
How do contact systems affect regional development?

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Abstract. The paper reports on theoretical and empirical studies of contact systems. It refines and extends the framework, and consequently the implications, of such systems. This framework forms a base for extensive empirical studies, the results of which are used to suggest how contact systems are resolved and how they affect the quantitative and qualitative aspects of regional development. The analysis aims to determine how control of the course of development can be exerted by planning bodies at various levels.

1 The questions to be studied

1.1 Background

Transportation has long been the focal point of many attempts to explain regional development. Traditionally, much attention has been given to the costs of transportation of raw material and finished products. Lately it has also been recognised that the exchange of messages through the transport of people can consume considerable resources. Cost calculations alone, however, give a biased picture of the effect of communications. The outcomes are often neglected as they are less easily measurable in monetary terms.

Of special interest in this context are effects which change the basic conditions for regional development. The aim of this paper is to discuss how those contact systems which bring together different activities and regions can effect such changes of the structure. The paper will deal with three main questions, which are discussed in the sub-sections below.

1.1.1 *What is a contact system?* Technology, market conditions, and social values are changing at a more and more rapid pace. When changes are considered, contacts between the various parties are often necessary. The actors are often spread over space. The exchange of information can take the form of face to face contacts, or can use technical devices. In both cases a contact pattern is often created which reflects the fact that certain channels are faster, cheaper, more accessible, or more efficient than others. The various contact patterns may therefore be used in different contexts and affect different groups of actors. Combinations of actors, contact patterns, and contexts can be expected to appear with a certain regularity, that is to form contact systems. This report describes how these systems are formed and how they behave.

1.1.2 *How do the contact systems affect development?* The number of changes involved in bringing about development, and the number of actors as well as the need for contacts, can be expected to increase. Location in different regions, each offering different possibilities of utilising and combining many kinds of contact systems, can therefore appear more and more important in economic development. This is an example of how the form of the contact system can facilitate or limit the growth potential in different regions.

1.1.3 *How can the contact system (and thereby development) be altered?* New technical devices such as TV-phones and data terminals, or changes as regards speed,

frequency, prices, and capacity for other means of transport are only some examples of possible changes. Many of these are under the control of regional or national bodies. This means that it may be possible, within limits, to control regional development⁽¹⁾.

1.2 *Limitations*

The possibility of controlling development by changes in the communication system should not be over-emphasised. Other technical, social, or market conditional factors in the country (and outside) severely restrict the freedom of action of organisations and planning authorities. Far reaching differences in the structure of employment and production between different regions affect the outcome of changes in the communication system. A more complete account of the conditions for 'footloose units' is to be found in another report from the Swedish Department of Home Affairs (1970a, 1970b).

Although the analysis does in many respects go far beyond the limits of a purely economic analysis, the activities of individuals outside their work has not been taken into account. For a report on these aspects the reader is referred to another paper and its appendices, especially Hågerstrand's analysis of the total utilisation of time by individuals (Hågerstrand, 1970).

2 *Earlier papers*

Difficulties in exchanging information between different plants were long overlooked. In recent years they have attracted much more interest, especially among Swedish researchers in the field. Hågerstrand (1952) studied the connection between flows of information and innovations; Kristensson (1967), Ramström (1967), and Thorngren (1967a, 1967b) studied the impact of information on the development of organisations, Wärneryd (1968) studied interaction between regions, and Törnqvist (1970) the effects upon the distribution of employment. Taken together, these works provide a very comprehensive and—even from the international point of view—unique source of empirical material about the development and the consequences of contact systems. The combined theoretical and empirical results seem to be quite compatible in many respects despite the differences in approach and treatment. The compatibility exists, however, mostly as far as the analysis of historical development and the immediate future is concerned. When it comes to the long run effects, more than 20 years ahead, opinions differ between the representatives of different disciplines.

2.1 *Present tendencies*

Very briefly, a general—that is, accepted by most scholars—picture of development tendencies might be described as follows:

1. the volume of contacts between different firms, research bodies, organisations and authorities is great. It is expected to increase considerably;
2. the contact work is mainly performed by people in higher positions. It is expected to involve an increasing proportion of employees, in the lower echelons also;
3. the means of communication now available do not permit a separation of contact-dependent functions and others within organisations. Even new devices, such as TV-phones or data terminals, cannot be expected to change this within the next few decades;
4. instead, new techniques for telecommunication may—by permitting a spatial division of the firm's administrative and production units—increase the tendencies towards growth within the bigger urban regions.

(1) When the word 'development' is used, it does not contain an evaluation. It is only used as a linguistic variation of the word 'change'.

Suffice it to note that the propositions above build upon assumptions that are commonly accepted as reasonable and valid only for the immediate future (Thorngren, 1967a, 1967b).

2.2 Possible long run developments

As noted above, opinions differ when it comes to long run consequences. Researchers with a *technological* background often emphasise the possibility that quite new means of communication with higher speed, frequency, capacity and quality, and lower cost, will be in use in the relatively near future, that is, 10–20 years from now. TV-phones and data terminals are examples of such new means of communication. Some authors have sketched far reaching perspectives in which face-to-face contacts would no longer be necessary (Johannesson, 1966).

Other researchers with backgrounds in *organisation theory* emphasise that the content and mutual relations of the tasks are subject to continuous change. Consequently, the habits and conventions that now affect the need for contact could be adapted to a new technology (Ramström, 1969).

Researchers with a background in *economics*, however, note that other forces, such as economies of scale, might be even more important, should restrictions upon communication diminish. As decreasing costs of transportation of raw materials and finished products have been a condition for large scale production, so might improved means of long distance exchange of information lead to increased rather than decreased spatial concentration. Increased dependence on a large and diversified labour market might stress this conclusion even more (Thorngren, 1967a, Andersson, 1970).

Statements of the kind made above are based on conflicting assumptions regarding 'expected', basically uncontrolled, developments in different fields. Other writers stress instead the possibility—and the necessity—of controlling the course of developments by political decisions so as to lead it in directions more 'desirable' than those 'expected'.

2.3 Conclusions

Even this short review of earlier works forms a contradictory but fruitful base for further analysis.

Some treat the problems as pure matters of transport. Others treat information as one production factor among others. Still others regard exchange of information as a process which goes on—or should go on—unaffected by technical and economic conditions. In order to compare these different views, it is thought desirable to treat the contact patterns, their spatial aspects, and the actors involved, in a consistent framework, with particular emphasis placed on the time dimension, especially with reference to the ways in which contact systems are dependent on the time horizons of the processes involved.

3 Some models for contact systems

We begin with a number of definitions of concepts. A *contact system* refers to the set of links a group of individuals maintain to other (groups of) individuals, referred to as *the environment*. Groups of special interest in this connection are those individuals that are employed at the same site and in the same firm, authority, research body, etc. Such formal groups working on different levels of aggregation are labelled *organisations*. Their utilisation of physical resources will be called *activities*. Those members of an organisation who take an active part in communication with the environment will be called *actors*. Within the contact systems non-formalised groups of actors may also appear, whose mutual relations relate only to contacts. Such 'free' groups, the composition of which often changes, will here be called *groupings*. The interrelations of the concepts will be more thoroughly discussed later

in this section. The problem of stating limits and goals for organisations will also be dealt with (in this context see Stringer, 1967).

3.1 *The conceptual model*

An analysis of how the structure of contact systems may affect a region's development demands a more refined definition of the framework in which the contact systems perform their roles. Very roughly, such a framework may be described as follows: for its survival every activity requires access to information regarding knowledge and values in its environment. The diagram of the so-called 'development space' (Figure 1) describes how the sources of this information can be located⁽²⁾.

Value-oriented information is located in the upper portion, while the lower portion represents technological knowledge which may be directly or indirectly utilised in on-going activities. Activities (the utilisation of physical resources) have here been located in the two mid-sections of the development space. Some activities can be assumed to gather all their information from the adjacent segments, while others seek their sources in the more basic—and difficult to obtain—information to be found in the extreme segment of the development space. Thus, the location of the information sources within the development space is intended to represent the various degrees of accessibility of different types of information.

The following sections discuss the conceptual model in greater detail. The gap between this type of thinking and factual empirical observations is quite great. In a simplified and more refined form the model has formed the basis of comprehensive empirical studies, the results of which will be discussed in a later section⁽³⁾.

3.1.1 *Control of activities.* The utilisation of physical resources (*activities*) has here been placed in the middle section of the development space (Figure 1). The activities

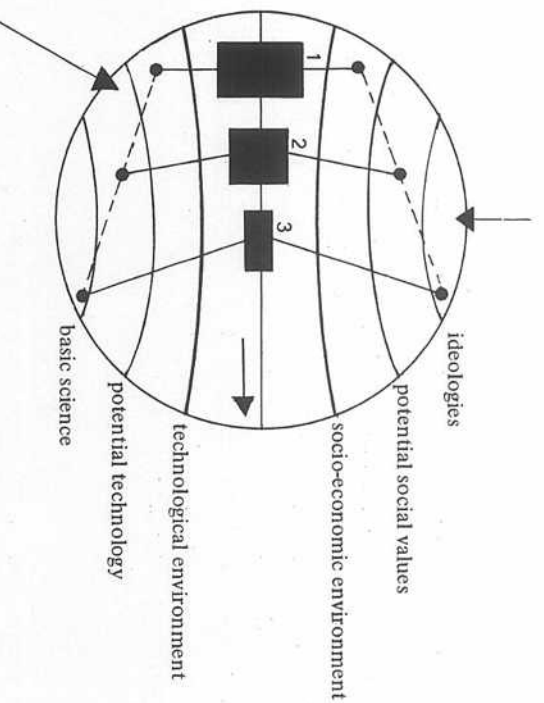


Figure 1. The basic model. For its survival every activity requires access to information regarding knowledge and values in its environment. The diagram of the so-called 'development space' describes how the sources of this information can be located.

⁽²⁾ The concept 'development space' was introduced by Jantsch in connection with his studies of long run technological development (see Jantsch, 1967).

⁽³⁾ Earlier theoretical and empirical studies indicate that actors might be connected to different segments of the environment during different kinds of change within an organisation. These studies also suggest that the number of possible combinations of actors, transfer systems, and sub-environments is limited and can be reduced to a small number of principal cases (Thorngren, 1967a, 1967b).

are distributed in three different positions along the periphery of the development space, as utilisation of resources may refer to different time horizons, for example routine production (1) or long run utilisation (2 and 3). These differences in time horizon are assumed to imply quite different connections with the environment, that is the use of different contact systems. Heavy emphasis will be placed here upon these temporal dependencies, which may be expected to be of central importance also for the explanation of regional changes.

Ehrlmark (1964) has paid much attention to problems related to processes having different time characteristics of control. He distinguishes between *programmed* processes related to routine transitions and transactions with the environment, and *planning* processes related to changes of programme processes. A third type consists of *orientation* processes aimed at directing the planning processes by extensive scanning of the environment⁽⁴⁾. One basic difference is that these three kinds of processes may be expected to make quite different demands on the relations with the environment.

In terms of the conceptual models, the *utilisation* of alternatives within programme processes (1) may imply exchange of information with the nearest surrounding segments of the development space only. The *development* and *choice* of alternatives going on within the context of planning processes (2) demand more comprehensive connections with social groups and potential technology as well as with the socio-economic environment and existing technology. The orientation processes scanning the development space for *new alternatives* demands the most far reaching relations⁽⁵⁾.

Moreover, the interaction between information flows, material flows, and money flows may also be expected to differ for the various processes. In the programme processes the three different sorts of flows may be closely knit together. In planning processes the information flows may be expected to be weakly linked to the material flows and money flows which occur in programme processes. Instead, they may be related to more exploratory physical flows involved in development processes. In orientation processes, information flows appear independent of any material flows. Such differences may make quite different demands on the design of the communication systems and their accessibility, and also on the internal control mechanisms.

In simple terms, information flows related to programme processes are said to 'control themselves' by feedback to the markets where material flows and money flows are exchanged. The result of different communication alternatives and different scope of contact exchanges can be compared and—at least in principle—evaluated in monetary terms (Ahlberg and Thorngren, 1970). The information flows related to planning processes can less often be controlled or evaluated in this simple way. With orientation processes there is instead need for a more complicated form of control which can be called 'feed-forward' (Ashby, 1952; Beer, 1966; Normann, 1968; Johannisson, 1969).

While programme processes involve a *utilisation* of existing alternatives, orientation processes are concentrated on the *discovery* of new alternatives. Planning processes may be said to direct both of the other processes through the *selection, development,*

(4) A similar set of concepts has been suggested by Ansoff (1965). However, his use of the concepts differ markedly from the one presented above. For example, Ansoff's approach does not explicitly treat the relations to and within the environment. The framework used by Ehrlmark (1964) has a closer relation to the discussion of contact systems external to organisations.

(5) The discussion above is held on a general level pertaining to all kinds of organisations. Even within a specific type of organisation, for example a business firm, each type of process will contain a broad range of activities. Programme processes can cover activities within manufacturing and selling, planning processes cover activities like research and development and marketing, and so forth.

and *realisation* of newly acquired alternatives. In this way the processes are interrelated.

3.1.2 *Organisation*. Activities have here been described as resource users, while organisations have been ascribed resource-controlling roles. It is important to note that this control may be exercised outside as well as inside the organisation, and may take the form of an interplay between actors in the development space. Formal groups, of the kind represented by organisations, may therefore stretch over the entire development space. In Figure 1 such an all-inclusive location of actors has been illustrated. Other and more specialised patterns of actor groups are, of course, possible.

The actors here play dual roles in the change process. They participate not only in the organisation of which they are formally members, but also in the other organisations involved in the contact system (Bauer, 1965). The contact system may therefore act as a superstructure, linking different organisations together in more or less stable but complex groups. Similar formations of groups have been identified for material-handling activities, which are sometimes relatively easy to delimit. For example, the connection of activities within the petrochemical sector can be said to reflect the relations between various stages in the chemical processes (Isard *et al.*, 1964). In the same way functional dependencies between organisations may link them into clusters, which have their counterparts in agglomerations in space. Various methods of identifying such mutual and stable dependencies between seemingly independent activities have already been developed (Guteland, 1967; Thorngren, 1967a, 1967b). Thus the formal borderlines between different organisations are in many cases of limited interest. The contact system—and the control of resources—may in many aspects be common for formally separated, but otherwise complementary, organisations.

3.1.3 *Groupings*. The picture is further complicated by the fact that the actors in many cases may have relations with 'free' groupings, whose composition can be derived from several organisations. The linkage between organisations that such groupings may imply is highly complex and shifting over time. Taken together, however, many such 'free connections' may form an extended contact system of great importance, especially for orientation processes. Consequently, they may be of basic importance also to those planning and programme processes that are basically controlled by more stable and well structured contact systems.

3.1.4 *Demarcation of organisations and goals*. Thus, it is very important to avoid all rigid demarcations of different organisations. Changes in such demarcation may instead be regarded as one of the most important long run functions of the contact system. When, in empirical studies, the data is sub-divided according to the social or geographic origin of the actors, this should be seen as but a provisional classification.

3.1.5 *Goals*. The term 'organisation' has here been used to cover a broad spectrum of activities from private enterprises to administrations, research organisations, and planning departments. Their behaviour within the development space may reflect widely differing goals. Even within the frame of a mutually coordinated goal, conflicts may occur between the goals controlling different kinds of processes (Stymne, 1970).

Even if, for example, profit maximisation is applied as a goal for private firms, this goal may be split into a number of sub-goals, which are often conflicting. For programme processes the responsibility for goal attainment may be divided among units, some of which have short run cost-minimising and others revenue-increasing tasks. In their turn these units compete for resources with the units handling planning and

development processes. The gain from the latter kind of processes, however, is not easily evaluated and directly compared to the gain from programme processes. This is one of the reasons that purely economic assessments tend to be all too short sighted. Even more complicated goals may control other kinds of organisations, such as research organisations.

Thus, if in empirical studies of contact systems only 'nominal' and mutually comparable goals are ascribed to the acting parties, an over-simplification may occur which cuts away vital elements of the reality one aspires to study (Churchman, 1961). The handling of conflicts within and between organisations—as well as changes in the boundaries of organisations—is one of the main duties of the control systems reflected by contact systems.

3.1.6 *The structure of the contact systems.* Already the simple basic model outlined indicates the need to distinguish between at least three different types of contact systems with different tasks and structure.

1. Contact systems linking the use of previously allocated resources (programme processes) with well known and well defined segments of the environment. Flows of information may here interact with flows of material and money in a relatively closed circuit.
 2. Contact systems linking changes in the use of resources (planning processes) with parts of the environment other than those involved in current programme processes. Flows of information in this context may interact with flows of physical resources, in certain cases also with flows of money. The interaction of different kinds of flows is, however, less direct and less stable than in programme processes.
 3. Contact systems linking planning processes to previously unconnected parts of the environment (orientation processes). Flows of information here may have a more independent function and be aimed at linking other, more structured, communication processes to relevant parts of the environment.
- The variability and scope of different contact systems are shown in Figure 2.

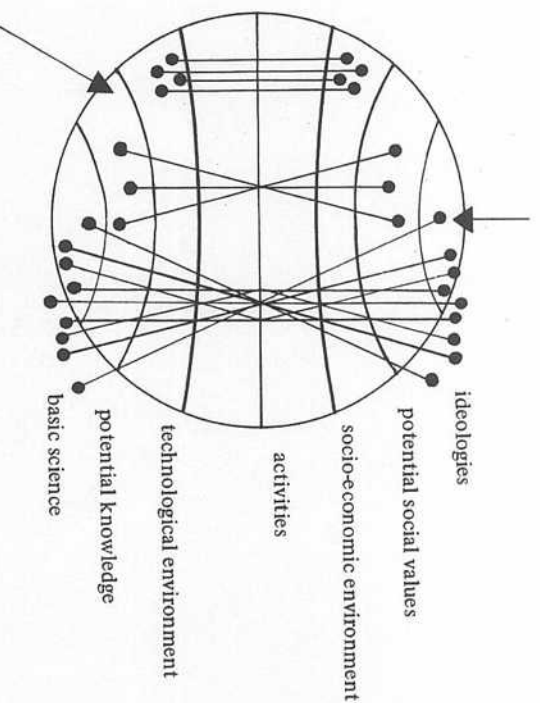


Figure 2. New elements in the contact system are searched for during orientation processes, selected and developed during planning processes, and routinely applied in programme processes. The structure of the communication system often limits the possibility of building more complex contact systems, involving search, selection, and development functions in a given region. This means that the activity level in some regions is often constrained—consciously or unconsciously—because the contact system does not allow access to new development alternatives.

These differences must be taken into account when planning and interpreting empirical studies. As is shown in Figure 3, an organisation usually has flows of information attached to different kinds of processes (see Rhenman, 1969). They usually relate to different parts of the environment, but might concern the *same* organisation, for example a certain client or bank. This situation may conceal the fact that the interacting organisations involve actors with different tasks, and that control may occur outside the organisation.

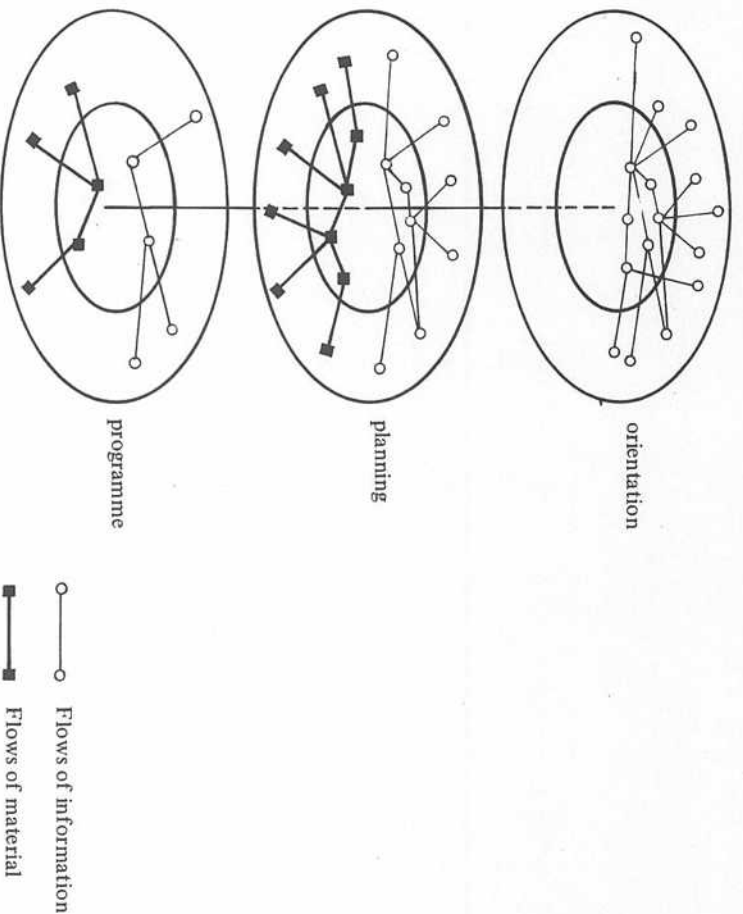


Figure 3. An organisation can exchange information flows simultaneously with various types of processes. While these commonly involve different segments of the development space, they can involve what appears to be the same organisation, such as a certain customer or bank. This means that in empirical studies the relatively few contacts exchanged in more complex processes may easily be hidden by the large volume of routine contacts. Special methods, such as multi-variate statistical techniques, must be used to distinguish the various contact systems from one another.

3.2 Empirical studies

Studies of contact systems must therefore include studies of the processes they affect and are affected by. The 'thinking model' has been used as the basis for further empirical research, the aim of which has been to integrate these various aspects. This means that in the empirical analysis account has been taken not only of flows of information, but also of their dependence on the exchange of physical flows and flows of payment occurring between units studied and their environment⁽⁶⁾.

(6) Earlier repeated studies of an organisation that left a contact-intensive region have, for example, shown that the organisation's connection with the central contacts may be *one* important factor determining location. The studies were started in 1965, and subsequent comparisons over time indicate that the communication patterns have so far been stable (see Thorngren, 1967a, 1967b). The extensive studies performed at the University of Lund confirm that communication possibilities may be an important push behind the heavy displacements of employment between different regions. Since contact-intensive activities have so far concerned mainly people with a high level of education and high salaries, the composition of employment in some regions has inevitably been affected (see Törnqvist, 1970; Sahlberg, 1970).

The empirical investigation therefore covered three different areas:

1. the structure characterising a *unit of activity* (for example a plant) as regards *production, engaged, and active participants* in the exchange of information (*actors*);
2. the structure characterising the *transfer* of flows of information, resources, and payments;
3. the structure of the parts of the environment with which the component, through its actors, exchanges different kinds of flows.

The model places heavy emphasis upon the differences in possibilities for control characterising each different structure. The unit's structure of production, employment and actors is assumed to be affected by some kind of unit management, which in its behaviour must regard the other two structures (transfer and environment) as non-controllable. The transfer structure is assumed to be under the control of some kind of a planning body, for example through its ability to change the structure of the system of communication. The planning body is thus able to affect indirectly the possible set of alternative actions open to the unit management. The structure of the environment, as well as other structures and bodies, are assumed to be affected by other circumstances, for instance technical development, as well as the total interplay of all structures.

This schematic model has formed the basis for an extensive collection of data which has enabled the successive specification of the relationships between the variables.

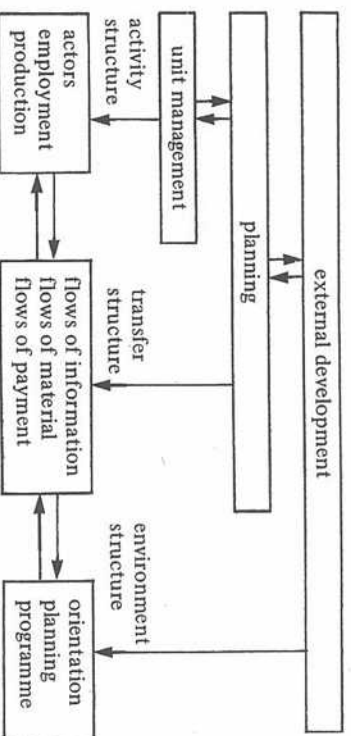


Figure 4. The empirical study comprehends the structure of the activities with reference to employment, production, and those actors involved in the contact work. The structure of the transfer systems which transmit the flows of materials, information, and payments to the environment is also studied. Great importance is given to the effort to determine the influence on the course of development that can be exerted by planning bodies at various levels. For example, by accelerating or retarding the speed of development of new means of communication, the planning body may determine the long term conditions for regional development.

3.2.1 *The collection of data.* The empirical studies, which were performed early in 1968, included:

1. a study of the contact structure, undertaken with the help of specially designed contact diaries covering a three-day period. Some twenty variables were studied, including *input* for the exchange of information in the form of *time spent, number of participants, planning time, and time for travel* (if any), as well as *capacity*, measured as the possibility of mutual exchange of information (*feedback*), the giving and receiving of information (*direction*), the need for structuring of the messages exchanged (*scope*), and the breadth of the content as well as the establishing of new contacts (*novelty*). In the contact studies the various elements of the environment were also sought out, with reference to each party's sector and regional location as well as to which segment of the environment the relation concerned.

For the contacts concerning the programme environment, the actors were studied with respect to the direction of the relation (buyer/seller), and the products with respect to the stage of introduction into the market.

The studies of contact included 3000 executives, who during the three-day period took part in some 15000 contacts. Drop-out, measured by comparison of collected data and the contact diaries, was low.

2. a study of the *structure of actors*, noting their *education*, *age*, *number of years in the firm*, *number of years in the present position*, *function*, and *salary* level.
3. a study of the structures of *employment* and of *production* for the three-year period preceding the study. The development of employment and salary distribution as well as the development of *technology*, *number of production lines*, *investments*, *research*, and *development* expenditures, *area*, *turnover*, *value added*, and percentage of value added stemming from new products, were included in the study.

3.2.2 Empirical findings. The analysis has yielded results that seem to confirm the basic assumption that the contact structure can be decomposed into a comparatively simple pattern⁽⁷⁾. The analysis of the *transfer* structure showed, for example, that the 15000 observations could be classed into three fundamental contact patterns. With reference to the conceptual model they are labelled the programme, planning, and orientation network, respectively (see Figure 5).

The programme network—innermost in Figure 5—is characterised by fast and short contacts. Here the daily coordination or routine activities takes place. A

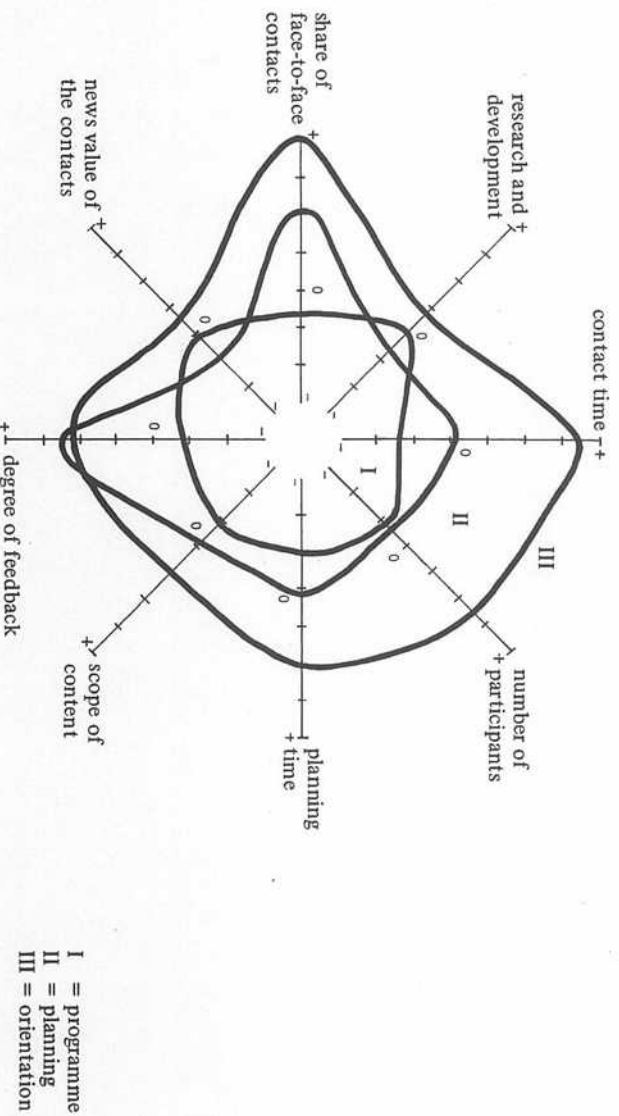


Figure 5. Networks of the contact system. Three 'main networks', through which necessary information is channelled, can be distinguished in the contact system of organisations. Programme and planning networks are the channels for quick, short, and generally routine information. The orientation network is a more exclusive and more time-consuming link with the environment. It is the channel for 'sensitive' information. The figure is based on an analysis of 15000 'contact events' in 100 Swedish organisations, described in more detail in the text. The axes and points on the scale represent the amount of the contact in each network that is devoted to development processes, how much planning time the contact requires, how much news value the exchanged information has.

(7) Data have been analysed using, among other things, latent profile analysis (LPA). This method of analysis makes it possible to group all observations similar in the dimensions studied into homogenous groups or clusters that are similar according to all characteristics studied.

major part of the purchasing activity occurs here, also. This network accounts for 70% of the total number of contacts, but the breadth of information exchanged is insignificant and the share of contacts devoted to research and development is relatively low. The messages passing through are one-way and well structured. The information often concerns one single question. The contact is usually planned the day it is carried out and seldom lasts longer than a quarter of an hour. The main part of the work is performed on the telephone and telex, but TV-phones and data terminals may increase efficiency in the future. New teletechnical discoveries may be expected to have their greatest impact for this type of contact.

The *planning* network contains information of greater scope, which also, in contrast to the programme network, is exchanged in both directions. The time spent is generally about 30 minutes, but seldom more. Telephone and face-to-face contacts are mixed in this network. It contains well established relations, 'you know whom you are going to talk to about what'. In the short run it can be a very efficient contact pattern, but the risk is that it changes from being 'in-worn' to 'down-worn', that is under pressure of new conditions and events the well adjusted network will petrify. As is evident from Figure 5, the share of research and development is low.

Finally, the *orientation* network has a more sophisticated and time-consuming relationship with the environment. It is the channel for difficult problems. It contains less than five per cent of the firm's total contact work but 80% of all new contacts. There are only face-to-face contacts in this network, and it is difficult to imagine how TV-phones and data terminals could have any greater impact on this unstructured exchange of information. The number of participants in these exchanges is often more than three, and the planning time for the meetings can be more than a week. The information is almost always double-directed, and the contact time may stretch over several hours. Through this network with its pattern of contacts which are difficult to handle, the organisation gets its opportunity to renew itself and the contact net. It is here that the search for new ideas takes place, and it is primarily through this channel that new combinations of people, techniques, and markets enter into the systems.

Comparative studies relating to patterns of contact with actors and processes have been carried out. From these it is clear that stable components, such as plants with slowly changing technology, volume of production, and structure of personnel, usually involve a low proportion of actors. These actors are connected mainly to the well structured programme environment via less time-consuming contact systems.

Strongly market-oriented components often show a more versatile but more extensive connection with the environment in which orienting processes play an important part. The proportion of actors is higher, and time-consuming contact systems are used.

Components dealing with technical development often show a narrower but more intensive connection to limited parts of the environment. The proportion of actors dealing with planning processes is high and relatively established contact systems are used.

The results indicate that systematic correlations between communication structures, actor structures, employment structures, and production structures may be identified empirically.

Communication structures can be traced back to the actor structures. The actors—the active participants in the exchange of information—show a high degree of selectivity in their use of communication channels and segments of the environment. Certain actors are specialised in, for example, the programme environment. The proportion of actors of different kinds can be traced back to the structure of employment, which in turn is connected to the degree of stability or variability of

the structured production. The analysis involves a simultaneous study of changes in the different structures, showing both long run and short run connections between flows of information, physical resources, and payments.

3.3 *Other studies*

In addition to the empirical studies mentioned in the introduction, projects are in progress in various parts of the world. In Great Britain, for example, extensive studies are being planned, of which certain results have already appeared.

Goddard (1968), in a study of the need for different activities to be concentrated in the very centre of London, is using a similar contact diary, which is being completed by a sample of 1000 businessmen, to measure the strength and characteristics of existing information flows. This study is paralleled by an analysis of the geographical agglomeration of office activities which has suggested that those activities linked by frequent face-to-face contact are located very close to one another in the city centre. Also in London, a pilot study based on the British civil service is attempting to identify related blocks of Government work with links that can be stretched over space and so be re-located outside London. The researchers are developing a model to help in making decisions about the communication costs and regional benefits of different locations. Finally, in London, a project directed by Alex Reid will be attempting to assess the impact of new communications technologies by carrying out laboratory experiments in which volunteers will be monitored as they attempt to perform different tasks involving face-to-face contact. In this way Reid hopes to establish which types of information exchanges are most likely to be transferred from face-to-face meetings to telecommunications. This important work will complement that using diaries and other 'field' survey techniques which establish the existing importance of different types of contact.

Back, Dalborg and Otterbeck (1970) have studied the development within ninety plants during an eight-year period (1960-1967), during which they identified fundamental changes of the production and employment structures. They demonstrate systematic correlations between structural changes within the plants and structural changes in the environment. A correspondence between these developments and changes within the group of potential actors also existed⁽⁸⁾.

3.4 *Conclusions*

There are many reasons why those aspects of regional development presented here have not aroused much interest. Researchers, regional planners, and politicians have lacked the frame of reference, the concepts, and the means of data collection which would have enabled them to observe the gradual polarisation into 'information-rich' agglomerations and areas with less opportunities for contacts. Rather, re-location of physical production between actors and regions have been the focus of attention. Measured in this way, the development of the big agglomerations has been normal or even stagnating. Less than ten years ago many people regarded differences in the cost of transport as the dominant—not to say the only—obstacle to a dispersion of employment. Against the background of falling costs for transportation of raw materials and finished products a spontaneous decentralisation seemed highly probable.

The real change took quite another direction from the forecasted development. Available statistics tended to draw attention away from what happened 'across the categories'. In the longer run this 'observation problem' may be one of the primary obstacles to controlling the development.

(8) These authors also took an active part in the design and realisation of the above-mentioned study.

We are beginning to see the contours of a new aspect of the 'anatomy' of development in which the critical question is: which groups of individuals, firms, and social sectors interact in the exchange of information? If this knowledge is to be useful in a changing society, it must be made more general, and less sensitive to unforeseen discontinuities than the usual type of classification.

This means that data collected according to categories such as firms, sectors, and regions must be interpreted with great caution. The reality they represent is subject to unforeseeable change. A new type of classification, using individual task descriptions (functions) as its basic components, has been suggested in Sweden (Kristensson, 1967; Törnqvist, 1970; Back *et al.*, 1970). This will give increased flexibility of analysis at higher aggregation levels.

However, functions also undergo rapid change. Ideally, the description should be transformed into a more general form, which can be translated into the categories needed in each specific instance. The solution to this problem should be sought along the lines that have led to the coordinate referencing of other regional data and, if possible, connected to this system (Hägerstrand, 1955; Jones, 1969).

4 Some long run conflicts

The model presented here seems to have a certain foundation in reality—as it has appeared up to now. However, it is not enough to ascertain what has already happened. It is of greater interest to establish whether models of the kind presented can be used to direct development towards the goals that may be stated for regional policy. Such an analysis cannot take the form of a forecast in the usual meaning of the word. Instead it will be necessary to distinguish between controllable and non-controllable conditions of the structures.

A first step will be to identify possible tendencies towards change, and conflicts between such tendencies. A second and later step will be to discuss the possibilities of controlling these tendencies to make them interact and generate a path towards the intended goals.

4.1 Changes in the internal structure of activities

4.1.1 *Technology—organisation.* Changes in technology and organisation are often closely related. In particular, Woodward (1965) has established how technological changes influence organisational structure. She demonstrates that the ordinary type of mass production is often reflected in a hierarchic organisational structure, consisting of workers, foremen, supervisors, etc. New technology and increased economies of scale, however, tend towards processing technology, in which the organisation—and those employed—are freed from the fixed dependencies that have characterised mass production.

For activities which, because of a high degree of complexity and of change in product design and marketing, cannot allocate resources in process production or mass production patterns, new forms of 'handicraft' unit production may be a more common alternative. This structure of production may also make an increased 'self rule' possible. Ramström (1969) has analysed how such changes in technology and organisation can be reflected in the flows of information and material within the organisation (see Figure 6).

4.1.2 *Social changes.* Increased education levels and increased demands for improved working situations may accelerate the transformation from mass production to unit and flow production, the latter giving greater opportunities to apply personal skill and 'self rule'. For a more detailed analysis of conflicts and cooperation between technical—organisational and social development tendencies, see for example Dahlström *et al.* (1965).

4.2 Changes in the external structure of activities

4.2.1 *Technical-organisational.* The organisation might to an increasing extent be divided into six relatively independent controlling units (managements) and three independent units with production tasks (see Figure 7). This division mainly concerns the time horizon relevant to those employed within each unit. The units may be considered to be oriented towards different segments of the environment. This external connection, between functional unit and environment, can often be of greater importance than the internal connection with other units within the same organisation. Such an organisation, 'splintered' in terms of time and oriented towards various segments of the environment, may tend to be spatially dispersed as well.

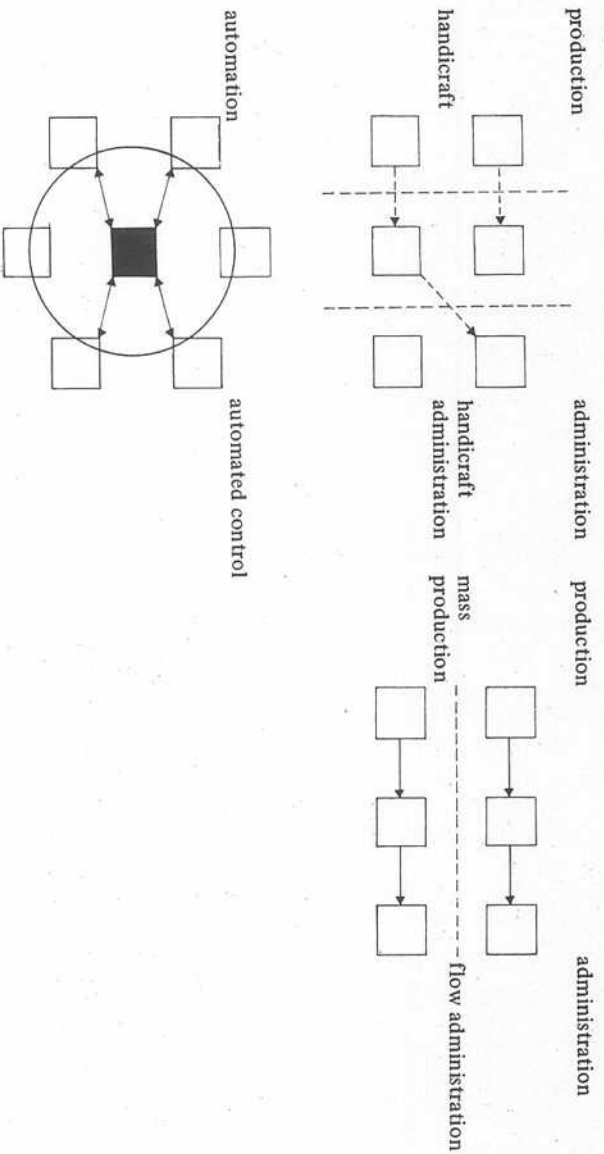


Figure 6. In both production and administration a move away from the principles of mass production may be expected. New forms of 'craftsmanship administration' can become necessary in planning and developing functions, while routine activities will become more automatised. Thus employment will be transferred to less and less routine tasks (figure taken from Ramström, 1969).

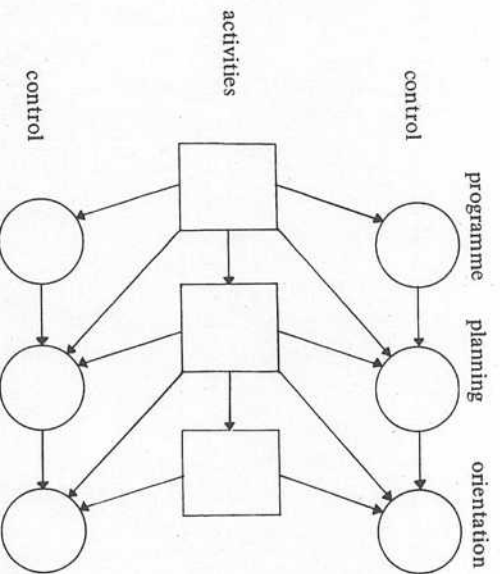


Figure 7. Changes in the character of employment. Ultimately, all employees may be expected to belong to some management group with value- or knowledge-oriented tasks on various time horizons. The internally oriented hierarchical structure is thereby broken down and replaced by more externally oriented groupings. Such groupings are more sensitive to the quality of the communication system, as measured in accessibility, frequency, time spent, and cost for various contacts.

4.2.2 *Social changes.* Simplifying, one can talk about a 'polarisation', whereby the influence employees have on their working situation can be strengthened on the local level, represented by the plant, while direct day-to-day influence on the organisation as a whole may be weakened.

Increased dependence on the environment may, however, increase the significance of more indirect and long run influence exercised by representative bodies on the level of society.

The picture is even more complicated if the risk that the different units may develop separate 'working cultures' is taken into account. The differences between them might be reflected in a regional disparity with respect to, for instance, education and wage level. Such tendencies, however, can be counterbalanced by a general increase of the level of qualification within all kinds of units. Units working on different time horizons will have a rather similar composition with respect to the employees' education and salary. Thus tendencies towards regional segregation, based on the differences in the time horizons with which the units work, could counteract the tendencies to regional differentiation with reference to education and wage levels.

4.3 *Changes in employment*

The changes within the fields of technology and organisation outlined in the preceding section may shift employment successively from production to controlling tasks. Such social changes as increased education levels and increased demands for influence on the working situation for all employees may strengthen such tendencies. They may also involve increasing numbers of the actors in the contact systems that control planning and future orientation processes.

Taken together, these external and internal changes will mean a strong tendency towards increased employment within more environment-oriented units and contact systems.

4.4 *Changes in transfer technology*

4.4.1 *Information.* New technical devices such as TV-phones and data terminals may be expected to facilitate communication primarily between *processing units* within the same organisation, and secondly, between the parts of *different* organisations that are both characterised by a high degree of automation. Such units may therefore be given a more independent location as regards processing as well as control.

The situation is radically different for those parts of the organisation that have planning or orientation tasks. The exchange of contacts here refers to frequently changing combinations of groups or groupings in the environment. Such external groups must be motivated to take part in the contact work. This will require a high degree of flexibility or adaptation with respect to timing and location on the part of the information-seeking organisations. The large number of participants and new combinations of actors, as well as the lack of formal relations between those involved and the often unstructured character of the content exchanged, will make the utilisation of teletechnical devices for these types of contacts extremely complicated (Thorngren, 1967a, 1967b).

4.4.2 *Material flows.* The picture is complicated by the fact that many development activities need a *combined* transfer of material and information flows. Development and planning work will also increasingly engage potential buyers and demands a complex exchange between different combinations of actors. The need for rapid, random exchanges of both information and material will put a heavy restriction on the choice of location.

In the field of transport of materials a new technology may therefore be expected to have its greatest impact on rather routine transfers between process-controlled

units. Such units where both information and material plans are highly programmed will be rather 'footloose'. However, the need of 'reprogramming' at certain intervals will enforce clustering, facilitating exchange of specialised resources (Thorngren, 1967b).

4.5 *Changes in contact habits and norms*

The exchange of information and material is not controlled by the design of the communication system alone. Social norms, attitudes, and habits, as well as legislation, naturally affect with whom and how a contact is made. An important possibility is that changed contact habits may facilitate the use of teletechnical devices. In that case, the need for personal contacts could diminish (Ramström, 1969). However, the tendencies towards higher levels of education, increased 'self rule', and freer rules for the exchange of contacts implies that there will be more and more participants in the contact system, increasing the volume of face-to-face contacts.

4.6 *Conclusions*

The main interest here has been on the identification of change conflicts, that is to say changes that may exclude or conflict with one another. The double-directed impacts of technical development seem to be especially important. On the one hand technical development may tend to allow possibilities of giving many routine activities (programme processes) a more independent location. Also, economies of scale may improve the possibilities of overcoming remaining transport obstacles. On the other hand, the same technical development will tend to decrease demand for employment in programmed processes—the kind of activity which can benefit from technological development in communication. In contrast, growth of employment will occur within those types of activities that are strongly dependent on each other and where telecommunications are difficult to apply. Against such a background it is easy to understand why technologists, economists, geographers, organisation theorists, sociologists, and other experts can come to divergent conclusions. The aim here has not been to put forward any prognosis, but to illustrate the importance of a multi-dimensional point of view.

5 *The possibility of a 'controlled' change*

Regional development is often considered in terms of the number of people employed or the number of inhabitants in a region. Economic development is often measured as the increase in Gross National Product. As has been pointed out by many writers, such measures give an all too simplified picture of the development. Changes along such lines are reflected on many other levels. Structural adjustments affect the base for further development for society as a whole, often with dramatic expression at the regional levels. Technological, organisational, market, and social changes act to decrease the opportunities for production and employment in certain regions. New possibilities are formed in regions with structures offering a better starting point under shifting conditions.

5.1 *The contact system as a control device*

Transportation has long had a central position in the theory of location. The discussion has often been limited, however, to a comparison of the costs for certain alternative locations. Location has often been regarded as a once-and-for-all decision, as a question of more or less finally placing activities in a regional pattern, that seems desirable. However, such a view seems to be a dangerous over-simplification, an evasion of the problems involved in keeping activities of a desired kind going under even changing conditions.

Different means of transportation have different speed, frequency, capacity, quality, and effects on the environment (Björkman, 1965). New means for the long range transmission of information, such as video phones and data terminals, are being developed. Changes in transport conditions in this broader sense can be used as a means for controlling the potential for further development within and between regions. However, in order to give the intended results, changes in communication structures must be combined with measures taken on other levels and must take into account all types of change directed toward society and toward different activities.

5.2 *Demand for change on the level of society*

The course of international development within the fields of research, technology, marketing, and communication appears impossible to control in a country of, for instance, Sweden's size. While it may be possible to break away from these external forces at certain points, the main impulses are given from outside.

Certain previous decisions reinforce changes that can hardly be reversed. The expansion of education and the claim for increased security of employment are examples of this.

5.3 *Demand for change on the level of the firm*

New legislation, new valuations, new technology, new organisation, and new market conditions represent demand for change on the level of the firm. At the same time, the number of different raw materials, personnel categories, production technologies, finished products, and categories of users tends to increase. Previous investments in development, education, organisation, and marketing represent long run commitments. Thus the sensitivity to external changes tends to increase.

5.4 *Adaptation or change*

To a certain degree, sensitivity can be lessened by the systematic choice of technology, products, raw materials, markets, and tasks having extremely low frequencies of change, plus a contact system which increases the possibility of early warning and planning. However, this is a passive solution implying a rather low rate of growth in employment in the long run. Another possibility is to seek to change the structural conditions in order to meet change. This demands a simultaneous expansion of education, labour market, industrial service, and communications on the regional level.

5.5 *The effects of telecommunication*

The conflicts between various developments are treated in earlier sections of this paper. When considering the impact of these conflicts it is important to take into account those elements of development that may increase the action space for regional planning. Even if the change itself cannot be affected, the possibility still remains of affecting its course, as well as of affecting the sequence in which certain changes appear.

One important possibility is to accelerate the development and introduction of teletechnical devices in order to re-locate units that are still expanding their employment, together with increases in the frequency, capacity, and quality of more conventional means of transport.

As an isolated measure, the introduction of teletechnological communication between different regions might reinforce tendencies towards routine production in less developed regions. Telecommunication might even decrease employment possibilities in sparsely populated regions.

However, if the whole set of measures is *combined*, changes in the contact system can affect the possibilities of dispersing planning and orientation processes, where opportunities for employment are forthcoming.

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