Planning Perspectives
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rppe20

Modelling plans and planning models: the cybernetic vision of a Swiss Integral Concept for Transport (1972-1977)

Stefan Sandmeier [a]
[a] Historisches Seminar der Universität Basel, Hirschgässlein 21, Basel CH-4051, Switzerland
Published online: 14 Dec 2010.

Planning Perspectives
Vol. 26, No. 1, January 2011, 3–27

Routledge
Taylor & Francis Group

Modelling plans and planning models: the cybernetic vision of a Swiss Integral Concept for Transport (1972–1977)

Stefan Sandmeier*

Historisches Seminar der Universität Basel, Hirschgässlein 21, Basel CH-4051, Switzerland

In order to match the Swiss transport policies with the changing demands of modern transport, the Swiss Federal Council decided in January 1972 to implement an expert commission. The commission was to analyse the Swiss transport system and to elaborate a comprehensive Swiss Integral Concept for Transport (SICT). The SICT was to coordinate the technical, economic, financial, environmental, social and political aspects of transport, thus providing the foundations of a transport policy for the next 25 years. To achieve their goal, the experts chose the cybernetic approach of Systems Analysis. It allowed them to model transportation networks and their spatial, environmental, economical, political and social effects and constraints as interacting elements of a cybernetic system. Furthermore, it provided a conceptual and methodological framework serving also as a model of the task and of the targeted workflow. Actual transport models and plans could be integrated in this model. Although a report with 40 policy suggestions was delivered, the SICT was bound to fail: the political implications of System Analysis turned out to be incompatible with the processes of decision-making in Switzerland. The SICT's models and plans were too far from the political and societal realities. Its 'top-down' character failed in the context of Switzerland's highly federalist and consensus-oriented political system.

Keywords: Swiss Integral Concept for Transport; transport planning; spatial planning; transport policy; Cybernetics; Systems Analysis; modelling; policy advice; Switzerland

Throughout the twentieth century, infrastructures have become ever more important factors in shaping our daily lives and environments.[1] Among the most noticeable infrastructures are transport infrastructures such as railways, highways and airports. Due to their scale, their longevity, their costs and their alleged importance for economic growth and national prosperity, transport infrastructures were subject to planning, scientific modelling and technocratic decision-making processes. However, the concepts of planning and technocracy not only promised technological progress and rational solutions to complex problems. Often, technocratic planning projects also tended to ignore the needs of large parts of society and therefore had problems with their political legitimacy: their utopian nature collided with the demands of democratic decision-making. The case of Swiss transportation policy of the 1970s highlights both aspects. The making of the Swiss Integral Concept for Transport (SICT) shows how cybernetic models were taken as the basis for technocratic planning, while its inherent shortcoming and the country's strong elements of participatory democracy highlight the limits of scientific modelling as a basis for planning decisions.

*Email: stefan.sandmeier@unibas.ch

ISSN 0266-5433 print/ISSN 1466-4518 online

DOI: 10.1080/02665433.2011.527545
http://www.informaworld.com

Congestions and deficits: the problems of Swiss transport policy 1950–1970

After the Second World War Switzerland experienced an unprecedented economic boom. The raised standard of living soon became visible on the streets: In only 20 years the number of automobiles increased from 188,512 (1950) to 1,524,036 (1970).[2] The negative consequences of this enormous growth of street traffic soon became apparent: congestion became more and more frequent in town and city centres, while accidents, noise and air pollution threatened to poison even the pastoral peace of villages. In the traffic-related discourses of the 1950s and 1960s, the term 'Verkehrsnot' ('traffic crisis') was coined to describe these new phenomena. Cities and urban regions often met the call for more street and parking space for motorized individual transport with very generously proportioned transportation plans (Figure 1).[3] To achieve their ideal of unobstructed traffic flows, transport planners and traffic engineers promoted strictly separated lanes for cars, trams and pedestrians. In their attempt to fix the problems of the present and simultaneously meet the demand for transport capacities of the future, they planned to transform cities into enormous 'traffic machines'.[4] Although only parts

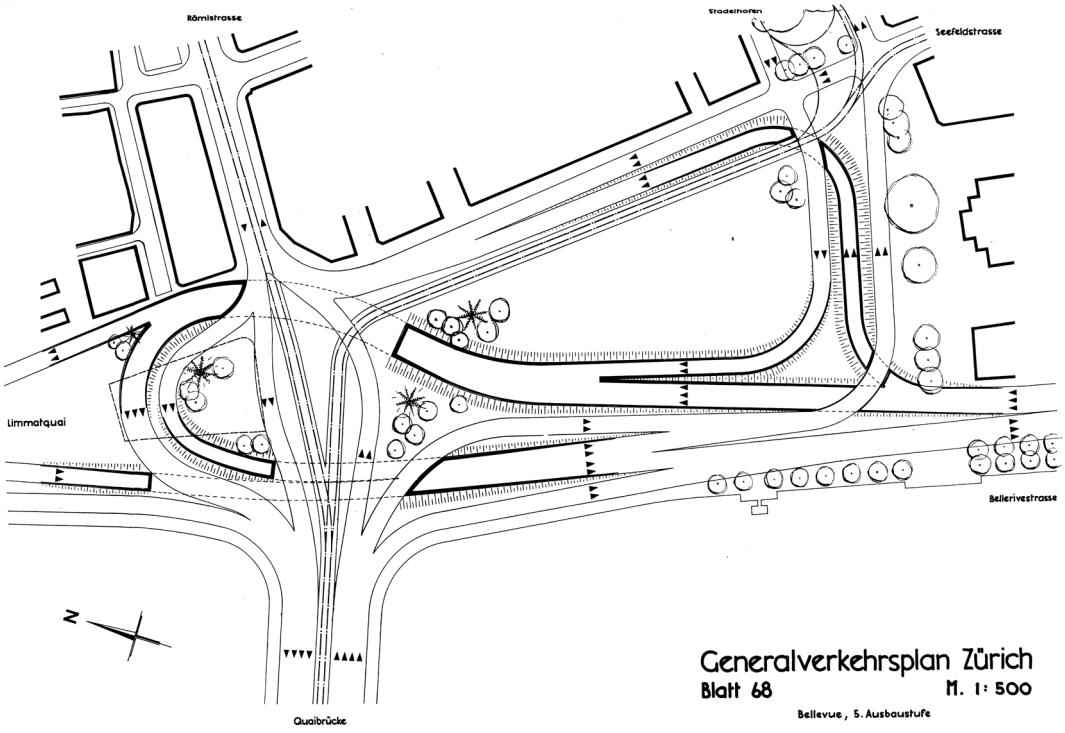

Figure 1. Generalverkehrsplan Zürich: during the 1950s, cities tried to solve their congestion problems with generously dimensioned communal transport plans. Separated lanes for cars, trams and pedestrians should guarantee unobstructed traffic flows. These plans threatened to transform cities into enormous 'traffic machines' though. Source: Kurt Leibbrand, 'Plan Bellevue', in *Generalverkehrsplan Zürich, Vol. III: Zeichnungen* (Zürich: Speich, 1954), 68.

of these grand plans were actually put into effect, the transport planners' car-friendly leading paradigm strongly influenced the developments in urban and regional transport planning between 1950 and 1975.[5]

The automobile's aura as an icon of progress and prosperity also yielded car-friendly decisions on a federal level.[6] In 1958, an overwhelming majority of Swiss voters agreed upon the construction of a Swiss highway system.[7] This new high-capacity street infrastructure connecting all major cities and regions of Switzerland highlighted a considerable distortion in the transport market: Although subsidized to some degree, the Swiss Federal Railways (SBB) had to build, maintain and finance all rail infrastructures on their own budget. Roads, however, were built and financed with public funds.[8] As the highway and road networks were expanded and cars and lorries became ever more efficient, the proportions of cargo and passengers transported by rail decreased noticeably. Furthermore, the railways were obligated to maintain public services regardless of their profitability. Consequently, by the end of the 1960s the SBB budgets were slithering into the red.[9]

Apart from the unequal competition between road and rail transport, more problems loomed on the horizon: the motorization of Switzerland was progressing much faster than expected[10] and the construction process was slower and much more expensive than planned.[11] In addition to the problems caused by its uncontrolled growth, the institutional setup of the Swiss transport system led to even more problems: Each mode of transport (rail, road, water and air) was regulated and operated separately. Therefore, their policies were uncoordinated and even conflicting in some cases. This had led to a suboptimal use of infrastructures and finances. By the end of the decade, spatial and urban planners as well as economists and conservationists became aware of potentially negative developments connected to highway construction and motorized individual transport. It became clear that the Federal State's existing political, legal, financial and organizational framework was insufficient. In the face of these problems, the federal government reacted with a series of planning-related measures. In its outlook to the political goals for the legislative period of 1968–1971, the Swiss Federal Council stated the need for a comprehensive concept for transport policies.[12]

The Swiss Integral Concept for Transport: purpose, task and organization

Despite the broad political consensus about the urgency of a comprehensive transportation concept, it was not until January 1972 that the Swiss Federal Council definitively decided to appoint an expert commission that was to elaborate a comprehensive SICT.[13] During the previous year, a group of seven experts and politicians had evaluated the possibilities of organizing the SICT commission as well as the structures, tasks and goals of the concept itself. According to their propositions[14] and the commission's mandate formulated by the Swiss Federal Council,[15] the expert commission resembled a veritable 'transport parliament'.[16] It comprised of 62 members ranging from politicians, transport planners and engineers, academics of various faculties to representatives of federal and cantonal authorities, of transport carriers, transport users, industrial enterprises and of organizations and associations from the transport sector (Figure 2).[17]

National Councillor Alois Hürlimann presided over the commission and chaired the board of seven leading commission members[18] directing and coordinating the commission's

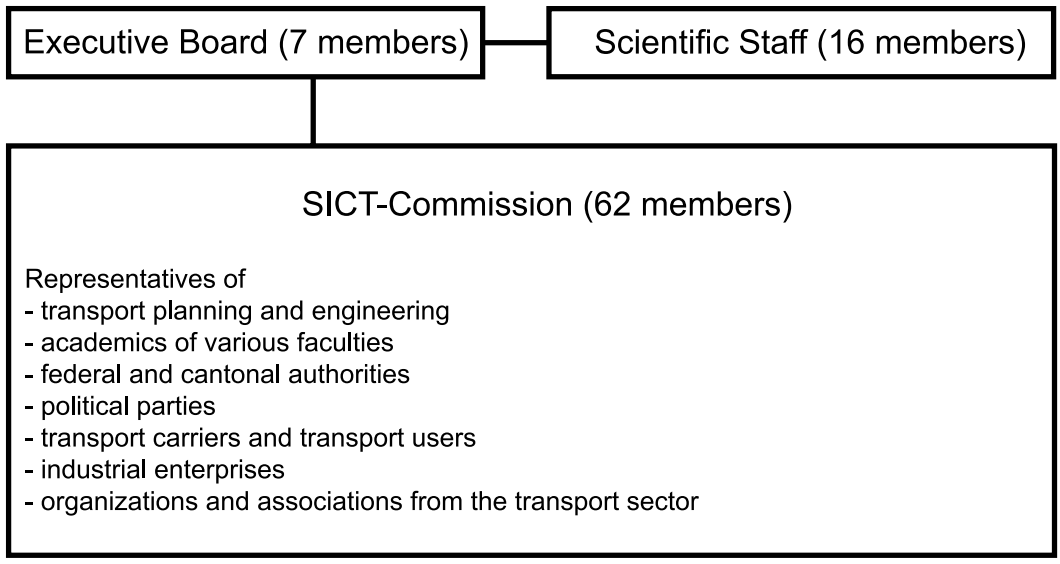

Figure 2. Structure of the SICT commission: The SICT commission with its 62 members resembled a 'transport parliament', representing as many stakeholders of the Swiss transport system as possible. Source: Author.

activities. A staff of 16 academic workers from different disciplines supported the commission. Led by board member Carl Hidber, professor for transport planning at ETH Zürich,[19] the staff provided the SICT commission with the scientific foundations needed. Their 'Arbeitsberichte' ('working papers') presented the findings of their own research and synthesized the results of data collections, traffic models and sociological, economical and legal research commissioned from university institutes and private planning and engineering firms.[20] The commission would then discuss these findings and decide on them thus providing the SICT staff with the information needed to tackle the next task. The size of the commission, the scope of its task and the amount of research done made the SICT the biggest endeavour of science-based policy advice in Switzerland.[21]

The commission's task was to propose and evaluate planning and policy measures enabling the federal government to improve the Swiss transport system (railways, streets and highways, airports as well as waterways and pipelines). It had to better satisfy the economy's and the society's needs for transport in terms of efficiency, costs and environmental sustainability. Technical, economical, financial, ecological, judicial, social and political aspects of traffic and transport had to be integrated into an all-encompassing transport policy for the next 25–30 years.[22] Contradicting its claim of comprehensiveness, the SICT mandate almost completely left out urban transportation problems. The justification for this neglect is Switzerland's political structure: the federal state has (almost) no competences in communal and cantonal matters.[23] The concentration on domestic aspects of the Swiss transport system caused a second flaw in the SICT mandate. Although included in the modelling process, the high grade of integration and interdependence of the Swiss rail and

road networks in the European networks was only given little attention in the SICT's final conclusions.[24]

Despite these drawbacks – the degree of comprehensiveness of the SICT was new for most of the actors involved in Swiss transport policy. The commission's mandate forced policy-makers and planners to abandon the notion that transport policy should deal foremost with new infrastructures as solutions for sectorial transport problems. Although infrastructures remained a central part of the equation, numerous other variables with equally important effects on traffic and transport were introduced: spatial planning, land-use policies, regional policies, laws and regulations, environmental protection, etc. Also, the financial resources for transport infrastructure had to be reallocated. As the SBB deficits and the problems with the highway finances indicated, the strictly separated financing modes for roads and railways (as well as for airports and waterways) were no longer adequate. If the construction and maintenance of new infrastructures should be possible in the future, the policies established separately for each transport sector had to be unified and coordinated.

Apart from these policy-induced novelties, the methodology used was rather new and hardly established amongst the practices of transport planners;[25] the experts tried to 'ensure as comprehensive an approach as possible'. Instead of 'handling individual questions in a pragmatic manner' they sought to 'tackle the complex transport problems' as a whole employing the cybernetic concepts of Systems Analysis.[26] A system of problem categorizations, predefined goals and indicators was used to assess possible solutions. The results of the research done for the SICT were synthesized into two different scenarios of possible development ('Schlussvarianten' ['Final Alternatives']). The scenarios then were tested as to how well they fulfilled the requirements formulated in the goal system[27] and served as basis for the commission's 40 policy proposals presented in the final report.[28]

Although the policy proposals turned out to be too complex and, in certain respects, too revolutionary to be accepted as a whole, the SICT was enormously influential for the future formulation of transport policies in Switzerland and many of the original propositions were realized later without explicit reference to the SICT.[29] In the history of Swiss politics, this indirect success of the SICT policy proposals is so remarkable that the novel methods employed to devise these proposals are easily overlooked.[30] But in the contexts of planning history and history of science, the cybernetic concepts grasped by the SICT commission to tackle their task are of equally great interest.

Systems Analysis and planning

Before delving into the details of the SICT, a few introductory remarks about the concepts of Systems Analysis and its methodological 'twin', Operations Research (OR),[31] are necessary as both were applied in the SICT.[32] Systems Analysis and OR are both firmly tied to Systems Theory and Cybernetics and operationalize their theoretical concepts. OR was developed during the Second World War and 'usually referred to a systematic analysis of operating systems, or operations'.[33] It consists, at its core, of a bundle of mathematical models and concepts to effectively analyse structures, manage actions and optimize interactions within complex systems (e.g. large industrial enterprises, government agencies or whole branches of economy).[34] Although OR quickly became an important part of the cybernetic canon of methodologies it lacked the instruments to analyse aspects of such structures, systems and operations

which had to be 'evaluated by [their] accord with general social, governmental, or other high-order judgments, rather than by simple economic efficiency'.[35] The RAND Corporation, one of the key developers of OR at the time, therefore added 'an explicit policy component to OR studies' thus achieving a new methodology: Systems Analysis.[36]

This new methodology enabled analysts to deal 'with the comparison of systems that offered alternative solutions to problems'[37] and was defined as 'the process of studying the network of interactions within an organization and assisting in the development of new and improved methods for performing necessary work'.[38] More pragmatically Systems Analysis can be regarded as 'a systematic approach to helping a decision-maker choose a course of action by investigating his full problem, searching out objectives and alternatives, and comparing them in the light of their consequences, using an appropriate framework – insofar as is possible analytic – to bring expert judgement and intuition to bear on the problem'.[39] Accordingly, Systems Analysis is concerned with formulating the problem, defining the goals and objectives, considering constraints, forecasting future contexts or states of the system and its environment, building and using models for predicting the results and evaluating alternatives (e.g. in terms of costs and benefits) to allow the decision-maker 'an informed choice' among these alternatives (Figure 3).[40]

It is already difficult to properly distinguish Systems Analysis and OR, but it is even more difficult to trace the history of Systems Analysis – as described above, it cannot be divided from the history of OR.[41] After RAND had established Systems Analysis in the military context shortly after the Second World War, applications in industrial production processes, business administration and other management tasks followed. Even 'a few sporadic attempts were made to solve problems in transportation, e.g. the design of roadways'.[42] Social and

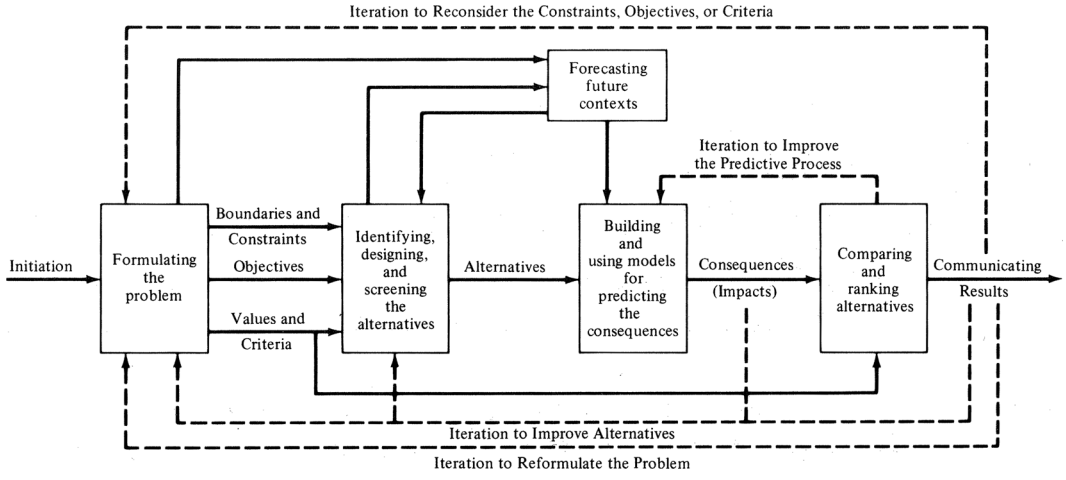

Figure 3. Systems Analysis procedure with feedback loops: the commission expected Systems Analysis procedures to hand them tools for formulating the SICT's problems, defining the goals and objectives, considering constraints, forecasting future contexts or states of the system and its environment, building and using models for predicting the results and evaluating alternatives. Source: Findeisen and Quade, 'Methodology of Systems Analysis', 124.

political scientists took up the concepts of Systems Analysis and developed new approaches to the understanding of social and political systems, analysing issues such as national reform programmes, research and development in science and technology, educational systems and other social services.[43]

During the second half of the 1960s, mainly British urban and regional planners, whose interests converged with the political, technical and managerial understandings of OR and Systems Analysis, adopted these concepts and developed them into central parts of spatial and transport planning methodology.[44] One of the basic assumptions of systems and cybernetic thinking is the notion that analysing a system means not only understanding it, but, due to the structure and principles of cybernetic systems (i.e. interrelated elements, interacting through information flows, regulating itself via feedback loops) also enables one to control it. This notion became a central theoretical assumption for urban, spatial and transport planning processes.[45] Even for very complex, dynamic and probabilistic systems, their elements and the rules of their inner workings could be formulated and modelled in mathematical terms and computable algorithms. Simulations of these models allowed the forecasting of possible future developments of the system under scrutiny and provided indicators for the evaluation of adequate courses of action.

The methodological framework of Cybernetics and Systems Analysis seemingly provided planners with 'an elegant and beautiful means to understanding the man-environment relationship, and a potentially powerful means for its control and guidance'.[46] Not only to planners in Britain and the USA did this sound immensely promising, their colleagues in Germany, Austria, Switzerland and the Netherlands too praised systems thinking as an ideal tool for getting the complex problems of transportation and spatial planning under control.[47] Nevertheless, at the end of the 1960s, the British spatial planner Brian McLoughlin had to concede that cybernetic methods such as Systems Analysis were still 'completely untried in practice' and many planners were yet to be persuaded to use them.[48] Although for parts of the German 'Bundesverkehrswegeplan' ('Federal Transport Network Plan') of 1973 some (non-specified) OR methods had been employed to carry out the plan's cost–benefit analysis,[49] the German political scientist Dieter Aderhold criticised the lack of practical implementation of cybernetic planning theory in Germany.[50]

In the Netherlands, the books of McLoughlin and the British planner George Chadwick were widely received and formed the basis for a 'home-grown version of the systems approach'.[51] However, the SICT seems to be one of the few instances of a comprehensive and consistent implementation of Systems Analysis in large-scale, national-level transport planning in Western Europe.[52] One of its most important characteristics – the confluence of problem analysis, formulation of solution alternatives and decision-making process – made Systems Analysis immensely appealing to planners. But it was probably this very characteristic that would also prove a major obstacle for its implementation in planning practice because the 'systems view of planning' attempted 'to arrogate to planning an area that had hitherto been considered a prerogative of the polity: the formulation of goals against which to evaluate alternatives'.[53]

The application of Systems Analysis, models and simulation in the SICT

Although no references (or traceable allusions) were made to any author in the field of planning methodology and Systems Analysis throughout the whole of the official SICT publications,[54]

the workflow design and methodologies chosen for the SICT closely followed the blueprints provided by planners and practitioners such as McLoughlin, Chadwick or Quade. As a first step, the staff delineated the overall system (i.e. the Swiss transport system in its entirety) and a multitude of sub-systems, categorized the problems and identified external constraints.[55] Next, the planners derived objectives and indicators for the overall system (i.e. the Swiss transport system in its entirety) and all its sub-systems from the commission's mandate.[56] To ascertain the best possible solutions, the objectives were prioritized and weighed according to the results of repeated polls among the commission members and of representative public opinion polls.[57] Thus, the commission aimed simultaneously at structuring their complex task and overcoming the long-established and still predominant planning practice of extrapolating existing trends into the future with no regard to influences from outside the transport system (Figures 4 and 5).[58]

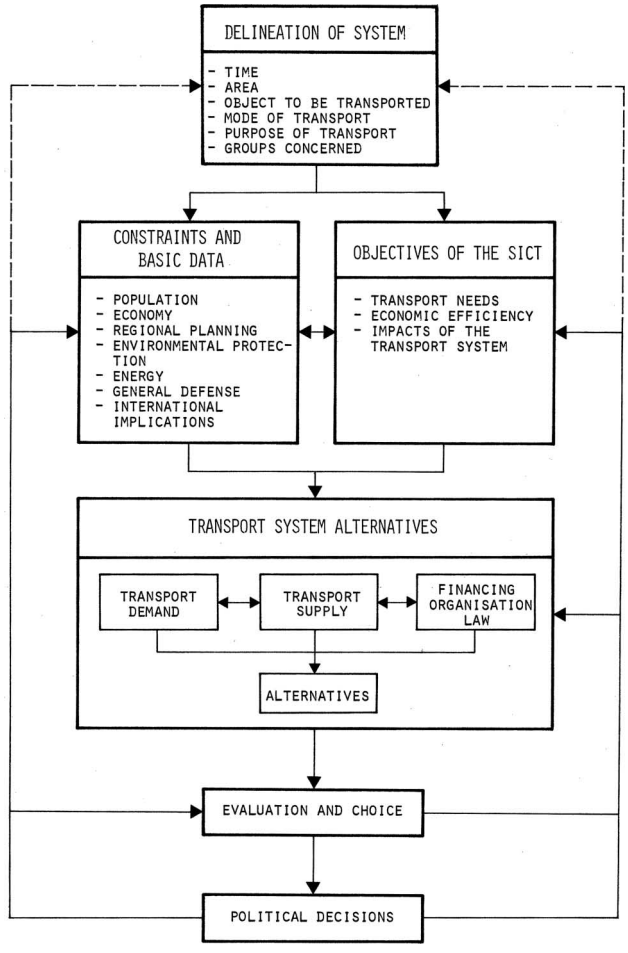

Figure 4. Systems Analysis provided the SICT planners with a conceptual and methodological framework for their work. Source: SICT, *Summary of the Final Report*, 13.

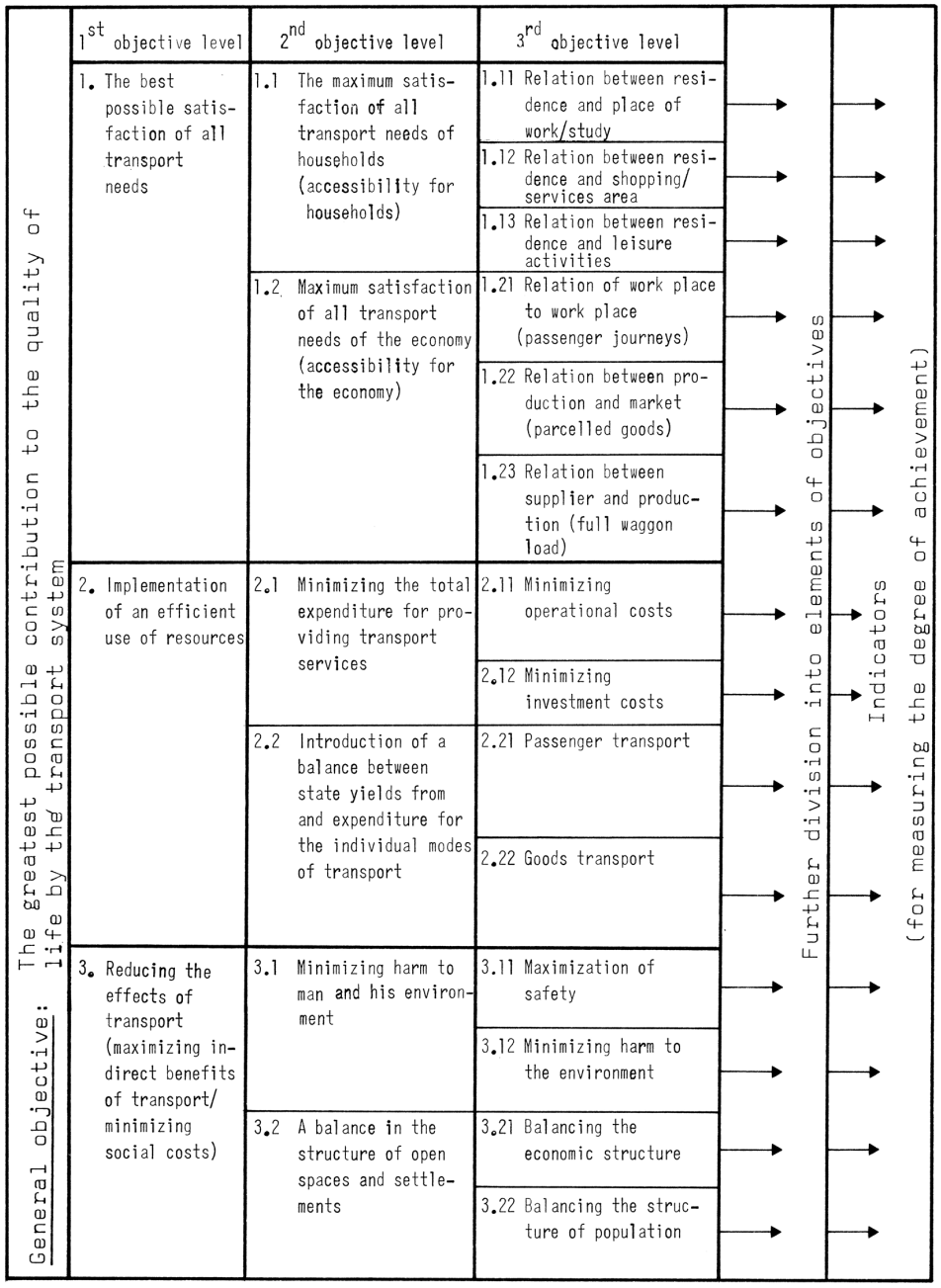

Figure 5. System of objectives of SICT: the SICT's objectives were prioritized according to polls among the members of the SICT commission and representative public opinion polls. Source: SICT, *Summary of the Final Report*, 12.

In the next step, after the 'current situation' of the Swiss transport system had been reviewed thoroughly, several alternative scenarios of future transport systems were

> set up and tested in three working stages. […] The Pilot Study[59], as the first stage, […] was to show the form […] transport concepts could take. It provided […] information on the effect of the traffic volumes in the networks, on regional development, on energy consumption, harm to the environment, the economic results and investment requirements.[60]

The second working stage provided the Basic Alternatives[61] looking 'deeper into the consequences of transport policy solutions with extreme objectives'. These alternatives would optimize the transport system according to objectives such as economic self-sufficiency, regional promotion or protection of the environment.[62] In the third stage, the results of the previous studies were synthesized into two final scenarios (Final Alternatives) presented in the final report (Figure 6).[63]

As in most planning endeavours, models and simulations of future system developments played a key role in the making of the SICT. On a general level, the conceptual and methodological framework of Systems Analysis allowed the planners to model transportation networks, their spatial, environmental, economical, political and social effects and constraints as interacting elements of an exactly defined cybernetic system. Simultaneously, it worked as a model of the task and of the targeted workflow and – as is a general characteristic of models – helped the SICT planners bring together 'disparate data from many sources […] and provided a coherent narrative for the presentation of the data'.[64] On a more particular level, computer models were used to simulate transport patterns and future demands for transport infrastructures. As the models for previous planning endeavours had mainly covered urban and regional (agglomeration) passenger transport, the planners had to modify existing models and also develop new ones, including freight transport in order to comply with the task of the SICT. They built their models along the lines of the four-step approach (Figure 7):[65] transport processes were analysed as a sequence of consecutive stages that could be modelled separately. In the first step ('traffic generation') the number of journeys originating and terminating in each (geographical) zone of the transport system was estimated. In the second step ('traffic distribution') the spatial distribution of journeys was determined by assigning the possible journey origins to all possible destinations. In the third step ('modal split') the likelihood of use was determined for all available modes of transport. In the fourth step ('route assignment') the information from the first three steps was combined to ascertain the particular routes most likely to be used for the possible journeys. Separate four-step models were made for passenger and freight transport within Switzerland and across the borders, respectively.[66] They then were merged into an 'integrated overall model' (Figures 8 and 9). 'On the basis of the constraints and basic data as well as established objective priorities', the results of the model calculations and simulation runs were crucial in the process of developing the alternative scenarios – or, in filling the narrative with content. Apart from forecasting demands and capacities for the different modes of transport up to the year 2000 for each alternative, the models and simulations provided the planners with 'indicator values for the system of objectives' (Figure 10).[67] In the penultimate stage of the SICT Systems Analysis, these indicator values were used to evaluate how well the alternative scenarios had fulfilled the requirements of the system objectives. This evaluation process resulted in the two Final Alternatives presented as the most viable scenarios in the final report.

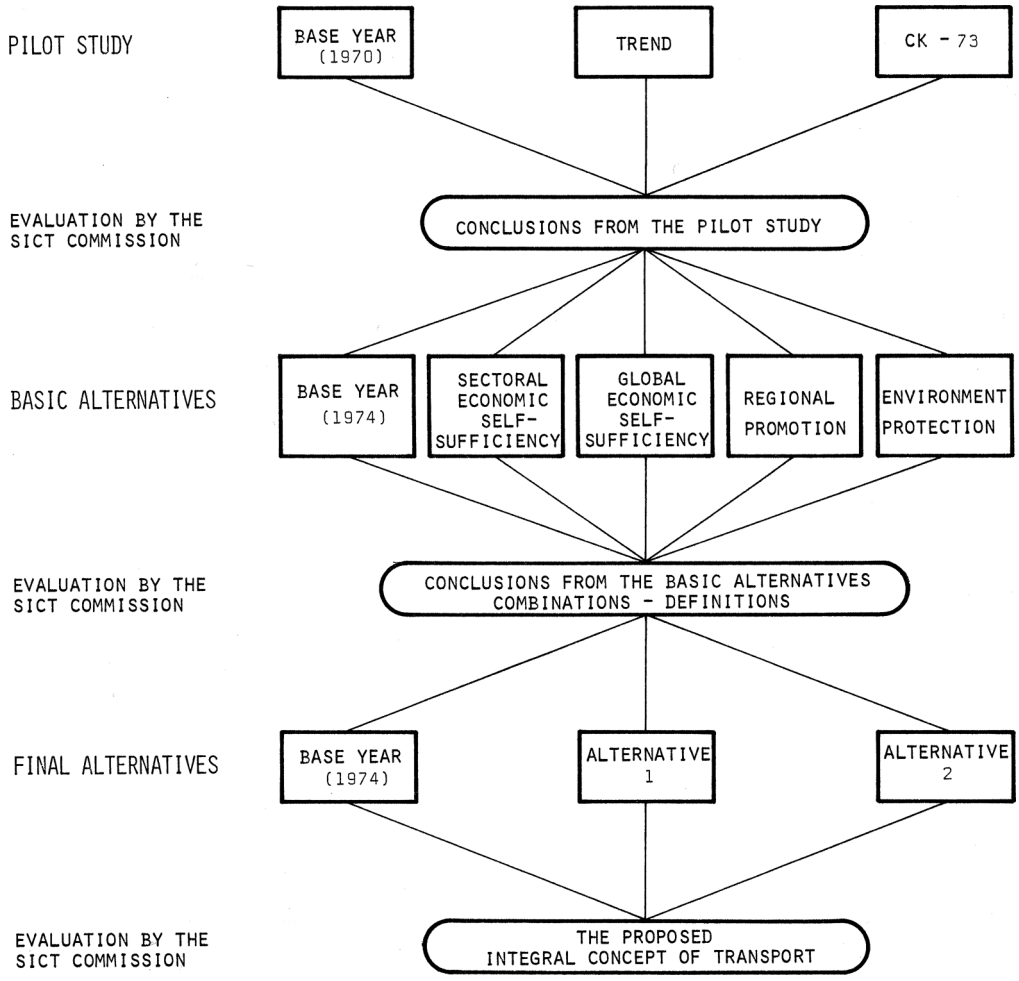

Figure 6. SICT workflow diagram: After the results of the Pilot Study had been discussed in the commission, Basic Alternatives with different main objectives were developed. Again, the commission evaluated their results and worked them into the two Final Alternatives presented in the Final Report. [a]Alternative taking as its main objective regional development recommendations set up by the regular conference of the directors of offices in all Federal Ministries. Source: SICT, *Summary of the Final Report*, 15.

With subliminal regret the SICT planners conceded that the final step of the SICT Systems Analysis was not theirs to take: 'the political realization of the proposed reorganization of the transport system, the last and decisive step in the chosen procedure of Systems Analysis, now has to follow the procedures laid down in the Swiss political system.'[68] The first step in this political process was the consultation of all actors and stakeholders involved in transport politics (such as the cantons and municipalities, political parties and interest groups). Bearing the

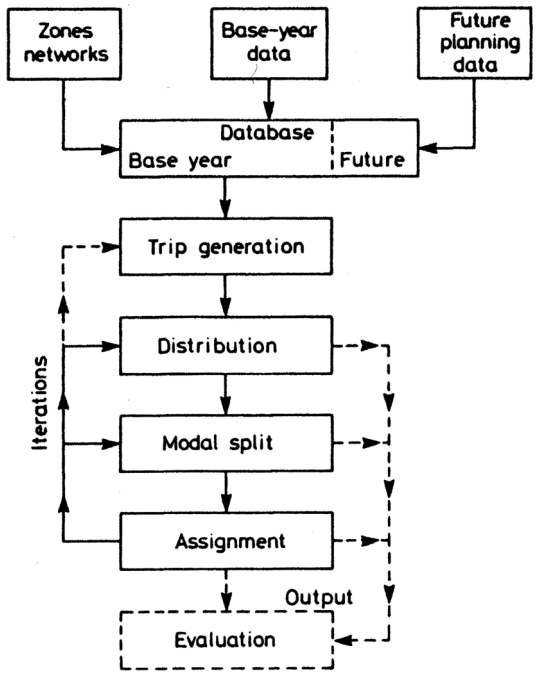

Figure 7. The four-stage transport model: one of the most important model types used in SICT was the four-stage transport model. It was applied to simulate transport patterns and future demands for transport infrastructures. Source: de Dios Ortúzar and Willumsen, *Modelling Transport*, 23.

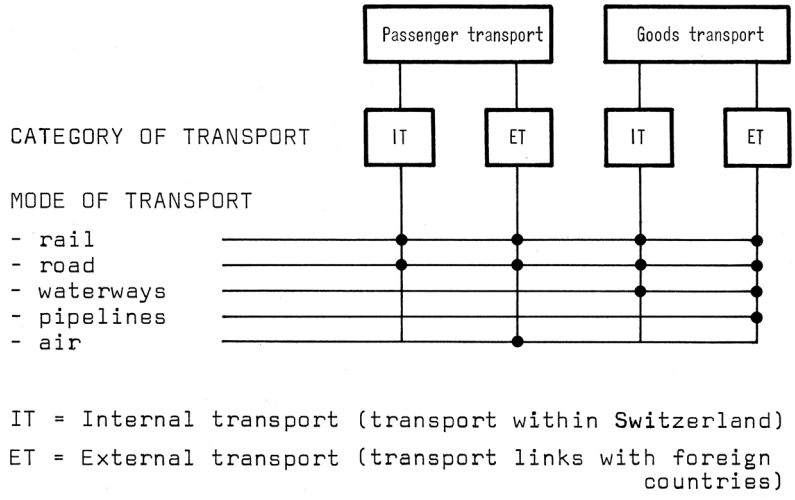

Figure 8. Categories of transport models: transport models for different modes of domestic (internal) and international (external) passenger and goods transport were developed. Source: SICT, *Summary of the Final Report*, 17.

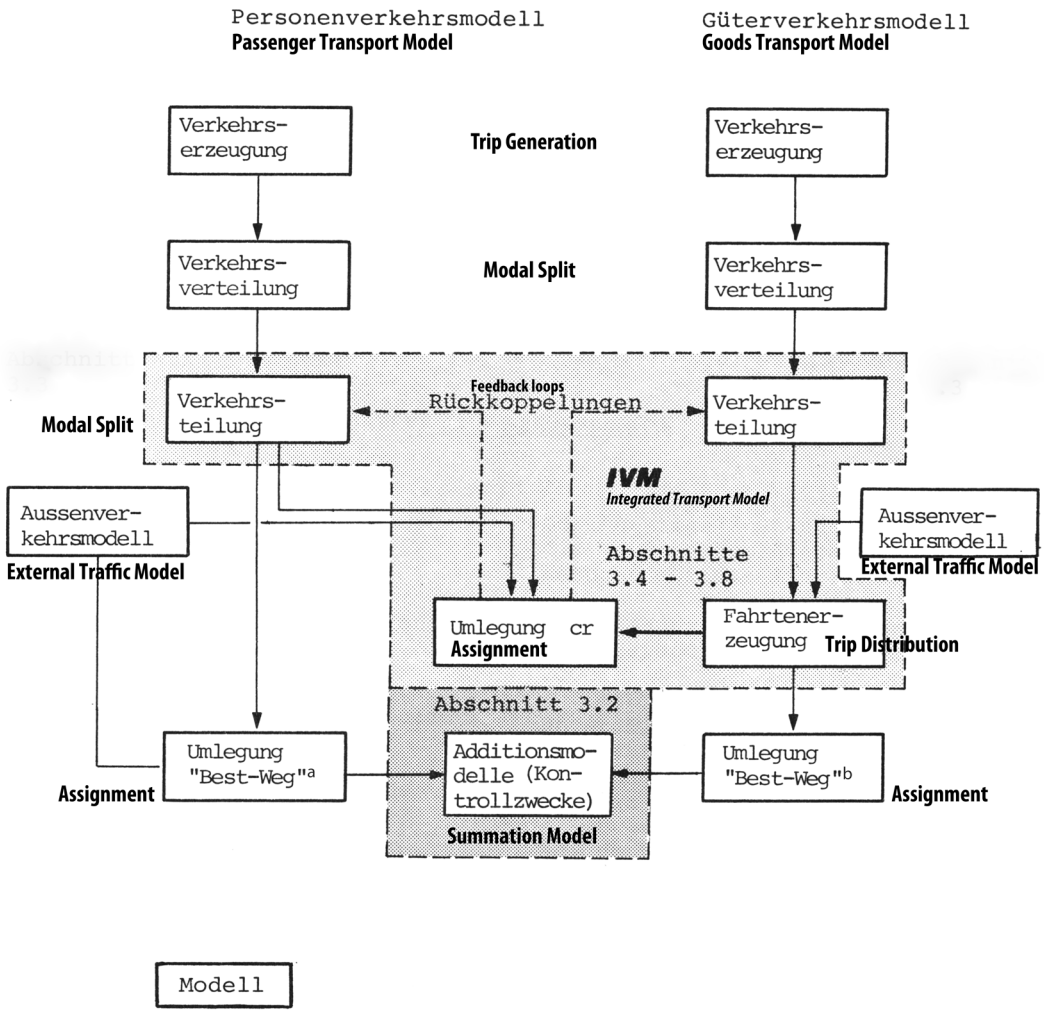

Figure 9. SICT integrated transport model: the different transport models (see Figure 8) were synthesized into an Integrated Transport Model (grey area in the diagram). This model was used to simulate the behaviour of the Swiss transport system according to the different Basic and Final Alternatives. [a]Stochastisch; [b]Deterministisch. Source: Econsult, *Integriertes Verkehrsmodell. GVK-Auftrag 97* (Zürich: Econsult, 1977), 3.

outcomes of these consultations in mind, the Federal Council drafted a bill suggesting the necessary modifications of the federal constitution and certain laws. These governmental proposals were then subject to debates in both parliament chambers. Subsequently they had to be approved by the Swiss voters: 'Only after a positive outcome from the referenda is the way open for realization of the Commission's proposals, because only few of the measures can be introduced in the short term by government decree.'[69] Apprehensively, the planners estimated that 'the whole process will take at least three years'. Indeed, the political decision-making

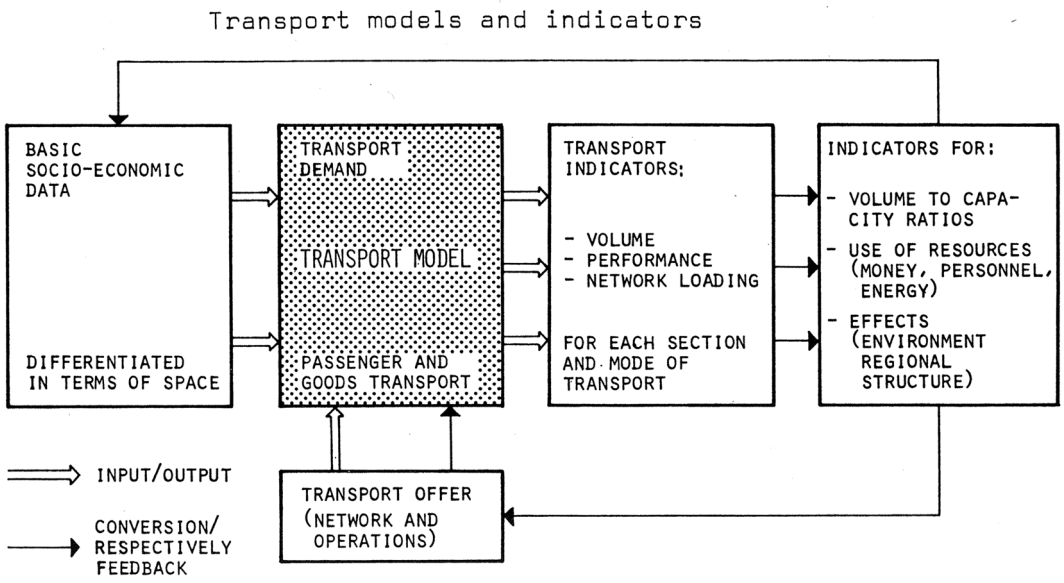

Figure 10. Transport models and indicators: the results of the simulation runs yielded indicator values which were used to measure how well the Alternatives complied with the objectives (see Figure 5). Source: SICT, *Summary of the Final Report*, 16.

process on the SICT findings took a very long time – even by Swiss standards: after the extensive consultation process (December 1978–October 1979) had taken place, the drafting of the bill for the now so-called 'Koordinierte Verkehrspolitik' (KVP) (Coordinated Transport Policy [CTP]) took another three years.[70] After a further four years of considering and reconsidering the measures covered by the bill in both chambers of the parliament, the Swiss people finally were called to the ballot in June 1988.

The utopian core of the SICT: the making of a 'governing machine'

From the 1950s onward, scientists, engineers and futurologists expected Cybernetics to provide a 'meta-science' uniting science and technology with the knowledge of societal and political control. Thus, the complex problems of states and societies could be analysed, desirable solutions found and their implementation rationally planned.[71] This universalistic understanding of Cybernetics bears utopian traces – as does the concept of planning as the possibility to anticipate the future with rational methods: in the systems view of planning these concepts were amalgamated. Planning and policy-making were no longer separate things but two interwoven phases of one single process.[72]

The conceptual structure of the SICT, its methodology, workflow, models and ultimately its outcomes were based on the notion that the future could be forecasted and planned rationally. Using Systems Analysis as a means of planning led experts to interpret transportation networks, their spatial, environmental, economical, political and social effects and constraints

as interacting elements of an exactly defined cybernetic system. The system elements and their interrelations could be formulated in mathematical terms and their future behaviour simulated. Accordingly, these models enabled the planners to forecast future states of the system. Problems could be detected and solutions planned – thus, modelling plans and planning models appeared to be completely objective and to provide the best possible solutions. The experts assumed that their thorough scrutiny of the Swiss transport system, their models and simulations would lead to the optimal development of the systems of transport and transport policy. They were convinced that Systems Analysis provided them with instruments to assess these possible solutions according to the criteria laid down in the goal system. The best solutions could be selected and summarized in scenarios clearly showing which measures would bring about the politically desirable developments according to the goals and objectives formulated by the Federal Council in the SICT mandate.

The idea to synthesize analysis, planning and policy-making into one rational, science-based process was inspired by the thought style of technocracy.[73] The SICT's cybernetic planning mechanism, its attempt to synthesize analysis, planning and policy-making into one rational, science-based process can be considered a technocratic 'governing machine'.[74] The concept of a 'governing machine' was inspired by Norbert Wiener's ideas about the mechanisms of regulation and control in any kind of systems and the possibility of computers performing these tasks.[75] In the ensuing debate the expression was used more metaphorically, either to label cybernetic mechanisms of political analysis, decision and control or to describe technocratic ways of decision finding and policy-making.[76] In this setting the idea of a 'governing machine' reflects the fact, that the application of systems thinking and Cybernetics in social and planning contexts always had political implications. On the one hand, cybernetic principles could be applied to regulating and governing (e.g. via Systems Analysis). On the other hand, the notion that understanding a system also enables one to control it is political. Especially in Germany these aspects of Cybernetics and systems thinking were connected to planning and technocracy and were debated very controversially during the 1960s and 1970s.[77]

Although nobody directly intended to hard-wire transport planning or to computerize the decisions on transport policy in Switzerland, the SICT staff and commission members were building such a 'governing machine' in the metaphorical sense. Again, this links directly to the utopian core of the SICT: the technocracy-inspired confidence that even most complex systems could be analysed, understood and consequently controlled and that Systems Analysis handed them the appropriate instruments to achieve this.

The machine's collision with reality

Not only the theoretical and structural concept of the SICT was new and utopian. Compared to previous policies, the policy proposals presented in the final report were quite revolutionary insofar as the commission shifted its focus from infrastructure-based engineering solutions to rather economical and environmental issues.[78] Nevertheless, some of the measures proposed to overcome the market distortion between road and railway were heavily infrastructure-based. They included 'the construction of new main rail axes between Lakes Geneva and Constance and between Basel and the southern foothills of the Jura which would be capable of competing with road passenger transport'.[79] Economic utilities of transport services and infrastructures were to be assessed and financed according to the costs-by-cause-principle: 'transport system

users should in principle cover the costs they cause.'[80] For the financing of transport infrastructures, the commission put forward a solution with two funds for public and private transport, respectively: the funds should be fed by a percentage of the national turnover tax, fares from users of railway and street infrastructures.[81] Complementary to the benefits, also the negative consequences of traffic and transport such as air pollution, land consumption and undesired changes of spatial development and land use, the need for new regulations and legislations or questions of financing were to be considered.[82] Other propositions concerned compensations for the public service-functions,[83] the tasks of SBB and other transport enterprises,[84] competition and the abolition of market distortions,[85] new federal transport law[86] and organizational changes in the structure of the transport-related parts of the federal administration.[87]

After the publication of the final report in December 1977, comments in the press indicated that the Systems Analysis process undertaken with SICT had worked out well and was received with much goodwill.[88] However, during the consultation process, the commission's consensus about the necessary measures began to crumble. Namely exponents of the private transport sector who had been represented in the SICT commission and had given their assent to the SICT propositions[89] soon fell back into their old roles as lobbyists for their own particular interests.[90] The longer the political process, the lesser they were inclined to accept the changes proposed. Especially the areas of financing transport infrastructures and regulating competition between the modes of transport became a target for a massive campaign from the lobby organizations for road transport during the months before the referendum was held in June 1988. In newspaper adverts they sketched road transporters and car users as victims of governmental 'raids' on their money to 'endlessly subsidize and privilege public transport'. Moreover the SICT was said to lead to a 'Bürokratendiktatur' ('dictatorship of bureaucrats'), to new taxes and to the dismantling of the people's democratic rights.[91]

On the other end of the political spectrum, environmentalist organizations, some left-wing parties and even the Christliche Volkspartei (CVP) were not too pleased with the technocratic attitude of the SICT propositions.[92] Especially environmentalist organizations were disappointed that neither of the two Final Alternatives included propositions how to lower the energy consumption of the transport system or how to avoid new traffic and new infrastructures.[93] As a result of this dissent, some propositions were cut from the draft bill and others were modified to some degree during the parliamentary debates. The surviving propositions incorporated in the KVP draft bill by the Federal Council were still highly controversial. Apart from synthesizing and reformulating the articles of the Federal Constitution concerned with transport they touched the established processes of planning, decision-making and implementing policies on federal and cantonal levels. Although a majority of political parties and a multitude of organizations (e.g. transport users, farmers, trade unions and the World Wildlife Fund) recommended voting in favour of KVP, the opponents prevailed: the Swiss people declined the bill.[94]

The cybernetic planning utopia of the SICT had not survived its collision with the hard reality of politics. Apart from the political differences and particular interests, it was the utopian aspects of the SICT that clashed most apparently with the political realities of the day. As mentioned earlier, the idea of the SICT was rooted in the technocratic idea that the future – in this case Switzerland's transport systems and the policies regulating them – could be planned and was technically controllable. The concepts of Cybernetics and Systems Analysis

contributed a great deal to this confidence that was shared by transport and spatial planners, civil engineers and politicians alike. However, questions arose about the democratic legitimacy of planning and policy-making by authorities and other non-elected bodies such as the SICT commission.[95] One reason for this perceived deficit of legitimacy has its roots paradoxically in the consensus orientation of the Swiss political system: with no clear government opposition system, decisions have to be found consensually. To get to decisions broadly accepted, compromise solutions are sought after in commissions and consultation processes within the administration, lobbies, etc. Thus, a very important part of the political process takes place in a semi-informal field of policy-making.[96]

In a time of growing public awareness for such problems and the demand for more citizen participation in planning matters, this argument hit the SICT hard. In fact, the political failure of SICT/KVP probably marked the end of the 'hierarchical-deductive' planning concepts. From the ruins of SICT, a more open and pragmatic mode of planning emerged, allowing for more citizen participation.[97] Apart from the legitimacy argument, not only some left-wing critics and ecologists were suspicious of the SICT's 'governing machine'-type of policy-making. Federalists in all political parties also feared that the cantons and the municipalities would lose some of their influence to the federal government if the responsibilities and competences concerning the transport networks would be rearranged according to the SICT propositions. Although they accepted the SICT as a usable basis for further political discussions, liberals and conservatives, preferring market rather than state-planned solutions, disapproved of some central SICT propositions too because they did not want to see state-owned enterprises with quasi-monopoles (such as the SBB) strengthened as the SICT would have it.

Conclusions

In terms of comprehensive model building,[98] the SICT was a rather successful attempt to analyse and model the Swiss transport system. Based on the notion that analysing a cybernetic system means not only understanding but also controlling it, the systems view of planning allowed the planners to grasp transportation networks together with their infrastructural, spatial, environmental, economical, political and social aspects in one comprehensive scheme. Into this methodological framework actual transport models were fitted and, qua simulation, provided data for the planning scenarios presented in the final report. Furthermore, the procedural framework of Systems Analysis helped the SICT staff to structure the planning process and the commission's workflow. In terms of creating a lasting 'epistemic community'[99] to establish their concept of transport policy in real-world politics, the SICT was bound to fail. In order to bring this utopian concept to fruition, it would have been necessary to integrate all stakeholders of the Swiss transport system in one enormous actor-network.[100] Although quite successful within the SICT commission (which was intended as 'transport parliament' representing as many of the transport system's stakeholders as possible) and until the publication of its final report, the SICT's technocratic 'governing machine' concept of policy-making could impossibly succeed in the Swiss political system. The methodology of Systems Analysis, which seemingly had provided solutions to all kinds of problems, turned out to be the problem: amalgamating planning with policy-making on such a large scale could not work in a referendum-based political system like the one in Switzerland.

Notes on contributor

From 1998 to 2004, Stefan Sandmeier studied general history, musicology and mass communication and media research at the University of Zürich. From 2005 to 2008, he worked with the Institute for Transport Planning and Systems (IVT) at the Swiss Federal Institute of Technology Zürich (ETH Zürich). He researched and published on the disciplinary and institutional history of transport planning and traffic engineering in Switzerland. Since 2009, Sandmeier has been research assistant at the History Department of the University of Basel with Prof. Monika Dommann and is working on his PhD thesis.

Notes

1. See Paul N. Edwards, 'Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems', in *Modernity and Technology*, ed. Thomas J. Misa, Philip Brey and Andrew Feenberg (Cambridge, MA: MIT Press, 2003), 185–225; Dirk van Laak, 'Infra-Strukturgeschichte', *Geschichte und Gesellschaft* 27 (2001): 367–93.
2. Swiss Federal Statistical Office, 'Strassenfahrzeugbestand nach Fahrzeuggruppe', http://www.bfs.admin.ch/bfs/portal/de/index/themen/11/03/blank/key/fahrzeuge_strasse/bestand.html (accessed 20 August 2010); Hansjörg Siegenthaler and Heiner Ritzmann-Blickenstorfer, eds., *Historische Statistik der Schweiz* (Zürich: Chronos, 1996), 779. Figures include buses, trucks and tractors.
3. Major Swiss cities such as Zürich, Basel, Berne and St. Gallen commissioned transport plans but even small towns as Bienne and Appenzell developed transport plans.
4. Barbara Schmucki, 'Cities as Traffic Machines: Urban Transport Planning in East and West Germany', in *Suburbanizing the Masses: Public Transport and Urban Development in Historical Perspective*, ed. Colin Divall and Winstan Bond (Aldershot: Ashgate, 2003), 149–70. Most of Schmucki's findings for Germany apply to Switzerland as well.
5. Barbara Schmucki, *Der Traum vom Verkehrsfluss. Städtische Verkehrsplanung seit 1945 im deutsch-deutschen Vergleich* (Frankfurt am Main: Campus, 2001). Specifically on Switzerland, see Ueli Haefeli, 'Stadt und Autobahn – eine Neuinterpretation', *Schweizerische Zeitschrift für Geschichte* 51, no. 2 (2001): 181–202; Jean-Daniel Blanc, *Die Stadt – ein Verkehrshindernis? Leitbilder städtischer Verkehrsplanung und Verkehrspolitik in Zürich 1945–1975* (Zürich: Chronos, 1993); George Kammann, *Mit Autobahnen die Städte retten? Städtebauliche Ideen der Expressstrassen-Planung in der Schweiz 1954–1964* (Zürich: Chronos, 1990).
6. Switzerland has three political levels: the Confederation (Swiss national state), the cantons and the communes. The Confederation incorporates 26 cantons and is only responsible for those areas where it is granted powers by the constitution, for example in foreign and security policy, customs or in enacting legislation applying to the whole of the Federal state. (The terms 'Confederation', 'federation' ('Bund') and 'federal' refer to the nation-state throughout this article.) Political tasks not explicitly designated federal matters are the responsibility of the cantons. Under the Federal Constitution, the cantons can impose taxes and regulate policy areas such as education, culture or regional and transport planning on their territory. (The terms 'federalism' and 'federalist' express this powerful position of the cantons within the federation.) The communes are the lowest level of the state structure. The Swiss government, the Federal Council, consists of seven members. It leads the federal administration of Switzerland, each Councillor heading one of the seven federal executive departments. The two chambers of the parliament are the National Council and the Council of States. The National Council represents the Swiss population, the Council of States the individual cantons. Together, the two chambers constitute Switzerland's legislative power. In case of constitutional changes, a popular referendum is compulsory. In the case of new or changed laws, a referendum is held if at least 50,000 people or eight cantons have petitioned to do so.
7. Its realization started in 1960 and culminated during the mid-1970s. In 1980, 64% (1171 km) of the planned network was completed, including the road tunnel at the St. Gotthard opened the same year. Swiss Federal Statistical Office, 'Streckennetz nach Verkehrsträgern', http://www.bfs.admin.ch/bfs/portal/de/index/themen/11/03/blank/key/infrastruktur.Document.21269.xls (accessed 20 August 2010).

8. Since 1958 more than 50% of the taxes on petrol had to be spent on the construction and maintenance of the highway system and the cantonal road networks. This appropriation initiated a positive feedback mechanism in which mass motorization, fuel consumption and road construction got interlinked: the higher the petrol consumption got, the more money was available for the extension of the road networks. In turn, more roads made cars more attractive. See Christoph M. Merki, 'Der Treibstoffzoll aus historischer Sicht: Von der Finanzquelle des Bundes zum Motor des Strassenbaus', in *Das 1950er Syndrom. Der Weg in die Konsumgesellschaft*, ed. Christian Pfister and Peter Bär (Bern: Haupt, 1995), 311–32.
9. Schweizerischer Bundesrat, 'Botschaft des Bundesrates an die Bundesversammlung zum Voranschlag der Schweizerischen Bundesbahnen für das Jahr 1969 (Vom 13. November 1968)', *Schweizerisches Bundesblatt* 2 (1968): 772–9. In 1968, SBB made a deficit of 15.6 million Swiss Francs. More negative results followed and reached 622.8 million Swiss Francs by 1975. Siegenthaler and Ritzmann-Blickenstorfer, *Historische Statistik der Schweiz*, 774.
10. The planning commission for the highways had estimated in their final report (1958) one million motor vehicles in 1980. However, this figure had been surpassed by 1965 and reached 1.7 million vehicles by 1970. Swiss Federal Statistical Office, 'Strassenfahrzeugbestand nach Fahrzeuggruppe', http://www.bfs.admin.ch/bfs/portal/de/index/themen/11/03/blank/key/fahrzeuge_strasse/bestand.Document.48969.xls (accessed 20 August 2010).
11. The construction of the Swiss highway network should have been finished by 1980 and cost 3.8 billion Swiss Francs. In 1970, only 35.4% (651 km) had been built but the cost had already reached 7.7 billion. This massive cost inflation overstretched the financial resources assigned to highway construction and caused a much slower realization of the network. Beratende Kommission für den Nationalstrassenbau, *Bericht an das Eidg. Demaprtement des Innern betreffend Stand des Nationalstrassenbaues: Überprüfung des langfristigen Bauprogrammes und seine Finanzierung* (Bern: EDI, 1971), 8; Robert Ruckli, 'Der schweizerische Nationalstrassenbau', *Veröffentlichungen des Verkehrshauses der Schweiz* 20 (1972), 7.
12. 'Angesichts der grossen Verkehrsprobleme, welche sich in der modernen Industriegesellschaft stellen, ist die Erarbeitung einer Gesamtkonzeption der schweizerischen Verkehrspolitik sachlich und zeitlich vordringlich geworden' (Due to the big transport problems encountered in modern industrial society, the elaboration of an integral concept of Swiss transport policy has become an urgent need). Schweizerischer Bundesrat, 'Bericht des Bundesrates an die Bundesversammlung über die Richtlinien für die Regierungspolitik in der Legislaturperiode 1968–1971 (Vom 15. Mai 1968)', *Schweizerisches Bundesblatt* 1 (1968): 1247.
13. GVK-CH, ed., 'Bundesratsbeschluss vom 19.01.1972', in *GVK-Grundlagen* (Bern: GVK-CH, 1972), 1–3. In German, the SICT was called 'Gesamtverkehrskonzeption Schweiz (GVK-CH)'. The English translation and abbreviation originate from the only SICT document in English, a summary of the SICT final report from: Swiss Federal Department of Transport, Communications and Energy (SCIT), ed., *Summary of the Final Report of the Federal Commission for a Swiss Integral Concept of Transport* (Bern: EVED, 1979). Wherever possible, I will quote from this document. Quotes and citations from all other SICT reports will be given in German (where needed, I will provide translations). All SICT working papers and reports were published under the name of 'Kommission für die Schweizerische Gesamtverkehrskonzeption GVK-CH' (Federal Commission for a Swiss Integral Concept of Transport SICT). References will refer to GVK-CH as author.
14. Vorberatender Ausschuss der Kommission GVK-CH, *Bericht über die Vorbereitungsarbeiten zur Einsetzung einer Kommission für die Schweizerische Gesamtverkehrskonzeption an den Vorsteher des EVED* (Bern: EVED, 1971).
15. Schweizerischer Bundesrat, 'Bericht des Bundesrates über die Richtlinien für die Regierungspolitik 1968–1971', 1232: 'Die bedeutsame Aufgabe, eine Gesamtkonzeption der schweizerischen Verkehrspolitik zu erarbeiten, ist unabwendbar geworden. Da dabei Interessen der verschiedenen Verkehrsträger gegeneinander abzuwägen sind, müssen diese an der Aufgabe mitwirken, ebenso die Wirtschaftsverbände und die Wissenschaft' (The important task of elaborating an integral concept of Swiss transport policy has become unavoidable. Because the interests of the different transport modes must be balanced, their delegates as well as those of the economy and the sciences have to participate in the task).

16. SICT, *Summary of the Final Report*, 5.
17. For a list of all commission members and their designation, see GVK-CH, *Schlussbericht über die Arbeiten der Eidgenössischen Kommission für die schweizerische Gesamtverkehrskonzeption, erstattet zuhanden des Schweizerischen Bundesrates* (SICT Final Report) (Bern: EVED, 1977), 332–42.
18. The board was identical to the expert group who had done the pre-evaluation for SICT in 1971.
19. Swiss Federal Institute of Technology Zürich.
20. For a list of the commissioned works, see GVK-CH, *Schlussbericht*, 346–54.
21. Ulrich Klöti, 'Verkehr, Energie und Umwelt – Die Infrastruktur und ihre Begrenzung', in *Handbuch politisches System der Schweiz, Vol. 4: Politikbereiche*, ed. Gerhard Schmid (Bern: Haupt, 1993), 238.
22. Bundesratsbeschluss vom 19.01.1972, in GVK-CH, GVK-Grundlagen, §4: 'Die Gesamtverkehrskonzeption hat den politischen Behörden verschiedene Varianten gangbarer Wege aufzuzeigen, auf denen das System des privaten und öffentlichen Verkehrs derart der ständigen Entwicklung angepasst werden kann, dass folgenden Zielsetzungen entspricht: (a) Das Verkehrssystem soll auf optimale Weise der allgemeinen Wohlfahrt des Landes und den daraus abgeleiteten nationalen Aufgaben dienen […] (b) Das Verkehrssystem soll die Verkehrsbedürfnisse mit einem möglichst geringen zeitlichen und finanziellen Aufwand sowohl der Allgemeinheit als auch der Verkehrsteilnehmer […] befriedigen. (c) Das Verkehrssystem soll im Rahmen einer geordneten Siedlungsentwicklung die freie Wahl des Wohn-, Arbeits-, Einkaufs- und Erholungsortes sowie der Verkehrsmittel für Personen und Güter möglichst uneingeschränkt gewährleisten. (d) Das Verkehrssystem soll dem unverfälschten Wettbewerb so viel Spielraum belassen, als ohne Fehlinvestitionen einerseits und ohne Vernachlässigung unrentabler oder uninteressanter aber für die allgemeine Wohlfahrt wichtiger Verkehrsbedürfnisse andererseits möglich ist.'
23. A few years previously, this lack of federal competences in questions of urban transport had caused the failure of the planning process for urban expressways which should have been parts of the national highway system. See Blanc, *Die Stadt – ein Verkehrshindernis?* and Kammann, *Mit Autobahnen die Städte retten?*
24. See Peter Güller, 'Neuer Akzent: Europäische Vernetzung – Grenzen der Autonomie?', in *20 Jahre Gesamtverkehrskonzeption – wie weiter? Tagungsdokumentation T1 (Tagung vom 27.11.1997)*, ed. Felix Walter (Bern: EDMZ, 1998) (Berichte des NFP 41 'Verkehr und Umwelt'), 58–9.
25. J. Brian McLoughlin, *Urban and Regional Planning. A Systems Approach* (New York: Praeger, 1969), 91.
26. SICT, *Summary of the Final Report*, 7.
27. GVK-CH, *Schlussbericht*, 209–12.
28. Ibid., 309–19.
29. For an overview of the implementation of SICT propositions, see Hans Ulrich Berger et al., *Verkehrspolitische Entwicklungspfade in der Schweiz. Die letzten 50 Jahre* (Zürich: Rüegg, 2009); Ueli Haefeli, 'Der grosse Plan und seine helvetische Realisierung. Die Gesamtverkehrskonzeption 1972–1977 und ihre Wirkung auf die schweizerische Verkehrspolitik', *Schweizerische Zeitschrift für Geschichte* 56 (2006): 86–95; Walter, *20 Jahre Gesamtverkehrskonzeption*.
30. Ueli Haefeli seems to be the only historian who briefly touches some methodological aspects of the SICT: see Haefeli, 'Der grosse Plan und seine helvetische Realisierung', and Ueli Haefeli, *Verkehrspolitik und urbane Mobilität. Deutsche und Schweizer Städte im Vergleich 1950–1990* (Stuttgart: Franz Steiner, 2008), esp. 90–2. Some (rather anecdotal) remarks on the analytical and organizational methods of the SICT can be found in Walter, *20 Jahre Gesamtverkehrskonzeption*, esp. the articles by Jörg Oetterli, 3–12 and Carl Hidber, 13–18.
31. The abbreviation 'OR' for Operations Research/Operational Research has become commonplace in literature whereas the term Systems Analysis is almost never abbreviated. Following this convention I will use 'OR' and 'Systems Analysis' throughout the text.
32. It is not easy to distinguish the two concepts clearly as they draw on the same principles and stem from the same sources. Some authors use them fuzzily or even synonymously. See for example C. West Churchman, *The Systems Approach* (New York: Delta Book, 1968), and C. West Churchman, Russel L. Ackoff, and Leonard E. Arnoff, *Introduction to Operations Research* (New York: Wiley,

1957). According to McLoughlin, OR 'applies systems thinking via Systems Analysis to real-life situations'. McLoughlin, *Urban and Regional Planning*, 75.

33. Thomas P. Hughes and Agatha C. Hughes, *Introduction to Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After* (Cambridge, MA: MIT Press, 2000), 1.
34. See for example Stafford Beer, 'What has Cybernetics to do with Operational Research?', *Operational Research* 1 (1959): 1–21; Stafford Beer, *Cybernetics and Management* (London: The English Universities Press, 1959); Stafford Beer, *Decision and Control: The Meaning of Operational Research and Management Cybernetics* (London: Wiley, 1966); Churchman, Ackoff, and Arnoff, *Introduction to Operations Research*.
35. John E. Gibson, William T. Scherer, and William F. Gibson, *How To Do Systems Analysis* (Hoboken, NJ: Wiley, 2007), 7.
36. Ibid., 5.
37. Hughes and Hughes, *Introduction to Systems*, 1.
38. Philipp Semprevivo, *Systems Analysis: Definition, Process, And Design* (Chicago, IL: Science Research Associates, 1976), 7; see also Churchman, *Systems Approach*.
39. Edward S. Quade and Wayne I. Boucher, eds., *Introduction to Systems Analysis and Policy Planning: Applications in Defense* (New York: Elsevier, 1968), 2.
40. Wladyslaw Findeisen and Edward S. Quade, 'The Methodology of Systems Analysis: An Introduction and Overview', in *Handbook of Systems Analysis, Vol. I: Overview of Uses, Procedures, Applications, and Practice*, ed. Hugh J. Miser and Edward S. Quade (Chichester: Wiley, 1985), 117–49; Francis Heylighen and An Vranckx, 'Systems Analysis', in *Web Dictionary of Cybernetics and Systems*, http://cleamc11.vub.ac.be/ASC/SYSTEM_ANALY.html (accessed 20 August 2010).
41. Searching for the history of Systems Analysis and OR, one will find a multitude of short introductory chapters and synoptic paragraphs in text books on Systems Analysis and OR written by systems analysts and OR-practitioners. See for example James Digby, 'Operations Research and Systems Analysis at RAND, 1948–1967', *OR/MS Today* 15, no. 5 (1988): 10–13; Churchman, *Systems Approach*; Gibson, Scherer, and Gibson, *How To Do Systems Analysis*. Some aspects are covered in the historiography of Cybernetics and Systems Theory, for example in Andrew Pickering, 'Cybernetics and the Mangle: Ashby, Beer and Pask', *Social Studies of Science* 32, no. 3 (2002): 413–37; Michael Hagner and Erich Hörl, eds., *Die Transformation des Humanen. Beiträge zur Kulturgeschichte der Kybernetik* (Frankfurt am Main: Suhrkamp, 2008); Claus Pias, ed., *Cybernetics: Kybernetik – The Macy-Conferences 1946–1953, Vol. 2: Essays & Documents* (Zürich: Diaphanes, 2004); Hughes and Hughes, *Introduction to Systems*. More specifically on the history of Systems Analysis: Majone Giandomenico, 'Systems Analysis: A Genetic Approach', in *Handbook of Systems Analysis*, ed. Hugh J. Miser and Edward S. Quade (Chichester: Wiley, 1985), 33–66; Paul N. Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, MA: MIT Press, 1996), esp. chap. 4.
42. Churchman, *Systems Approach*, ix.
43. See for example Karl W. Deutsch, *The Nerves of Government: Models of Political Communication and Control* (London: Free Press of Glencoe, 1963); David Easton, *A Systems Analysis of Political Life* (New York: Wiley, 1965). These two instant classics and other works, such as Quade and Boucher, *Introduction to Systems Analysis*, inspired a large body of German literature on cybernetic and systems thinking in politics. See for example Wolf-Dieter Narr, *Theoriebegriffe und Systemtheorie* (Stuttgart: Kohlhammer, 1969); Eberhard Lang, *Zu einer kybernetischen Staatslehre: Eine Analyse des Staates auf der Grundlage des Regelkreismodells* (Salzburg: Anton Pustet, 1970); Dieter Senghaas, 'Systembegriff und Systemanalyse: Analytische Schwerpunkte und Anwendungsbereiche in der Politikwissenschaft', in *Texte zur Technokratiediskussion*, ed. Claus Koch and Dieter Senghaas (Frankfrut am Main: Europäische Verlagsanstalt, 1970), 174–95; Dieter Aderhold, *Kybernetische Regierungstechnik in der Demokratie: Planung und Erfolgskontrolle* (München: Günter Olzog, 1973); Wolfgang Haseloff and Herbert Schramm, *Kybernetik und Politik* (Frankfurt am Main: Moritz Diesterweg, 1976).
44. Although some of the pioneering work was done within the Chicago Area Transportation Study during the late 1950s and the early 1960s, Faludi emphasizes the British efforts calling them 'a

distinct school of thought'. Andreas Faludi, *Planning Theory* (Oxford: Pergamon Press, 1973), 39. See also J. Douglas Carroll et al., *Chicago Area Transportation Study. Final Report in Three Parts* (Chicago, IL: City of Chicago/State of Illinois/U.S. Department of Commerce, 1959–1962). The most prominent exponents of the 'British school' are J.K. Friend and W.N. Jessop, 'The Nature of Planning', in *Local Government and Strategic Choice. An Operational Research Approach to the Process of Public Planning*, ed. J.K. Friend and W.N. Jessop (London: Travistock, 1969), 101–14; McLoughlin, *Urban and Regional Planning*; J. Brian McLoughlin, *Control and Urban Planning* (London: Faber & Faber, 1973); George A. Chadwick, *A Systems View of Planning: Towards a Theory of the Urban and Regional Planning Process* (Oxford: Pergamon, 1971).

45. The theoretical concepts of Cybernetics, OR and the Systems approach had left their traces in German reference works used by planners between 1960 and 1970: see for example Erwin Grochla, ed., *Handwörterbuch der Organisation* (Stuttgart: Poeschel, 1969); Akademie für Raumforschung und Landesplanung, ed., *Handwörterbuch der Raumforschung und Raumordnung* (Hannover: Gebrüder Jänecke Verlag, 1st ed. 1966, 2nd ed. 1970). For a critical review of international planning literature advocating the Systems view of planning, see Jakob Maurer, *Literaturnotizen zur Raumplanung. Schriftenreihe zur Orts-, Regional- und Landesplanung, vol. 20* (Zürich: ORL, 1974).
46. McLoughlin, *Urban and Regional Planning*, 91.
47. For Germany, see for example Werner Holste, 'Möglichkeiten und Grenzen bei der Planung des Systems Verkehr', in *Das gesellschaftliche Leitbild für den Verkehr der Zukunft und die Aufgabe koordinierter Planung. Schriftenreihe der Deutschen Verkehrswissenschaftlichen Gesellschaft DVWG, vol. B9: Kolloquium III – Saarbrücken*, ed. Deutsche Verkehrswissenschaftlichen Gesellschaft (DVWG) (Köln: DVWG, 1970), 69–90.
48. McLoughlin, *Urban and Regional Planning*, 91.
49. Michael Hascher, *Politikberatung durch Experten: Das Beispiel der deutschen Verkehrspolitik im 19. und 20. Jahrhundert* (Frankfrut am Main: Campus, 2006), 287–9; Hellmuth S. Seidenfuss, 'Möglichkeiten einer wissenschaftlichen Begründung der neuen Verkehrspolitik in der Bundesrepublik Deutschland', *ÖVG Verkehrsannalen* 25, no. 1 (1978): 7–19.
50. Aderhold, *Kybernetische Regierungstechnik in der Demokratie*, 10–11.
51. Andreas Faludi and Arnold van der Valk, *Rule and Order: Dutch Planning Doctrine in the Twentieth Century* (Dordrecht: Kluwer Academic, 1994), 115.
52. However, the systems approach had been involved with the formulation of the 'Landesplanerische Leitbilder der Schweiz' (Switzerland's General Concept for Spatial Planning) and the 'Teilleitbild Verkehr CK-73' by the ORL-Institute of ETH Zürich. See Martin Rotach et al., ed., *Landesplanerische Leitbilder der Schweiz: Schlussbericht*, 3 vols (Zürich: ORL-Intitut EHT Zürich, 1971); Martin Rotach, *Raumplanerisches Leitbild der Schweiz CK-73: Eine Grundlage für das Gespräch zwischen Bund und Kantonen* (Bern: EJPD, 1973). See also Carl Hidber, 'Gesamtverkehrskonzeption und Leitbild ‹CK-73›', *Raumplanung Schweiz* 3, no. 3 (1974): 27–30. Hidber, who was professor at the ORL Institute, had been the main author of the transport part of the CK-73 concept, as well as several of the SICT staff members who had worked with the ORL Institute and had been involved with both concepts. At a regional scale, a study for Lausanne employed a form of organization and systems methodology very similar to that of the SICT. See Milan Crvčanin, 'Application de modèles intégrés à la planification des systèmes de transports de la région lausannoise', *Swiss Journal of Economics and Statistics* 109, no. 3 (1973): 357–73, esp. 368–70.
53. Faludi, *Planning Theory*, 39.
54. The only exception I found to date is the bibliography of a commissioned report by Alfred J. Gebert, *Politikwissenschaft und Verkehr: Erstellung einer Übersicht der für die GVK-CH massgebenden politologischen Literatur, GVK-Auftrag Nr. 11* [Political science and transport: A review of SICT-relevant literature in political science, SICT-commission no. 11] (Bern: EVED, 1973), where some aspects of Cybernetics, Systems Theory and Systems Analysis are alluded to in a political context.
55. GVK-CH, *Systemabgrenzung GVK-CH, Arbeitsunterlage Nr. 3* (Bern: EVED, 1973); GVK-CH, *Zusammenstellung von Problemen einer schweizerischen Gesamtverkehrskonzeption: Aufgrund der Beratung der Kommission GVK-CH überarbeitete Fassung des geschäftsleitenden Ausschusses. Arbeitsunterlage Nr. 2* (Bern: EVED, 1973); GVK-CH, *Systemanlayse. Arbeitsunterlage Nr. 5* (Bern: EVED, 1972), 1–2.

56. GVK-CH, *Schlussbericht*, 61–4; GVK-CH, *Operationales Ziel- und Messystem für die GVK-CH. Arbeitsunterlage Nr. 16* (Bern: EVED, 1974).
57. SICT, *Summary of the Final Report*, 11–13.
58. 'In der Verkehrsplanung […] soll nicht mehr dem aus der Vergangenheit abgeleiteten Trend vorbehaltlos zum Durchbruch verholfen werden, sondern an erster Stelle steht die Festlegung von Zielen und Massnahmen, welche die Erreichung der Ziele gewährleisten sollen (zielorientiertes Planen)' [Transport planners should not try to realize trends derived from the past unchallenged. Rather, they should define goals and measures to ensure their realization (goal-oriented planning)]. GVK-CH, *Leitstudie GVK-CH. Teil I: Grundlagen, Methodik und bisherige Verkehrspolitik* [SICT Pilot Study, Vol. I: Foundations, methodology and previous transport policy] (Bern: EVED, 1978), 9–10.
59. GVK-CH, *Leitstudie GVK-CH*, 3 vols (Bern: EVED, 1978).
60. SICT, *Summary of the Final Report*, 13.
61. GVK-CH, *Hauptstudie GVK-CH: Basisvarianten* [SICT Main study: Basic alternatives] (Bern: EVED, 1977).
62. SICT, *Summary of the Final Report*, 13. To evaluate the Basic (and later the Final) Alternatives, the SICT staff applied the OR concept of value analysis which allowed (in contrast to the customary cost/benefit analysis) the comparison of monetary quantitative aspects with non-monetary qualitative aspects. SICT, *Summary of the Final Report*, 18.
63. GVK-CH, *Schlussbericht*, 73–110.
64. Fernando Elichirigoity, *Planet Management: Limits to Growth, Computer Simulation, and the Emergence of Global Spaces* (Evanston, IL: Northwestern University Press, 1999), 12.
65. SICT, *Summary of the Final Report*, 17. The method of four-step modelling was first developed for the Chicago Area Transportation Study (see Note 44). During the 1960s it was refined and, by the 1970s, had become one of the standard tools of transport planners in the USA and Europe. For a detailed account of its development, see Roger L. Creighton, *Urban Transportation Planning* (Urbana, IL: University of Illinois Press, 1970), esp. 245–67. On its diffusion to Britain, see William Solesbury and Alan Townsend, 'Transportation Studies and British Planning Practice', *Town Planning Review* 41, no. 1 (1970): 63–79. See also Juan de Dios Ortúzar and Luis G. Willumsen, *Modelling Transport*, 3rd ed. (Chichester: Wiley, 2006), 23–5; Werner Schnabel and Dieter Lohse, *Grundlagen der Strassenverkehrstechnik und der Verkehrsplanung. Vol. 2: Verkehrsplanung*, 2nd ed. (Berlin: Verlag für Bauwesen, 1997), 204–14; Carl Hidber et al., *Verkehrsplanung: Vorlesungsunterlagen des Instituts für Verkehrsplanung, Transporttechnik, Strassen- und Eisenbahnbau*, 3rd ed. (Zürich: IVT, 1985), 3.22–3.59.
66. SICT, *Summary of the Final Report*, 17. A considerable part of the used models had been developed and simulated with the software TRIPS (Transportation Improvements Programming System) by the engineering firm Jenny + Voorhees in Zürich and was run on the computer of the University of Zürich (SICT research commissions 4, 33, 33, 41, 43, 53, 66, 86, 96, 99d, 105, 115, 123). TRIPS had been developed by Alan M. Voorhees, one of the most prominent transport planners in the USA during the 1950s and 1960s. It bundled more than 50 programmes carrying out different stages of the four-steps-model. See Crvčanin, *Application de modèles intégrés*, 368. Other models (for example potential and distribution models for domestic freight transport) were made by the SICT staff and the Institute for Transport Planning and Systems at ETH Zürich, where Hidber had his chair.
67. SICT, *Summary of the Final Report*, 16.
68. Ibid., 18.
69. Ibid.
70. The bill was passed to the parliament in December 1982, Schweizerischer Bundesrat, 'Botschaft über die Grundlagen einer koordinierten Verkehrspolitik (Teilrevision der Bundesverfassung) (Vom 20. Dezember 1982)', *Schweizerisches Bundesblatt* 1 (1983): 941–1061.
71. Alexander Schmidt-Gernig, 'Das "kybernetische Zeitalter": Zur Bedeutung wissenschaftlicher Leitbilder für die Politikberatung am Beispiel der Zukunftsforschung der 60er und 70er Jahre', in *Experten und Politik: Wissenschaftliche Politikberatung in geschichtlicher Perspektive*, ed. Stefan Fisch and Wilfried Rudloff (Berlin: Duncker & Humblot, 2004), 349–68.
72. On the relations of utopia, politics and planning, see for example Barbara Goodwin and Keith Taylor, *The Politics of Utopia. A Study in Theory and Practice* (Oxford: Peter Lang, [1982] 2009); Dirk van

Laak, 'Planung: Geschichte und Gegenwart des Vorgriffs auf die Zukunft', *Geschichte und Gesellschaft* 34 (2008): 305–26; Robert Jungk and Josef Mundt, eds., *Der Griff nach der Zukunft: Planen und Freiheit* (München: Kurt Desch, 1964); Helmut Klages, *Planungspolitik: Probleme und Perspektiven der umfassenden Zukunftsgestaltung* (Stuttgart: Kohlhammer, 1971). The idea of applying Cybernetics to political processes is traced back to the French physicist André-Marie Ampère who sketched his idea of 'Cybernétique' as a knowledge-based 'art of governing the state' in the middle of the nineteenth century. See André-Marie Ampère, *Essais sur la philosophie des Sciences ou exposition analytique d'une classification naturelle de toutes les sciences. Seconde Partie* (Paris, 1843), 140–143. See also Lang, *Zu einer kybernetischen Staatslehre*, 110–12; Joseph Vogl 'Regierung und Regelkreis. Historisches Vorspiel', in *Cybernetics: Kybernetik*, ed. Claus Pias, 67–79.

73. On the thought style of technocracy, see Hermann Lübbe, 'Technokratie. Politische und wirtschaftliche Schicksale einer philosophischen Idee', *WeltTrends* 18, no. 1 (1998): 39–61; Pietro Morandi, 'Zur Geschichte und Theorie der Technokratie', *Berliner Debatte INITIAL* 8, no. 3 (1997): 117–26; Koch and Senghaas, *Texte zur Technokratiediskussion*; Hans Lenk, ed., *Technokratie als Ideologie: Sozialphilosophische Beiträge zu einem politischen Dilemma* (Stuttgart: Kohlhammer, 1973).
74. The expression 'machine à gouverner' was first used by French Abbé Louis Dubales in his 1948 review (Le Monde, 28 December 1948) of Norbert Wiener's book *Cybernetics: Or the Control and Communication in the Animal and the Machine* (Cambridge, MA: MIT Press, 1948).
75. Pierre Bertaux, *Maschine-Denkmaschine-Staatsmaschine: Entwicklungstendenzen der modernen Industriegesellschaft* (Hamburg: Decker's Verlag, 1963); Pierre Bertaux, *Mutation der Menschheit: Diagnosen und Prognosen* (München: Scherz, 1963), esp. 110–15; Pierre Bertaux, 'Denkmaschinen, Kybernetik und Planung', in *Der Griff nach der Zukunft: Planen und Freiheit*, ed. Robert Jungk and Josef Mundt (München: Kurt Desch, 1964), 51–81.
76. Johan Hendrik Jacob van der Pot, *Die Bewertung des technischen Fortschritts: Eine systematische Übersicht der Theorien*, Vol. 1 (Assen: van Gorcum, 1985), 342–4 gives a summary of this debate.
77. For summarizing accounts on that debate, see for example Koch and Senghaas, *Texte zur Technokratiediskussion*; Klages, *Planungspolitik*, esp. 52–7; Lenk, *Technokratie als Ideologie*; Haseloff and Schramm, *Kybernetik und Politik*.
78. SICT proposition 3, SICT, *Summary of the Final Report*, 61.
79. SICT proposition 2, Ibid.
80. SICT proposition 20, Ibid., 66.
81. SICT propositions 20–24, Ibid., 66–7.
82. SICT propositions 9–11, Ibid., 63.
83. SICT propositions 12–16, Ibid., 64–5.
84. SICT propositions 25–30, Ibid., 67–8.
85. SICT propositions 17–19, Ibid., 65–6.
86. SICT propositions 31–35, Ibid., 69–70.
87. SICT propositions 36–40, Ibid., 70–1.
88. GVK-CH, *Presseorientierung Abschluss GVK-CH. Pressespiegel per 22.05.1978* (Bern: EVED, 1978) (Schweizerisches Bundesarchiv, Sign. E8001C-A.04.12-414).
89. SICT, *Summary of the Final Report*, 6.
90. Werner Schobinger, *Programmatische Aussagen zur schweizerischen Verkehrspolitik: Zusammenstellung von Absichtserklärungen, Forderungen und Postulaten von Behörden, Parteien, Parlamentariern, Verbänden, Organisationen und Wissenschaftern. GVK-Auftrag Nr. 60* (Bern: EVED, 1975) gives a comprehensive summary of the political positions and programmatic statements of the Swiss government, Federal authorities, political parties, lobby groups and associations.
91. Wolf Linder et al., *Detail-Analyse der Volksabstimmung über die Koordinierte Verkehrspolitik KVP: Studie im Auftrag des Stabs für Gesamtverkehrsfragen* (Bern: Forschungszentrum für Schweizerische Politik der Universität Bern, 1988), 24, 35 and appendices 7.1–7.4.
92. GVK-CH, *Zusammenfasssung der Ergebnisse des Vernehmlassungsverfahrens zum Schlussbericht über die Schweizerische Gesamtverkehrskonzeption* [Synopsis of the statements given in the process of consultations ('Vernehmlassungsverfahren')] (Bern: EVED, 1980), 13 passim.
93. GVK-CH, *Zusammenfasssung der Ergebnisse des Vernehmlassungsverfahrens*, 13, 23–4.

94. Although only 54.5% of the electorate voted no, a clear majority of the cantons (19 of 26) had voted against the KVP bill. See Hans Hirter et al., 'Infrastruktur und Lebensraum – KVP', *Année politique Suisse* 24 (1988): 138–40. The question whether the 9% margin by which the KVP was rejected should be regarded as wide or narrow was intensively debated after the referendum. Those in favour of KVP interpreted it a narrow outcome of the referendum and argued that it should not be seen as general rejection of the original SICT proposals.
95. For a general account on the problems to legitimate systems-based planning, see for example Horst Rittel and Melvin M. Webber, 'Dilemmas in a General Theory of Planning', *Policy Sciences* 4 (1973): 155–69.
96. See Damir Skenderovic, 'Umweltschutzbewegung im Zeichen des Wertewandels', in *Rechte und linke Fundamentalopposition: Studien zur Schweizer Politik 1965–1990*, ed. Urs Altermatt (Basel: Helbing & Lichtenhahn, 1994), 33–61, esp. 50–1.
97. Wolf Linder, 'Die GVK als politisches Lehrstück', in *20 Jahre Gesamtverkehrskonzeption – wie weiter? Tagungsdokumentation T1 (Tagung vom 27.11.1997)*, ed. Felix Walter (Bern: EDMZ, 1998), 29–31.
98. Paul N. Edwards, 'Global Comprehensive Models in Politics and Policymaking', *Climatic Change* 32, no. 2 (1996): 149–61.
99. Ibid., 150.
100. Abstracting Latour, Edwards described the realization process of technical projects as follows: '[…] projects begin as fictions – concepts, narratives, texts – seeking realization. As they gather commitment and financial support, they "gain reality". Successful projects produce fully real objects; subsequently, participants tend to agree on a single account of that object's creation and its nature. By contrast, the technological objects envisaged by projects that, like Aramis, eventually fail ultimately "lose reality". Without a stable object to unify the viewpoints of the participants, their accounts never converge.' Paul N. Edwards, 'Review of Aramis, or the Love of Technology, by Latour, Bruno', *Isis* 88, no. 2 (1997): 322–4, here 323. Interestingly, the SICT's process of 'gaining' and 'losing' reality through network-building looks very similar: a network was established whose actors welded concepts, plans and models into a planning concept 'gaining reality'. The network failed to maintain its links though and was therefore unable to 'unify the viewpoints' and bring the SICT to realization. Nevertheless, many of the SICT propositions were not so much 'losing reality' but were merely slowed down in their realization.