

## Development of the Transit Transport System and its Impact on Spatial Development in Switzerland (COST 340)

### Are Swiss traffic and land use policy consistent?

M. Tschopp  
P. Keller  
Ph. Fröhlich  
K. W. Axhausen

Conference paper STRC 2004

March 25-26, 2004

**STRC**

4<sup>th</sup> Swiss Transport Research Conference  
Monte Verità / Ascona, March 25-26, 2004

## Abstract

We know the problem of population losses in peripheral alpine regions as well as about the urban sprawl in the Mittelland. But the impressions often are not quantified and therefore subjective. The slow, steady process aggravates the difficulties of cognition additionally. About the spatial consequences not a lot is known. Only when we look at historic images of now built landscapes, we understand how tremendously our habits, our living space, the whole environment in which we live has changed through the last decades.

The goal of the paper and presentation is to make in the first part general statements about the accessibility, its development and its spatial patterns. Following questions are of interest: When did the accessibility grow? Where did accessibility grow and how did accessibility grow? In a second part we analyse spatial planning in Switzerland in the last 50 years. This leads us to a conclusion in which we discuss the interaction between accessibility, settlement and spatial planning.

The population data come from the censuses of 1950 – 2000. The extended time frame leads to some minor problems regarding the analyses and the mapping of the results. In the canton of Thurgau municipalities have been divided or merged; these changes are not considered within this data set.

The work is part of the project „Development of the Transit Transport System and its Impact on Spatial Development in Switzerland“, conducted within the framework of Action 340 of the European Co-operation in Scientific and Technical Research (COST) consortium, entitled „Towards a European Intermodal Transport Network: Lesson from history“. The focus in this paper is the on demographic aspect, as discussed above.

The presentation will be structured as followed:

- Accessibility of public and individual transportation
- Development of accessibility
- Accessibility, settlement patterns and spatial planning
- Discussion and Outlook

# 1 Improvement of accessibility

## 1.1 Accessibility: a definition

In this chapter populations connection shall be analysed. How can the inhabitants be reached? What accessibility does each municipality has?

In the present work, accessibility is defined as in Geurs and Ritsema van Eck, 2001:

“...the extent to which the land-use transport system enables [groups of] individuals or goods to reach activities or destinations by means of a [combination of] transport mode[s].

$AccPop_i$	accessibility to people living in municipality $i$
$A_j$	the number of residents of municipality $j$
$c_{ij}$	travel time by private vehicle between the municipality $i$ and municipality $j$
$\beta$	exponent

$$AccPop_i = \sum_{j=1}^{j=2903} A_j * \exp(-\beta * c_{ij})"$$

This “potential approach” weights attractiveness of the activity points with the necessary travel time to these points by mean of a negative potential function.

## 1.2 Comparison of accessibility of public and individual transportation

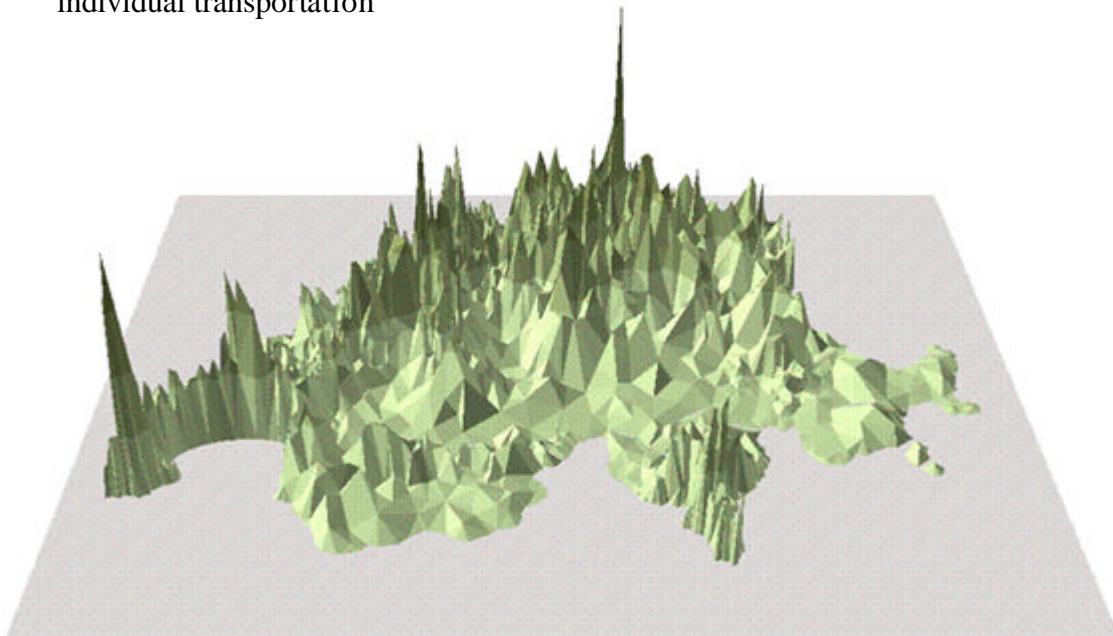
In 2000 the locations within the highest quintile of accessibility values for motorised individual transportation (MIT) are concentrated in a circular area around Zurich including Bülach, Olten and the northern part of lake of Lucerne (see figure 1). Around Bern, a cross-shaped

area with municipalities of high accessibility can be seen, reaching from Biel to Thun and from Solothurn to Fribourg. Around Lake Geneva, the distribution includes two main peaks, Genève and Lausanne, and two additional peaks at Vevey and Nyon.

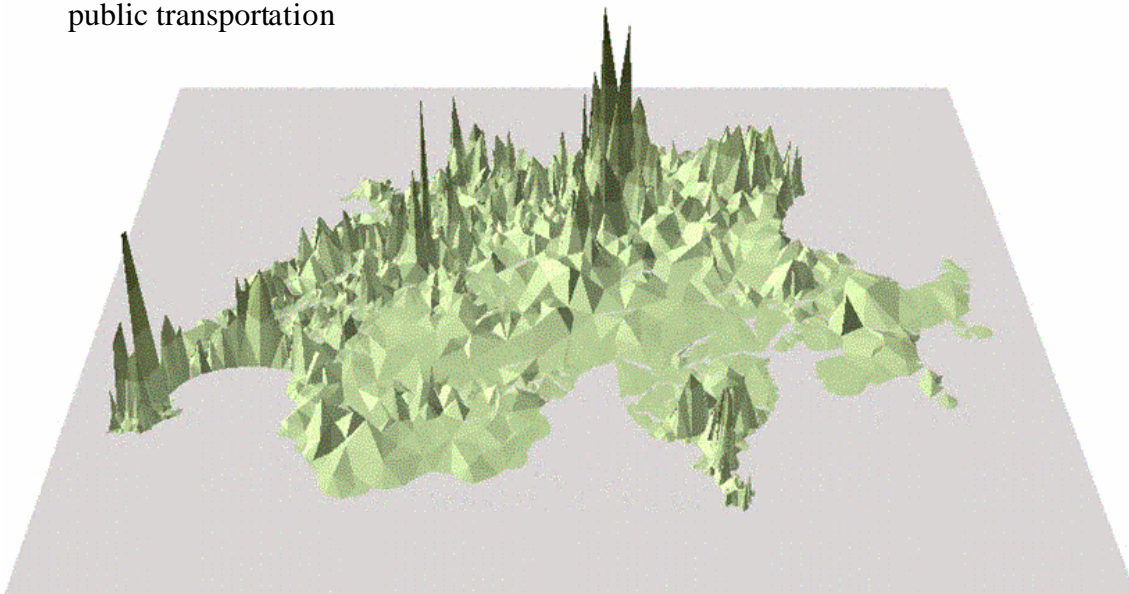
Figure 1 Accessibility 2000: Difference individual and public transport

---

individual transportation



public transportation



For accessibility for public transportation (PT) a similar view can be seen (Figure 1): In 2000 the locations within the highest accessibility values for individual transportation are concentrated also in a circular area around Zürich, but on a much lower level now. Around Lake Geneva, again two main peaks can be seen: Genève and Lausanne. Generally a massive disadvantage of rural, alpine areas can be seen. Only the Zurich area shows a more or less similar degree of accessibility of road and railroad access.

### **1.3 Comparison of accessibility development of public and individual transportation**

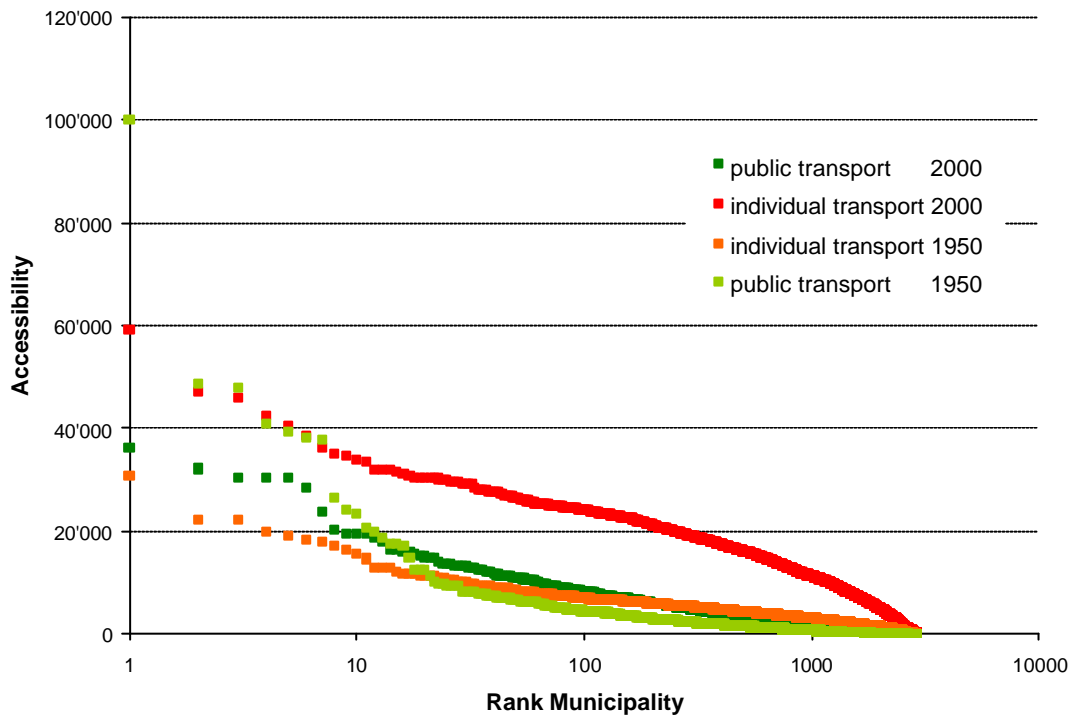
Focusing on MIT the last 50 years were influenced by the build up of the motorway network and bypasses in larger municipalities. This is a reaction on the chronic congested road network, on a principle of bottleneck abolishment.

The construction of the motorway network in Switzerland had huge consequences on the accessibility of the regions. Figure 2 shows a rank-size diagram with all municipalities in Switzerland. The x-axis shows the rank of a municipality, the y-axis the calculated value of accessibility.

Comparing the on road accessibility in 1950 with the accessibility 50 years later a dramatic increase can be stated. Interestingly this increase was relatively homogenous. The slope of the curve didn't increase. One reason may be Swiss federalism, where all regions shall be accounted.

Comparing the development of PT accessibility, which was 1950 comparable with MIT accessibility, the regression curve isn't much higher 50 years later, also the slope remained more or less the same. The network of PT did develop to a lesser extent as the network remained basically the same.

Figure 2 Accessibility development: Difference individual and public transport



#### 1.4 Where did accessibility increase?

In this paragraph the question where the growth of accessibility took place is in the centre of interest. For comparing the accessibility development of MIT and PT, their relation is calculated as follows:

$$DF = \frac{\frac{API_t}{APP_t}}{\frac{API_{t-1}}{APP_{t-1}}} \quad (1)$$

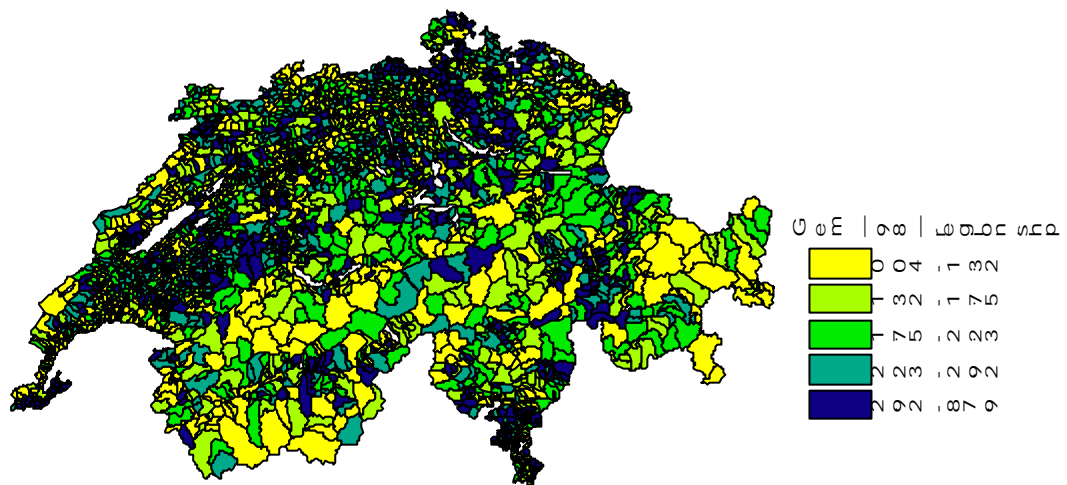
where:  $DF$  = Development factor public vs. individual transportation  
 $API_t$  = Accessibility of MIT in 2000  
 $API_{t-1}$  = Accessibility of MIT in 1950  
 $APP_t$  = Accessibility of PT in 2000  
 $APP_{t-1}$  = Accessibility of PT in 1950

$DF > 0$  : the relative development of individual transport system is higher than the relative development of the public transport system.

$DF < 0$  : the relative development of public transport system is higher than the relative development of the individual transport system.

In 2000 a heterogeneous development in Switzerland can be seen (figure 3). The major urban areas Zürich, Bern, Basel and Genève had a clear advantage of MIT accessibility development over the other parts of Switzerland (blue areas). The only area of higher PT accessibility development in the Mittelland is a narrow band along the major railroad lines spreading between Zürich and Bern, between Zürich and Basel respectively. With the exception of the Rhône valley, large parts of the mountainous regions have low DF values. Interesting are the blue areas around Zurich, where, even with the initialisation of the S-Bahn in the early nineties, the advantage of MIT accessibility did develop to a higher extent.

Figure 3 Accessibility development: Difference individual and public transport





## **2 Spatial development and planning**

### **2.1 Goal adverse trend development**

The represented development and distribution of the population in space and time is characterised in the last five decades by a progressive dispersion. With it are connected:

- increasing land consumption (table 1, table 2)
- increase of the distances (table 3)
- temporal and spatial dispersion of the traffic streams
- Increase of the portion of the motorized individual traffic debited to public traffic (table 4)
- rising costs of the building and maintenance of the technical infrastructure of traffic, energy and disposal
- harmful immissions for humans and environment
- impairment of urban and natural sceneries.

## 2.2 Development of land consumption

Table 1 Settlement and urban areas (Nettosiedlungsflaeche (NSF)): Comparison between variants of Swiss National Development Concepts (V1, V4, V9) and the reality (~2000)

	NSF-portion [%] of total surface			NSF-portion [%] of surface suitable for settlement		
	Z <sub>0</sub> (1960)	Z <sub>1</sub> (~2000)	Z <sub>2</sub>	Z <sub>0</sub> (1960)	Z <sub>1</sub> (~2000)	Z <sub>2</sub>
Trend	2.30	3.47	4.63	7.99	12.05	16.11
V1	2.30	3.48	4.65	7.99	11.30	16.17
V4	2.30	3.46	4.63	7.99	12.02	16.10
V9	2.30	3.42	4.57	7.99	11.88	15.88
reality	2.30	~ 6.8	.	7.99	n.i.	.

Source: ORL (1971c): 63-87, 88-114

Table 2 Settlement and urban areas (Nettosiedlungsflaeche (NSF)): Comparison between variants of Swiss National Development Concepts (V1, V4, V9) and the reality (~2000)

	NSF [ha]			NSF/E [m <sup>2</sup> /inh]		
	Z <sub>0</sub> (1960)	Z <sub>1</sub> (~2000)	Z <sub>2</sub>	Z <sub>0</sub> (1960)	Z <sub>1</sub> (~2000)	Z <sub>2</sub>
Trend	94'515	142'460	190'425	180	~ 180	~ 180
V1	94'515	143'070	191'123	180	~ 180	~ 180
V4	94'515	142'099	190'373	180	~ 180	~ 180
V9	94'515	140'455	187'806	180	~ 180	~ 180
reality	94'515	279'095 <sup>1</sup>		180	~ 400 <sup>2</sup>	.

Source: ORL (1971c): 61-87  
 ORL (1971a): 162-164  
 Land use statistics 1992/97 (BFS 2001)  
 BFS (1994 & 1999)

Table 3 Average total distance per person and day

	total distance per person and day [km]
1984	29.4
1989	33.1
1994	34.0
2000	38.1

Source: BFS & ARE (2001): 76

<sup>1</sup> NSF<sub>2000</sub> = inhabitants (average) 1992/97 (BFS, 2001)

<sup>2</sup> NSF/E<sub>Z1</sub> = inhabitants (average) 1992/97 (BFS, 2001) / at the end of 1992 and 1997 (BFS 1994 & 1999)

Table 4 Portions of motorised individual Traffic (MIT) and public transit (PT) to total daily distances in the transportation of persons

	Portion MIT [%]	Portion PT [%]
1984	68.4	18.7
1989	66.7	19.5
1994	69.7	18.2
2000	69.4	17.9

Source: BFS & ARE (2001): 77

These and further trends contradict strikingly to the goals fixed in constitution and law:

- spatial planning: "appropriate and economical land consumption and controlled settlement of the country" (BV 1999/2003: Art. 75<sup>1</sup>; RPG, 1979/2003: Art. 1<sup>1</sup>)
- environmental protection: "protection of humans and its natural environment from harmful or annoying effects" (BV 1999/2003: Art. 74<sup>1</sup>)
- sustainable development: "a in the long term balanced relationship between nature and its renewal ability on the one hand and their demand by humans on the other hand" (BV 1999/2003: Art. 75).

Despite various instruments on every three state levels the spatial, traffic and environmental planning did not succeed in yet causing a change of trend to achieve let alone the stipulated goals.

## 2.3 Development of population

The population development will be described with a shift analysis. A shift analysis compares the development of a municipality with the total development. It allows both, a cross-section and a longitudinal section analysis as follows:

$$R = \frac{b_t}{b_0} : \frac{B_t}{B_0}$$

where

R = Regional factor

$b_{t,t-1}$  = Population in a municipality at time t, t-1 respectively

$B_{t,t-1}$  = Population in Switzerland at time t, t-1 respectively

$R = 1$  Population development on a municipal level is equal to the population development in Switzerland

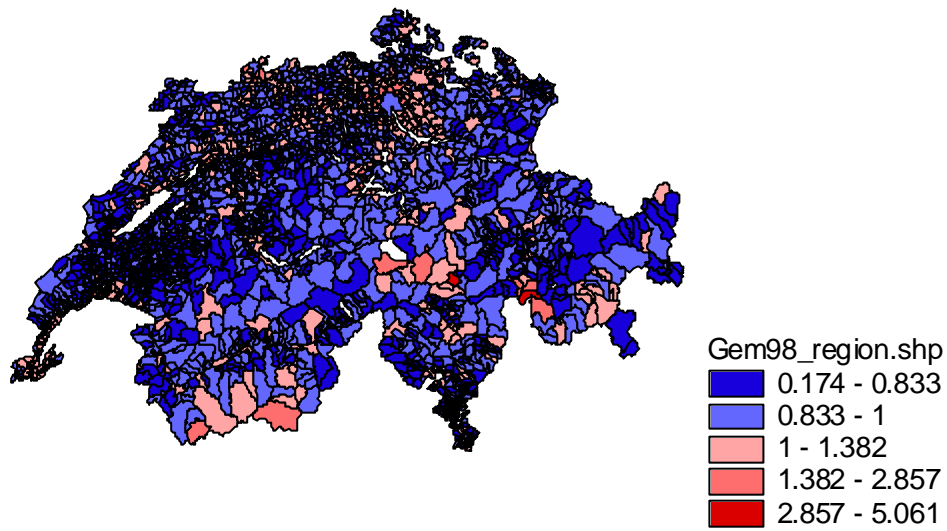
$R > 1$  Population development is above average

$R < 1$  Population development is below average

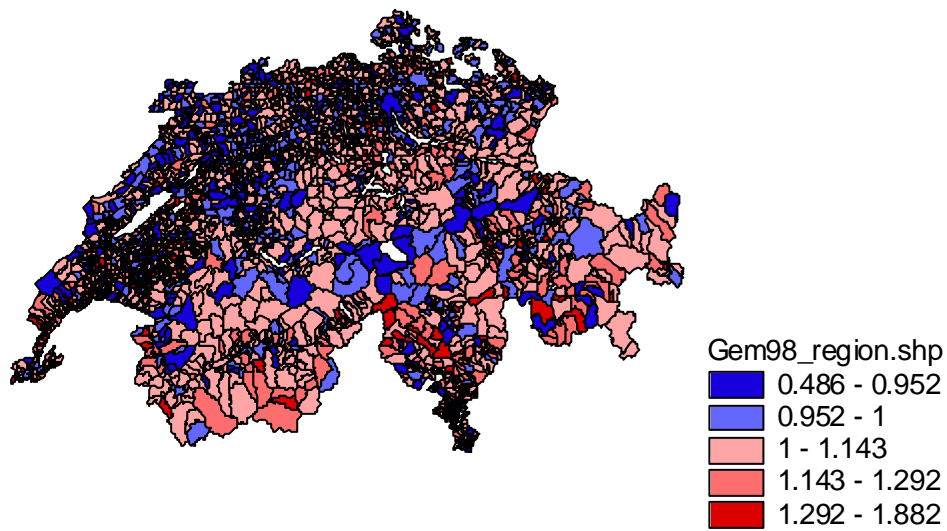
In Figure 4 a shift analysis for each municipality in Switzerland for 1960 and in the year 2000 is visualised. The differences are striking: Meanwhile in 1960 the above average municipalities are concentrated on the suburban areas in large agglomerations in the Swiss Mittelland, in 2000 municipalities with over average values are everywhere, the below average municipalities are concentrated in some alpine areas as well as in the inner circles of the agglomerations.

Figure 4 Shift analysis: Population development

1960 (compared with 1950)



2000 (compared with 1990)



## 2.4 Weaknesses of today's spatial planning

In the recent past there were several attempts to place development and shaping of our habitat on a load-carrying on a conceptual basis:

- the "Swiss National Development Concepts" (ORL, 1971a-d)
- the "National Development Concept of the conference of federal chief officials (CK-73)" (DRP, 1974),
- the "Transportation concept of Switzerland (GVK)" (GVK, 1977)
- the "Swiss Planning Policy Guidelines" (BRP, 1996).

As different as these planning bases might be, they all have an anti-thesis to the progressive disurbanisation in common. Terms like "decentralized concentration" (Swiss National Development Concepts) or "network of interlinked towns" (Swiss Planning Policy Guidelines) or "The proportion of total traffic volumes accounted for by public and non-motorized transport is to be increased" (Bundesrat, 2002: 29) refer to the desired trend reversal. A goal or starting point of these concepts are assumptions about the future distribution of population and jobs. For the conversion of the concepts are legislator has added the conventional instruments of municipal land use planning with special coordinative and programmatic instruments for a timely and appropriate realisation of the conceptual objectives (e.g. cantonal directive plans, federal concepts and special plans) with consideration of collective aspects.

In the planning and political reality of the conversion of the concepts these attempts are not able to unfold the desired effect. Local-regional and economic desires, sensitivities and ownership rights oppose to the conceptual synopsis. In place of a priority and a posteriority setting regarding the spatial distribution of the population trend or the accessibility, necessary for each arranging planning, a usual little reflected requirement for equality takes place. Instead of concentrating the population growth and the settlement in suitable areas and to create thus favourable conditions for an efficient construction and operation of the technical infrastructure as well as for an economical use of the soil in the interest of the public interest, the desires of regions and municipalities are satisfied as well as by property owners after as large a portion of the population and job growth as possible. Above all the development of the road system takes is influenced by the current or future demand (bottleneck removal) and not by super ordinate goals of the spatial development. Such an infrastructure policy strengthens un-

wanted trend developments of settlement and modal split. The result of this development is a settlement growth braked almost only by topographic obstacles into the surface with all negative results.

## 2.5 Change of spatial planning in the last 50 years

The weaknesses of the spatial planning policy and the spatial planning isn't only the result of inability of planners and politicians involved. Rather they are the result of a drastic paradigm change in the spatial planning.

The spatial planning in the 70's was in Switzerland like in other European countries shaped by the requirement of a comprehensive planning what's concerning content and space. The concepts at that time are characterised by two main characteristics:

- On the one hand they are based on thematically broad and deep analyses of the past as well as the possible future, space relevant developments (settlement, landscape, transport and supply, demography, production and productivity, economics, mobility, society, politics (ORL 1971a-b).
- On the other hand they are thematically broadly and content wise consistently put on. The conceptional statements to settlement, landscape as well as transportation and supplying structures are one on the other and with the accepted demographic, economic and social boundary conditions co-ordinated.

In recent time a progressive shift of spatial planning from concept orientation to project orientation is to determine in Switzerland as well as in other European countries (Schretzenmayr, 1996). Settlement, landscape and traffic planning has become independent to a large extent and detach of super ordinate objectives. Instead of the co-ordination of space effective measures on the basis of a super ordinate, conceptual synopsis, often planning is influenced by a muddling through steps forward, determined by local-regional practical constraints and particularistic interests. Even largest projects ("century projects") as for example the New Rail Link through the Alps (NRLA) are justified largely and developed due to field of activity and department-specific necessities (bottleneck removal, shift from road to rail, safety improving, pollution control, etc.). Systematic ex-ante-analyses of the possible long-term effects on the settlement and landscape development as well as demographic, economic and social implications are missing widely.



The synopsis, necessary for an effective, horizontal and vertical co-ordination of space effective activities, additionally still by the helvetic federalism. The competence for the spatial planning lies with the cantons, while the federation can specify only principles (BV, 1999/2003): Art. 75<sup>1</sup>). The Swiss planning system with 26 cantonal directive plans and nearly 3000 local land use plans compromises in the long run the principal purposes of the spatial planning fixed in the convention: "appropriate and economical use of the soil and [...] controlled settlement of the country" (BV, 1999/2003: Art. 75<sup>1</sup>). In some cantons these objectives do not even seem to be an urgent topic. The Federal Office for Spatial Development is about to formulate suggestions for a strengthening of the federation for the accomplishment of the core demand of the Swiss federal spatial planning law. They will be submitted next year - together with a report over 15 years spatial development in Switzerland - to the government and the parliament (Holenstein, 2004). The demand for more central power in the spatial planning contradicts however the today's trend. Liberalisation and shifting the authority downwards are in the centre of the recent political debate.

## 2.6 Conclusion

The spatial development (settlement and infrastructure) of the last decades contradicts obviously to the goals specified in convention and law. Spatial accessibility was tremendously improved by the development of the traffic systems. The conditions for a substantial expansion of the settlement were created in particular by the development of the road system. The misalignment of the traffic of public on individual means of transport was simultaneous one of the most important consequences of this development and condition for their continuation with all further negative results.

For this vicious circle responsible is a paradigm change in the spatial planning: Instead of a conceptual synopsis, independently realisable single projects are preferred. Thus, not only the view for complex connections of the spatial development gets lost but also the superordinate goals of the community (sustainable development etc.) in weight.

The spatial planning faces a dilemma which can not be dissolved easily: Either it uses itself unreservedly for the penetration of the politically given objectives and risks the marginalisation in the conversion, or it reduces its normative defaults to the level of the material-political possible. Both variants lead in the long run to a reinforcement of the actually unwanted trend

development. Nevertheless considerable action clearance exists also under these little pleasing basic conditions. To recognize this in advance as well as for implementing suitable tools represents one of the large challenges for the planning research, teachings and to practice. The development and care of knowledge and methods makes durable efforts of research and teaching inevitably.

### 3 Literature

- Brakman, S., H. Garretsen, C. Van Marrewijk und M. van den Berg (1999) The Return of Zipf: Towards a Further Understanding of the Rank-Size Distribution, *Journal of Regional Science*, **39** (1) 183-213.
- BRP (1996) Grundzüge der Raumordnung Schweiz, Bundesamt für Raumplanung (BRP), EJPD, Bern.
- BFS & ARE (2001) Mobilität in der Schweiz, Ergebnisse des Mikrozensus 2000 zum Verkehrsverhalten, Bundesamt für Raumentwicklung (ARE) und Bundesamt für Statistik (BSF), Bern, Neuchâtel.
- BFS (1994 & 1999) Taschenstatistik 1994 & 1999, Bundesamt für Statistik (BFS), Neuchâtel.
- BFS (2001) Arealstatistik der Schweiz 1992/97, Bundesamt für Statistik (BFS), Neuchâtel.
- BV (1999/2003) Bundesverfassung der Schweizerischen Eidgenossenschaft vom 18. April 1999 (Stand am 15. Juli 2003)
- DRP (1974) Raumplanerisches Leitbild "CK-73", in *Raumplanung Schweiz*, Sonderheft **3/74**, Chefbeamtenkonferenz des Bundes und Delegierter für Raumplanung (DRP), EJPD, Bern.
- Geurs, K.T. and J.R. Ritsema van Eck (2001) Accessibility measures: review and applications, *RIVM report*, **408505006**, National Institute of Public Health and the Environment, Bilthoven.
- GVK (1977) Gesamtverkehrskonzeption Schweiz (GVK-CH), Eidg. Kommission für die schweizerische Gesamtverkehrskonzeption, Bern
- Holenstein, Katrin (2004) Die Schweiz wird zubetoniert, *swissinfo*, <http://www.swissinfo.org/sde/Swissinfo.html?siteSect=111&sid=4718149>, 3.3.2004
- ORL (1971a) Landesplanerische Leitbilder der Schweiz, Schlussbericht, Bd.I, *Schriftenreihe zur Orts-, Regional- und Landesplanung*, **10A**, Institut für Orts-, Regional- und Landesplanung (ORL), ETH, Zürich.
- ORL (1971b) Landesplanerische Leitbilder der Schweiz, Schlussbericht, Bd.II, *Schriftenreihe zur Orts-, Regional- und Landesplanung*, **10B**, Institut für Orts-, Regional- und Landesplanung (ORL), ETH, Zürich.

- ORL (1971c) Landesplanerische Leitbilder der Schweiz, Schlussbericht, Bd.III, *Schriftenreihe zur Orts-, Regional- und Landesplanung*, **10C**, Institut für Orts-, Regional- und Landesplanung (ORL), ETH, Zürich.
- ORL (1971d) Landesplanerische Leitbilder der Schweiz, Schlussbericht, Pläne, *Schriftenreihe zur Orts-, Regional- und Landesplanung*, **10D**, Institut für Orts-, Regional- und Landesplanung (ORL), ETH, Zürich.
- RPG (1979/2003) Bundesgesetz über die Raumplanung (Raumplanungsgesetz, RPG) vom 22. Juni 1979 (Stand am 13. Mai 2003)
- Schuler, M. und R. Nef (1983) Räumliche Typologien des schweizerischen Zentren-Peripheriemusters, *NFP Bericht „Regionalprobleme in der Schweiz“*, **35**, Bern.
- Schretzenmayr, Martina (1996) Was führt zum Scheitern raumplanerischer Konzepte? in: *Raumforschung und Raumordnung*, **1996** (6) 397-410.
- Sieber, R. (2000) Atlas der Schweiz - interaktiv: Karten zur Bevölkerungsentwicklung, Bundesamt für Landestopographie, Wabern.
- Zipf, G. (1949) *Human Behaviour and the Principle of Least Effort*, Addison Wesley, New York.

Die *Arbeitsberichte Verkehrs- und Raumplanung* dienen der schnellen Verbreitung der Ergebnisse der Arbeit der Mitarbeitenden und Gäste des Instituts. Die Verantwortung für Inhalt und Gestaltung liegt alleine bei den Autor/innen.

The *Working Papers Traffic and Spatial Planning* are intended for the quick dissemination of the results of the members and guests of the Institute. Their content is the sole responsibility of the authors.

Eine vollständige Liste der Berichte kann vom Institut angefordert werden:

A complete catalogue of the papers can be obtained from:

IVT ETHZ  
ETH Hönggerberg (HIL)  
CH - 8093 Zürich

Telephon: +41 1 633 31 05

Telefax: +41 1 633 10 57

E-Mail: [sekretariat@ivt.baug.ethz.ch](mailto:sekretariat@ivt.baug.ethz.ch)

WWW: [www.ivt.baug.ethz.ch](http://www.ivt.baug.ethz.ch)

Der Katalog kann auch abgerufen werden von:

The catalogue can also be obtained from:

[http://www.ivt.baug.ethz.ch/vrp/veroeffentlichungen\\_d.html](http://www.ivt.baug.ethz.ch/vrp/veroeffentlichungen_d.html)