task is the monitoring and forecasting of “external” cost-influencing factors to enable adjustment of road asset management to meet changing conditions and demands.

2.5. Stage-wise implementation of the RAM

It is obvious that such a large task cannot be implemented in one single step. In the SRA, the decision was made to start with the maintenance and operation of the present road network. The primary reason for this was that all of the network would be covered (not just a selection of road projects) and that the issue of the continuity of road management will be enhanced. Road improvements, construction of new roads and the road transport sector tasks will be added later.

In the beginning, the SRA had quite a lot of components in different stages of development or decay that could be used. There were also some supporters and some opponents of this concept. The development of the RAM can be then described in following steps:

1. Approval by the top level management
2. The development of a rough Master Plan [3]
3. The integration of those existing components
4. The activation of those existing but unused components
5. Development of the most important missing components.

Today, we have advanced to steps 3 and 4 using a very limited sum of money and maintaining a low profile whilst engaging those supporters of the concept without disturbing those opponents. Integration has been achieved mostly using temporary interfaces and prototyping. Despite this we have obtained quite a lot of data that we can use at national level for the management and reporting to stakeholders and also in some business processes.

For the development of the Master Plan we have studied the earlier attempts of the SRA and made reference to a number of international reports and publications [4] – [8]. This research coupled with our own experiences including the lessons learnt has allowed the SRA to move forwards.

3. ROAD NETWORK MAINTENANCE AND OPERATIONS

A consistent model of the considered business function must be defined before the RAM can be applied.

3.1. Objectives of maintenance and operations

The objectives of maintenance and operations are to keep the road network condition at optimal level during its lifetime taking into account changing budgets and user demands. Over time the road network deteriorates while the road manager applies different types of road works to mitigate the deterioration.

3.2. Life cycles

The road network is expected to develop and be managed in life cycles. A life cycle of the road network is described as the ongoing change in condition of the various segments and components.

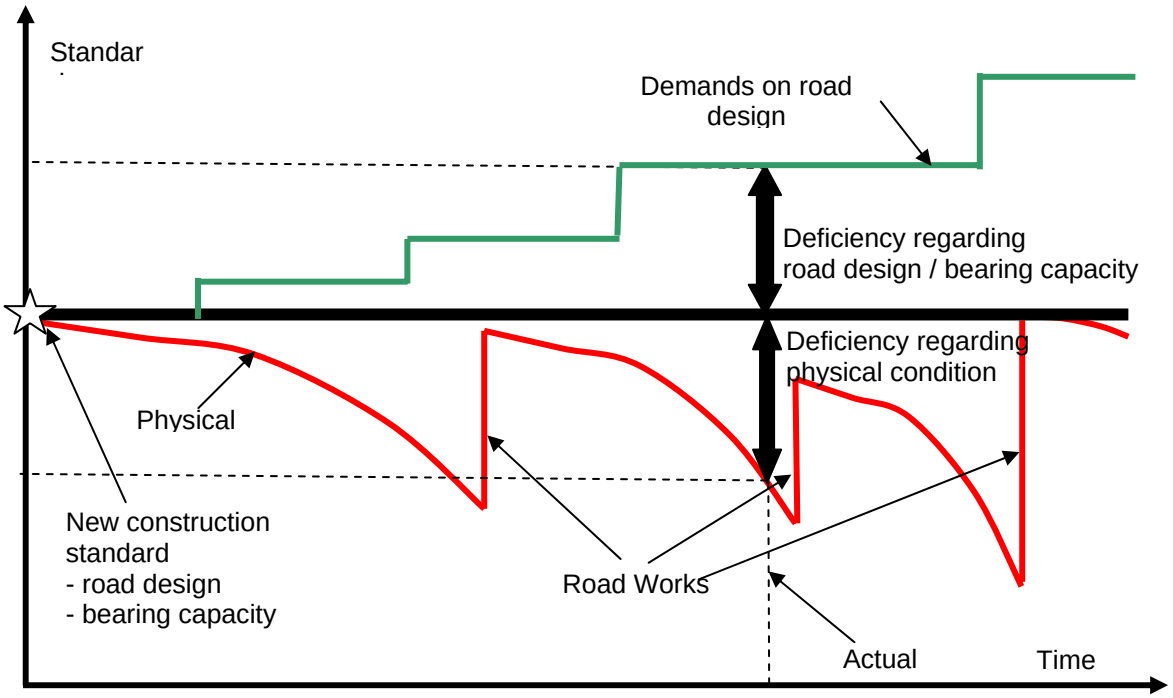

Figure 2 - Life cycle of a road segment or component

- The condition change curve (red) shows road deterioration and maintenance works.
- Demands on bearing capacity, traffic safety, environmental properties etc (green) are increasing stepwise during the life cycle.
- Improvement of a road – but not maintenance - would increase the condition over and above the original standard.

3.3. Road network components

The road network is composed of different components. They each have different properties and require different competencies. As a consequence they need to be managed in different ways.

For the task of road maintenance the Swedish state network is divided into the following components:

- Paved roads
- Gravel roads
- Bridges and tunnels
- Road furniture and verges/landscaped areas
- Road information systems.

Winter operations and Ferry operations are managed separately due to their large size and special characteristics.

Maintenance of each component is considered as a special business function with its own allocated responsibility and resources, selected representative measures and specified standards.

4. CONDITION MEASURES

Condition measures form the very basis for all aspects of management of maintenance and operations.

4.1. Objectives and methods of condition measurement

The road manager needs very good information about road network condition in order to keep it at the optimal level, despite frequent changes of available resources and road user demands. For this purpose a well-balanced set of representative condition measures is required together with robust data collection methods.

Objective measurement methods are generally preferred, but in many cases subjective condition assessment using visual observations is necessary. In this case standardised assessment methods should be applied and the observers should be frequently tested to ensure consistency. A typical example of an objective method is road surface measurement using laser equipment. Its results are used not only for monitoring of the longitudinal and transversal roughness of the road, but also for indicators of changes of structural capacity of the road and surface defects. A typical example of a subjective method is the system of visual inspections of bridge condition.

4.2. Technical and functional condition measures

The condition of each component is described using a number of representative condition measures. The starting point for successful asset management restricted to operations and maintenance is the identification of appropriate condition measures for the road network components.

In the SRA, we recognise the difference between the so-called functional and technical condition. Functional condition covers the condition variables primarily influencing the present-day road users. Technical condition covers the condition variables primarily influencing the road network preservation and in that way future road users.

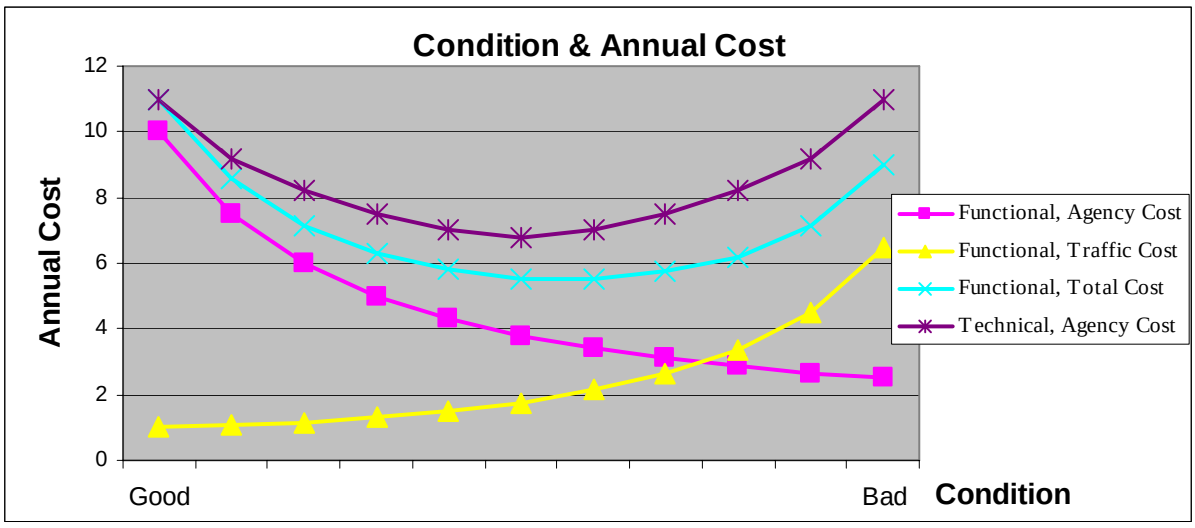

Figure 3 – Functional and technical condition

For the technical condition the following properties apply:

- Only road agency costs are applicable (traffic not directly influenced)
- There is a minimum level on the road agency cost curve (=optimum)

- To the left of the minimum costs increase due to the short lifetime of the road works
- To the right of the minimum costs increase due to rapid deterioration & expensive road works
- In the minimum state there is a balance between deterioration and road works lifetime/costs
- We cannot save money in the long term by selecting the better or worse condition
- Bad technical condition means successively bad functional condition (reason linked to result)
- For small roads an optimal technical condition results in good functional condition
- There is a minimum cost condition that should be found and sustained.

For the functional condition the following properties apply:

- Lower road condition means lower road agency costs and higher traffic costs
- Bad functional condition often indicates bad technical condition
- Total cost curve has a socio-economic minimum
- To the left of the minimum: road agency costs are higher than traffic benefits
- To the right of the minimum road agency costs are saved but road traffic loss is higher
- Budget constraints make road agency euro more valuable than road traffic euro
- Budget constraints dictate what road condition we can afford.

For example – at present the following condition measures are used for paved roads:

- Longitudinal roughness is expressed as average IRI for 20 m or 400 m and also as local deformations.
- Transverse roughness is expressed on wide roads as rut depth. On narrow roads, a combination of measures is used: rut depth, elevation between ruts, edge drop and theoretical water depth.
- Crossfall in %.
- Indicator of surface defects based on megatexture and macrotexture (transformed to Mean Profile Depth).
- Indicator of inadequate structural capacity based on increase of IRI or rut depth.
- Condition of drainage system (ditches, culverts, etc.) assessed by visual inspections.

Development is going on all the time. The goal is a good overall condition description using a limited number of variables, preferably collected using objective measurement methods.

4.3. Use of condition measures

Condition measures are used for a number of issues. The most important ones are briefly described below.

- The specification of maintenance standards using trigger values. There are several types of standard used for different purposes. Each standard has a corresponding annual cost. For the purpose of maintenance management the realistic budget-adjusted standard is normally used. It is preferable that road works are applied when the budget-adjusted standard is passed. The standards are based on SRA's experience, road user demands and to some extent socio-economic evaluations.

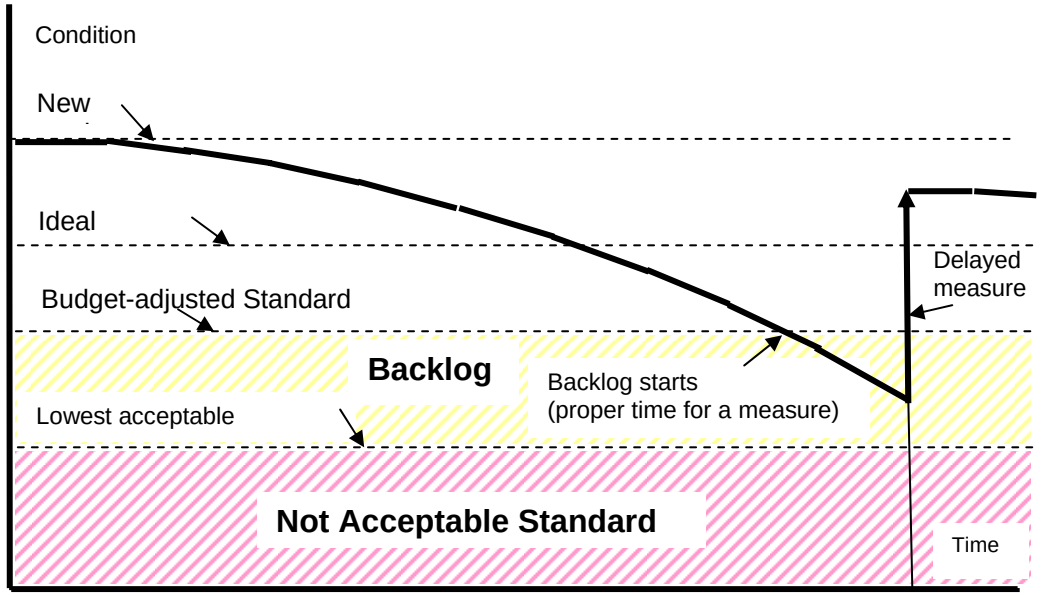

Figure 4 – Different standard levels and backlog

- Identification of road components with an insufficient condition. The components that passed the maintenance standard should be identified and considered for maintenance works. Historically, the “worst first” principle was usually adopted. Currently the “fastest deterioration first” principle is gaining popularity.

- General description of road network condition expressed as a backlog compared to the maintenance standard. The backlog is defined as the cost of optimal works that should have been done to achieve the maintenance standard.

- General description of road network condition expressed as condition-based road capital (under development). The measure is needed because the backlog regards only road components that have passed the maintenance standard while the road capital regards condition distribution of all road components.

- Specification of expected condition development for performance-based contracts. This type of contract is increasingly popular and we expect that in future a substantial number of the contracts will be of this type. The relationship between the government and the SRA can be regarded as a performance-based contract there the maintenance standard regulates the road network condition.

- Presentation of road network condition in the form of tables, graphs, maps etc. The different types of presentation are used internally to specify objectives, reporting of results, for network and project planning, for contracting, for research and development etc. They are also used externally for reporting to stakeholders including information to road users and residents. Communications with road users and residents at national, regional and local levels utilise the internet, press, radio, TV, and meetings. Both organizations and individuals are involved. Public questions are also registered and analysed.

- Analysis of road network condition and its development is a major source of information for managerial and technical development of road asset management. It helps to identify those methods, functions and organizational units that are effective in different conditions. A measure of internal effectiveness has been recently introduced. For

maintenance tasks it is based on a comparison of condition change and maintenance costs during one year. The condition change is expressed in terms of backlog change. The costs are adjusted for cost-influencing factors. For operational tasks the standards achieved during the year are assessed by sample observations instead of condition change.

Internal Effectiveness = Condition Improvement due to Maintenance / (Operations Costs – Cost-influencing factors)

Table 2 – Example of Internal effectiveness (fictive values)

Internal effectiveness of road maintenance	**2004**	**2005**	**2006**
RDC Road deterioration cost MSEK	2500	2500	2500
IB Increase of backlog MSEK	530	510	440
MC Maintenance cost MSEK	1950	2010	2000
IE Internal effectiveness = (RDC – IB) / MC %	101	99	103
Increase of Internal effectiveness		-2	4

- Estimation of traffic effects is done using traffic effect models. Road surface condition can also be translated to road traffic effects using traffic effects models. The traffic effects represent an objective description of the road condition from a road users' perspective. These are important for communication with road owner, road users and other stakeholders. Some of the traffic effects can be translated to traffic costs using unit costs. These costs can then be used in cost/benefit evaluations of different scenarios, and alternative proposals. In reality, there is a chain of models that can be used depending on available data.

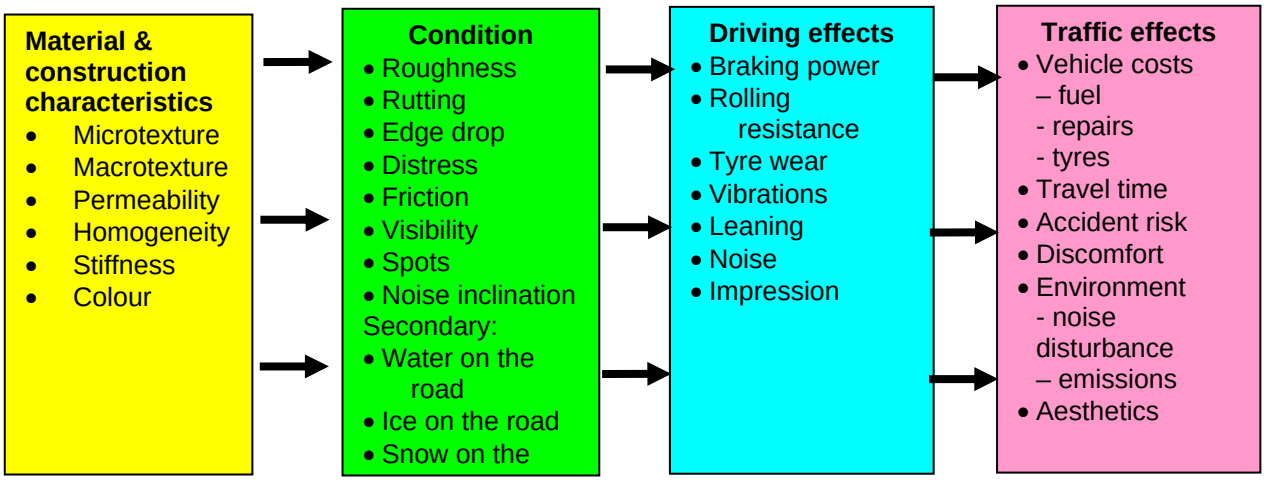

Figure 5 - Traffic Effects Models

5. EXTERNAL COST INFLUENCING FACTORS

A number of "external" factors have a significant influence on road network maintenance and its associated cost. We need to identify, follow-up and forecast these to ensure that they are taken into account when specifying objectives and allocating resource. In addition they are required when estimating effectiveness and developing road asset management.

The following cost-influencing factors are in use currently:

- New or removed road network components increase or decrease the maintained road network and also the costs for operations and maintenance. The new components are

often quite expensive and usually much more expensive than those that have been replaced. New components need no maintenance. The discussion is on going about when the maintenance needs should be taken into account at network level. Many improvements of the existing components make them more complicated, e.g. adding barriers, road informatics equipment, widening roads, construction of roundabouts etc. This results in higher operation and maintenance costs. The SRA often takes over responsibility for equipment from communities, e.g. lighting along the roads. On the other hand, some small roads are moved to private road management, usually after a substantial improvement has been made.

- Traffic growth increases the deterioration rate and also moves road segments to higher and more expensive standard classes, this is because in Sweden the operations and maintenance standard usually depends on traffic volume. The deterioration rate is especially sensitive for cars with studded tyres and for trucks during sensitive time periods like the spring thaw. The studded tyres can cause substantial damage if the road surface is bare and wet.

- Synergy effects of road improvements are of two types. The short-term effect is improvement of road condition without spending maintenance money. The long-term effect is lower deterioration rate and longer life-time. We use default values for different types of road improvements but their accuracy is poor.

- Changed maintenance standards determine the amount of road works needed. The effect is different for technical and functional condition measures. Changes of the technical standard depend on its adjustment to production methods, vehicle properties etc., sometimes saving money and sometimes leading to higher costs. The functional standard is usually increased to satisfy road users leading to higher operations and maintenance costs. Sometimes it can be decreased saving money for the road agency, but increasing road user costs.

- Weather variations have significant influence on deterioration rate and road works costs. The major influence can be attributed to regular critical seasons like winter with frost and snowfall or spring thaw with serious risks to weak roads. Also unexpected disturbances like storms or floods must be taken into account. The SRA has tried in new functional contracts for winter operations to “pay for the weather” using a winter index instead of paying for the actual road works. The idea is that the contractor should use the best available knowledge and data for removal of snow and ice to minimize the effects. A similar method could be used for managing the spring thaw.

- Changing environmental demands for road works usually results in the road works costs increasing. Examples include newly introduced demands on trucks and machines, disposal of contaminated road materials, restrictions on use of salt and natural gravel, protection of water and vegetation, noise restrictions, etc. We can expect that this trend will continue. It is evident that the restrictions must be respected, but it is our duty to recognise the costs involved.

- Changed traffic safety demands for road works usually result in increased road works costs. These demands were recently substantially increased to save road workers and road users from hazards and accidents during road works. This has resulted in a substantial increase in operations and maintenance costs. These protection measures are sometimes more expensive than the job itself. This trend will probably continue.

- Market situation (competition between contractors) has a significant influence on contract prices and work quality. There are only a few contractors competing for work, so illegal co-operation amongst them can result in high operations and maintenance costs. Thus as a big client the SRA have the possibility and responsibility to develop this market through a suitable contracting strategy. Currently we have no tools for assessment of market situation but some type of index is required.

- The increasing cost of the input products and services required for road operations and maintenance ultimately limits the level of materials and services that can be procured from the available budget. The budget of the SRA is usually adjusted using Consumer Price Index that is invariably always lower than the index for materials and services needed for road works. We have developed different index for most important types of road works. This can be used at least as an explanation why some objectives have not been met.

- Budget restrictions can result in the selection of suboptimal solutions. As a consequence there may be a shorter lifetime for road works and higher operations and maintenance costs in the future. This could be seen as the “interest on loans from road capital”. However this factor is very difficult to quantify.

- Internal effectiveness determines the final result. The SRA’s new method for estimating this gives us the opportunity to specify objectives for development of effectiveness and measure the results. One of the challenges is that for road maintenance it can take a very long time to realise the outcomes. Road pavements generally have a lifetime of between eight and twenty years. As a consequence many years have passed before new types of pavements have replaced the old ones.

As a whole, we have estimated in Sweden that the cost-influencing factors add for each year approximately 1.5 % to our operations- and maintenance costs.

6. USERS AND RESIDENTS

Road network management is carried out for the benefit of users and residents. So it is important that we continue to improve our understanding of their needs and aspirations to help us work more effectively. The SRA gets most of its user inputs by monitoring the demands that arise from its regular meetings and discussions with a range of different organizations. This input is used mainly for the development of standard specifications and road works planning. For example, when considering load restrictions and strengthening of roads there is a National Bearing Capacity Group and also a County Bearing Capacity Group in each county. Group members are representatives of different branch organizations with a particular interest in heavy traffic. They exercise significant influence when in discussion with the SRA concerning plans for strengthening of roads, application of load restrictions during spring thaw, control of load regulations and winter operations.

The SRA also tries to keep road users regularly informed about actual standards. For example, leaflets with a description of local principles for winter operations in an area are distributed to all households. They also contain emergency contact numbers and points of contact for questions. All the questions and demands raised are registered and evaluated thus providing another valuable input when reviewing operational effectiveness.

As a complement to the measured road condition and calculated traffic effects, road user opinion is monitored through regular surveys. A sample of car and truck drivers give marks on a five-grade scale on maintenance in general, roughness, rutting, road markings, snow removal and de-icing of the road surface. The trends are then analysed. Road user opinion is "subjective", but changes reflect both road network condition and the effectiveness of SRA's road user dialogue.

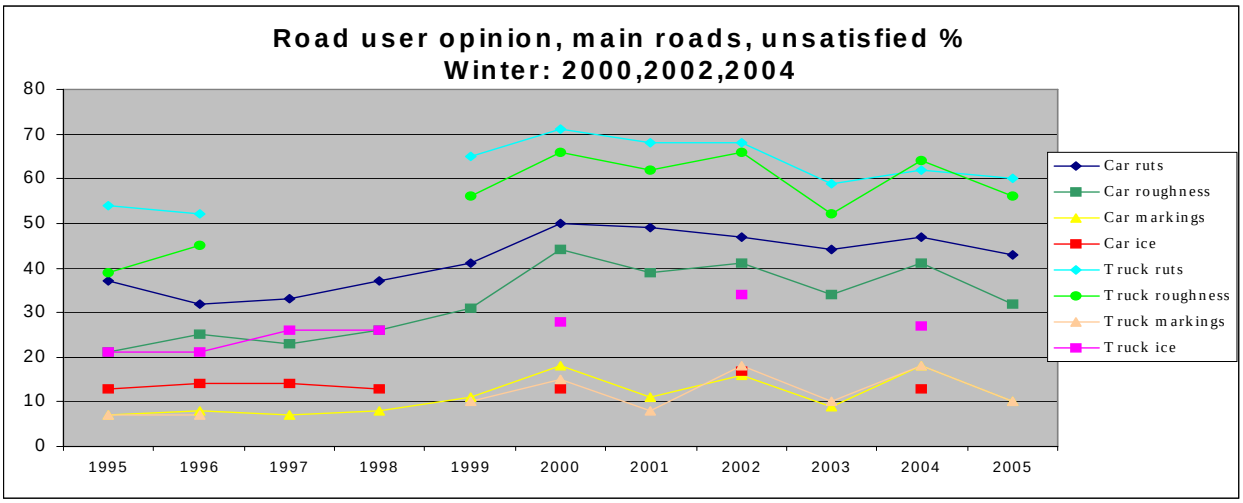

Figure 6 – Road user opinion

In addition to surveying road user opinion, the SRA utilise a "Satisfied Client Index". In this situation the clients are the public, transport enterprises and collaborating parties and they are asked on an annual basis to assess and score a number of different issues. By analysis the relative importance of each issue is then assessed. Changes between consecutive years are then recorded and investigated further when appropriate. Analysis of the data acquired so far confirms that road maintenance is the most important of the SRA's tasks and at the same time it is the area that those surveyed said they were most dissatisfied with. This is the same for both the general public and transport enterprises.

7. ROAD MANAGEMENT SYSTEM (RMS)

An integrated collection of tools is necessary for fast dissemination of good practices and fast suppression of bad practices.

7.1. Objectives of the RMS

An integrated set of tools for RAM is usually referred to as Road Management System (RMS). The tools consist of advisory and supporting documents with computer system support. The task of the RMS is to provide actual relevant knowledge and data together with tools for their use relevant to the business functions of road management. The RMS should be tailored to fit the specific needs of each business function. Involvement of system users in the development and management of the system is essential.

7.2. Business process

Each business function is conceived as a business process with a number of steps.

The input of one step provides the main input of the next step. Quite a lot of additional information is usually required for each step.

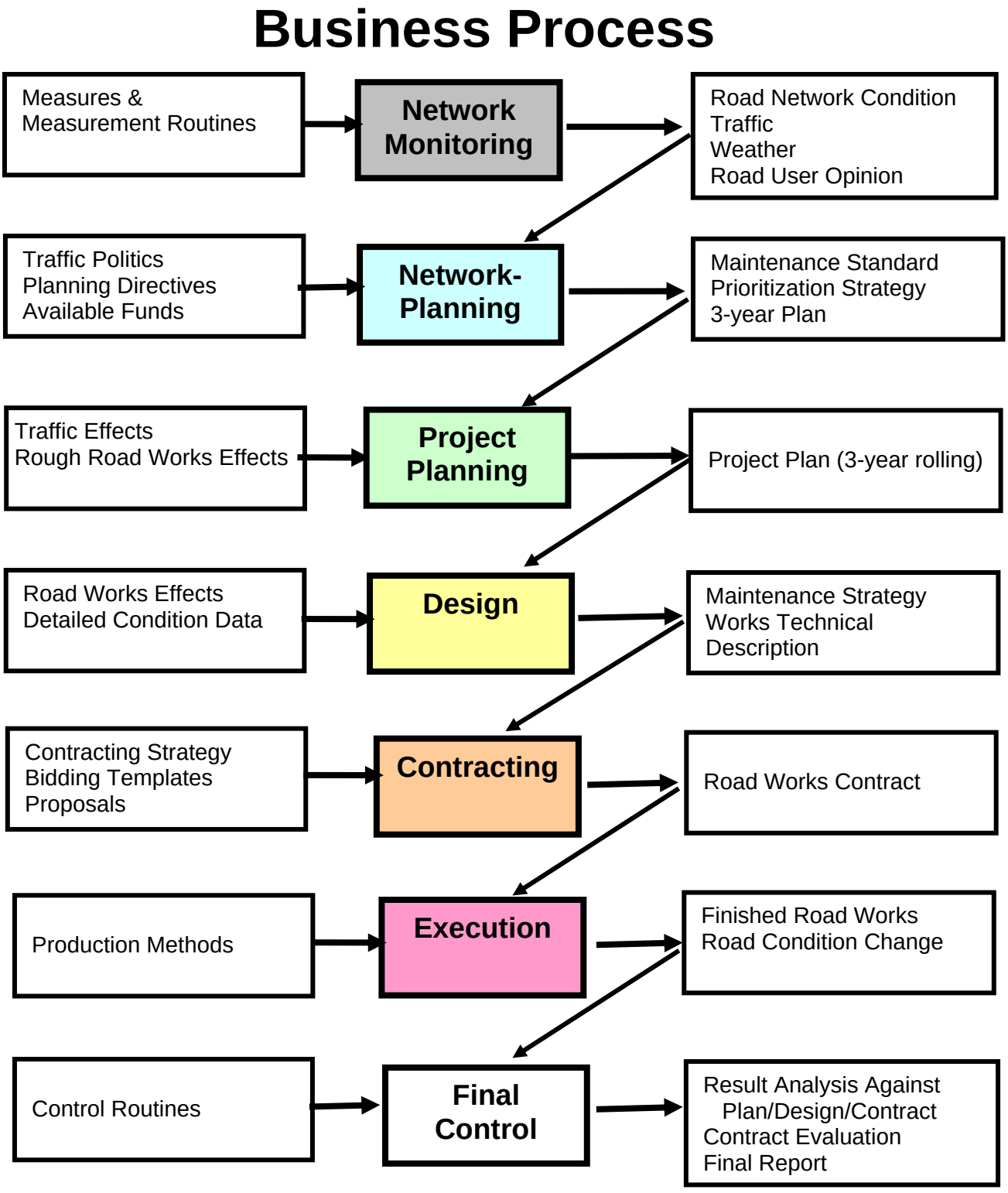

Figure 7 – Business process

7.3. Overall structure of the RMS

There is one management system for each business function. It is tailored to the business process of the function, often with subsystems supporting the steps of the process.

All management systems use data handled by general information systems.

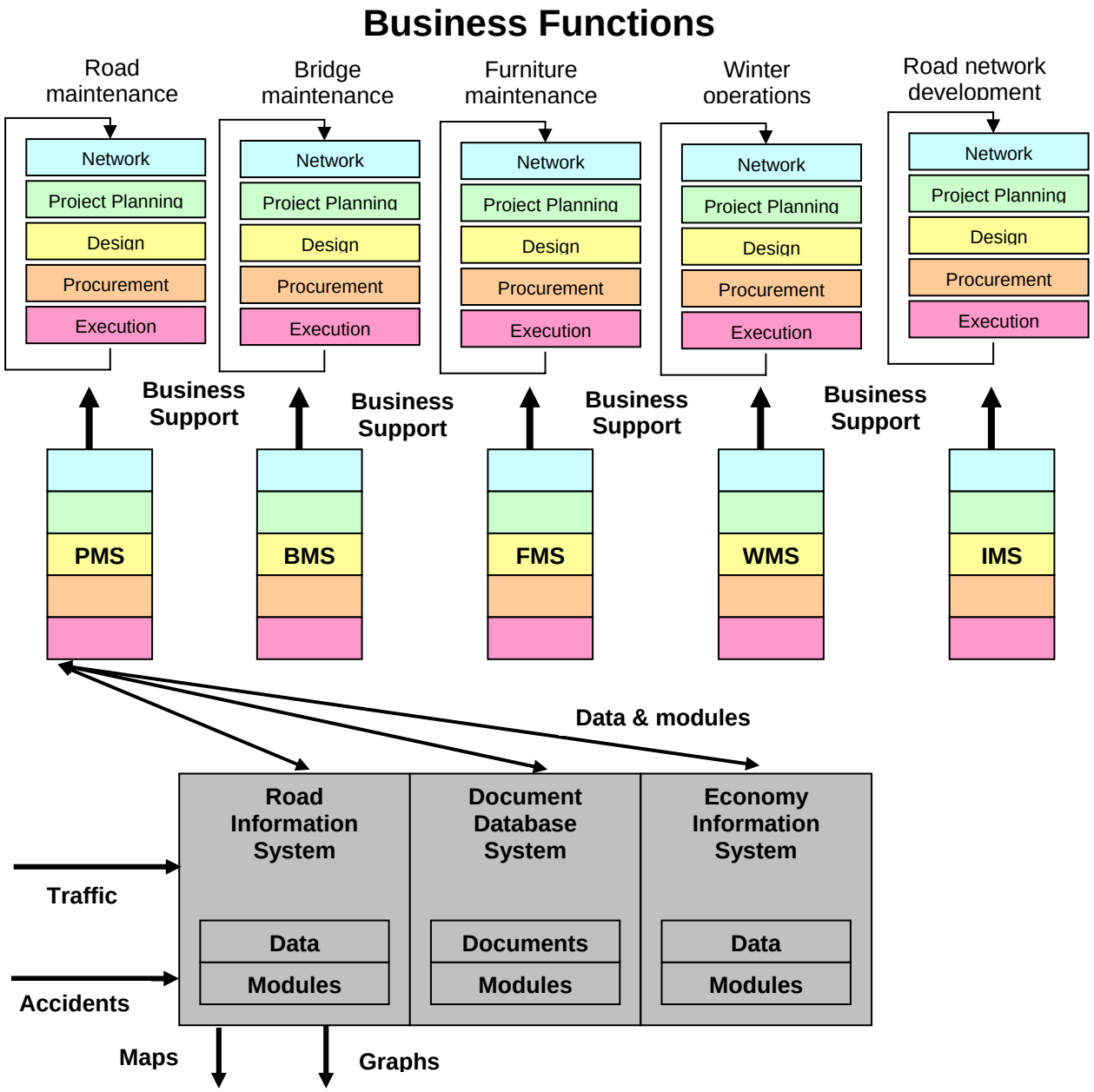

Figure 8 - Business functions, management systems and information systems

The Figure 8 shows the major management systems PMS (Pavement Management), BMS (Bridge Management), FMS (Furniture Management), WMS (Winter Management), IMS (Investments Management).

For each step of a business function there is a corresponding subsystem in the RMS. The subsystems support business activities and co-operate with the information systems mainly by the exchange of data and by common system modules.

7.4. Main steering documents

The main steering documents relate to operations and maintenance and increasingly are based on the RAM approach and use RMS data. The most important ones are as follows:

- Long-term plan approved by the government and parliament [2]. Present plan covers years 2004-2015 and is the first one to have tested some of the RAM principles. Work on the next plan to commence in 2010 has recently started. By adopting the RAM

principles this work has been simplified with much work being a simple update of the present plan.
- Standards for different types of operations and maintenance were developed within the framework of the long term plan corresponding to the specified economic level (budget-adjusted standards).
- Annual plans are based on the long-term plan, its data and strategies. Adjustments are made for actual budget restrictions and actual estimates of cost-influencing factors. Objectives for individual geographic units are specified based on allocated budgets.
- Internal annual reports on costs, road works and road network condition together with analysis of the achievement of objectives. These reports are to a great extent based upon RMS data and available at SRA's Intranet.
- SRA's annual report to the stakeholders [1]. This report is a summary of the internal reports. It is primarily addressed to the government, but widely distributed and available on the internet.

7.5. Main IT-systems

Most of the subsystems in use are part of our engineering heritage. Most of them are a result of in-house development over many years. They need to be integrated and in many cases updated. It is a very large task that is being performed in a number of small steps;

- Document Database System: Actual documents of different provenance, actuality and quality are accessible on the Intranet. An improved structure is required and these document revisions are progressing step by step.
- Economy Information System: Common economy systems require better integration with each other and with the management systems. Quite a lot of manual work is currently needed to do this.
- Road Information System: Two older systems have been recently put together and adjusted to suit modern IT hardware and software. Debugging, recovery of lost data and updating of data are still major nuisances.
- BMS (Bridge Management System) is the most complete management system, being based upon a vast amount of bridge data, reporting of maintenance works and regular visual inspections of bridge condition. A new planning subsystem is under development.
- PMS (Pavement Management System) contains time related condition data obtained since 1987 and for road works in many cases since "their very beginning". Condition data is obtained by systematic laser measurements of road surface and transformed into different condition measures. The design subsystem is well developed. There are some subsystems for planning and data collection from visual inspections that need to be upgraded.
- WMS (Winter Management): There are some subsystems that need to be integrated and some of them require upgrading.
- FMS (Furniture Management): There are some subsystems with road furniture inventory and condition that are rarely used and these also need to be upgraded.

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