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Flows of data and information for innovative ventures: A comparative approach between planned and market economies

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FLOWS OF DATA AND INFORMATION FOR INNOVATIVE VENTURES

A comparative approach between planned and market economies

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- A comparative approach between planned and market economies

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CONTENTS

Principal remark:
The text and illustrations do not reflect reforms introduced and measures taken under the Perestrojka-regime, as no valid and reliable information yet exists on permannent measures and changes, which comprise the entire economy of the SU.

FLOWS OF DATA AND INFORMATION FOR INNOVATIVE VENTURES

- A comparative approach to planned and market economies

Introduction

Comparative descriptions and analyses of planned and market economies are needed not only to understand systemic differences and the functions of various institutional and regulatory arrangements, but also

- o to assess the validity and applicability of various managerial methods and instruments, to the other system and
- o to comprehend another system with which one intends to enter into contractual or other business relationships.

Within the frame of a large east-west comparative project to the study of innovation management in old and large enterprises (IIASA Electrotechnology study, 1982-1985) it was necessary to develop a framework for the analysis of contextual differences under which enterprises have to operate and to innovate.

Many attempts have been undertaken to depict planned economies (1), as well as the context for innovation in industries, in particular that of the Soviet Union, but also of other socialist countries (2). Neither of them, however, lends itself for comparison, as they either only apply to one or a few of the socialist countries, or become very detailed, too detailed in order to correctly describe a very complex variety of approaches and reformatory measures. As the comparative aspect often is not the focus of the authors' interest and as a comprehensive as well as objective approach to the description and analysis of the systemic context thus is in demand, an attempt is undertaken to develop such a comparative framework, using as its core the flows of data and information for innovative attempts in industry and society.

A principal observation must be made: when a "top-down" model is used (science -> technology -> production -> market) this means a simplification, at least as market and almost-market economies are concerned. It is generally known that information and data flow in both directions, and that the initial flow in many cases is upstreams (e.g. the market or the production units requesting novel solutions for functional needs from e.g. applied or basic research). The top-down model, however, at the same time rather well reflects planning procedures and behaviour in many of the planned economies. For the comparative purpose one should keep in mind, that multilateral flows are a rule. The issue "technology push versus market pull" has been debated at length in the literature. Flows of initiatives and requests for new or better solutions from servicing (repair, maintenance) or from production, production engineering, product design and planning directed towards e.g. applied or basic research are in practice equally relevant, but appear less frequently in the literature (cf however contributions of de Solla Price and Sahal (3)).

Similarly, one talks about social and environmental consequences of technology, as if there were a unidirectional sequence. In reality new tech-

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Ref 1-3 see pp 12-13

nology in response to social, environmental or other change is also very much requested, although this is rarely reflected in writings about innovation.

In summary: the model is meant to be neutral to the sources and directions of data and information flows, but also to the various systems it is to be applied to.

Sources of knowledge (data and information)

For simplicity's sake data 1) and information 2) are hereafter substituted by knowledge. 3) Knowledge is differentiated by means of major sources of (data, information and) knowledge of use and relevance for innovative purposes.

Table 1 shows the major types of knowledge required for innovation, arranged by principal sources and specified by the degrees of availability. Knowledge/information generally available to the public is denoted by (P), indicating public or general availibility. Institutional information or that vested in individuals or information/knowledge which is partly public, partly secret, is labelled (SP, semi-public). There is also a third variety: knowledge/information needed for innovation in many cases is only available in individuals and thus partly secret, but it gradually becomes public, visible or discernible as consequences of strategies applied and actions taken. This variant is labelled (E) entrepreneurial. Finally, some organizations will strive to classify information, which means constraining its communication, or withholding it from potential competitors (C = classified).

The knowledge sources used are the following:

1. Basic knowledge, often available in the form of "laws". This information is accumulated over time and collected in literature of scientific (or popular) type, school books, etc. Its availability sometimes is constrained, in particular if it only concerns a few specialists. Nevertheless basic knowledge is principally public; only under exceptional circumstances it will be classified.

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1) Data are elements (signs or sets of signs) having meaning in relation to some phenomenon in a) the real world , b) in desired states (budgets, plans) and c) models of a and/or b.
2) Information consists of data which are related to decision making (decision situations, decision points, decision makers, decision rules); information consists (mostly) of "refined" data: analyses, compilations, tables, figures, curves, comparisons, comments, etc.
3) Knowledge consists of entities of information which are related to (clusters of) problems and which are controlled by either paradigma (e.g. theories, rules) or by attitudes (relevance, appropriateness) or by both paradigma and attitudes. Knowledge may be deterministic (laws) or probabilistic (expectations, often - but not necessarily always, as in the case of uncertainty - related to experience).
Data, information and knowledge must meet certain requirements as to validity, reliability, timelyness, and relevance (to decision situations as well as to periods covered by time series, and their forecasting properties).

Table 1. Knowledge required for innovation.

Knowledge types	Availability
1. Basic knowledge, "laws"	P
2. Knowledge on how to perform research (professional)	SP (C)
3. Knowledge for the development of products/processes	SP (C)
4. Knowledge on how to implement new products/processes	SP (C)
5. Production and process know-how	SP (C)
6. Knowledge on how to manage/control producing enterprise	SP (C)
7. Maintenance and servicing know-how	SP (C)
8. Product related knowledge	P (C)
9. Market related knowledge	P
10. Entrepreneurial know-how	
a) private enterprise economy	E
b) centrally planned economy	SP*
c) mixed economy	E&P
d) Japan (MITI-economy)	SP&E

* if at all available.

Available forms:
P = Public
SP = Semi-public: institutional, individual, partly public, partly secret
E = Entrepreneurial: individual, partly secret, becomes public as consequences of strategies applied, actions taken are discernible
C = Classified

2. Knowledge on how to perform research. This professional knowledge is vested in experienced research administrators and researchers. It comprises both professional or topical and adminstrative skills and knowledge. There is a strong relationship between basic/applied knowledge and knowledge how to perform research, as the persons doing or managing research are supposed to be familiar with the basic/applied knowledge of relevance to their work and tasks.

3. Knowledge for the development of products and/or processes is different from 2, as it also requires considerable knowledge about production processes, but also production controls, consumer preferences, characteristics of the distributive system, maintenance and servicing requirements etc.

Sources of information and knowledge about products on the one hand and processes on the other hand are rather differentiated and vested in various professions. The principal reason why they in this model are mentioned jointly is that they by necessity have to meet and to be treated jointly as this is an indispensible condition for the realization of novel ideas: new product ideas, for which no adequate processes are made available,will stay on paper only (cf also points 4, 5, and 7 below) .

4. Knowledge how to implement new products/processes. There are strong links between knowledge of types 3 and 4. Knowledge of type 4 is more specialized to developing both production processes, selecting machinery, problems of layout, sequencing, routing, utilization or need for auxiliary material, tools, fixtures, etc., but also knowledge about production control processes, logistics, supplies, and similar issues. Also problems of quality management, quality control, packaging and expediting, fall under this category.

   Under this heading must also be mentioned the case where suppliers are to be engaged, i.e where not all components of the product or the process to be implemented, to be developed, are to be produced within the entity of one firm. Increasing ranges of products and processes to-day are of such a complex type, making it advisable or necessary to engage specialized suppliers, who possess superior knowledge in certain fields. It is often, almost regularly, necessary to engage subsuppliers and to take the consequent possibilities and/or constraints into account, at the latest during the implementation phase. Very often, however, the cooperation will start or have to take place in phase 3 above and extend to phases 5, 6, and 7. The cooperation will comprise both technical, material, design, cost, administrative, servicing, logistic and other issues.

5. Production and process know-how refers not only to technical and administrative knowledge and skills in running plants, including the organization of necessary infrastructure in as far as logistics, supplies and servicing are concerned, but also to process control, routing, production scheduling, etc.

6. Knowledge how to manage/control producing enterprises comprises not only managerial attitudes, knowledge and skills in organizing, running and controlling enterprises, shops and plants, etc., successfully, but also comprises the acquisition, development and economic utilization of resource of all types, from human to financial and material resources.

7. Maintenance and servicing know-how. This knowledge refers to the proper servicing, maintenance, care, repair, etc., of products, machinery and processes in use, according to the characteristics of the functions to be rendered by the equipment. Maintenance and servicing thus comprises process and production equipment on the one hand and products in the hands of users on the other hand. Persons in charge of maintenance and servicing not only must know the products/processes very well. They are also important holders of knowledge and informants to levels 3, 4, and 6 (sometimes also to 2) on the properties and behaviour of the product/process in question under given or shifting conditions of utilization. Feed-back gained from persons in this category to the mentioned recipients is very important for the gradual improvement of new technology, both increasing its reliability and its economy in use as well as in production.

8. Product related knowledge 1) and

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1) A product may also be a process or a subassembly produced at the request of an industrial buyer/user.

9. market related knowledge may be treated together. Products render functions for which there is an existing demand or may be developed a new demand amongst users, that is, on the market. If there is such a demand for functions rendered by exisiting products, the products gain a certain value on the market. If requested functions are not rendered, the product will be difficult to sell in a market or to be used for any purpose. Knowledge of the product thus regularly also requires knowledge of actual or potential demand for functions in the market, so that products may be developed and produced, which not only fit the functional demand, but which do this at reasonable cost, with reasonable reliability, reasonable ease in their handling, servicing and maintenance, during a reasonable life-time.

   The capacity to both acquire and link product- and market-related knowledge is strategically vital for enterprises existing under conditions of market economies, but also much in request in planned economies. The capacity to link product and market related knowledge and to use the insights thus gained (in applying it to the categories 2 to 7 above) is what Schumpeter calls entrepeneurship.

10. Entrepreneurial know-how is the ability and capacity to link different types of knowledge in the above list together, in particular knowledge of types 4-9, sometimes also extending to 3 or even 2. The classical entrepreneur is the one described by Schumpeter, capable of picking up ideas, combining earlier (more or less well) known technology, and building a market for them, being capable of organizing the production of novelties and their marketing and servicing at attractive cost and price.

    Schumpeter has been describing the charateristics of the entrepreneur for the private enterprise or market economy. Clearly, entrepreneurs are needed also under other conditions, i.e. persons being motivated and capable of linking together different types of skills and knowledge to get innovations launched successfully, to get them accepted and used by (many) customers/users. Entrepreneurs will meet different contextual conditions if operating in a market economy, a centrally planned economy, a so-called mixed economy and, as a fourth case, the "MITI-economy" 1) of Japan, as a rather particular kind of a mixed economy.

The principal flows of knowledge

At first sight knowledge is often supposed to flow vertically from basic knowledge over research knowledge, development knowledge etc., to, finally, market knowledge (Figure 1, about here).

This flow scheme appears to be rational. As we will see later, there are, however, flows in the other direction as well. There is the principal (simplified) distinction between technology push (following the arrows in Figure 1) and market pull, reversing the arrows at least as far as necessary in order to find solutions requested by a market. There are many markets: consumers, producers, institutions etc.

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1) MITI = Ministry of international trade and industry.

The market economy

Figure 1 only comprises nine of the ten mentioned knowledge types. Entrepreneurial knowledge (Figure 2, about here) is of a separate type, as it is establishing links, transferring information, essentially using know-how about different types of information, about options and possibilities for the achievement of economic, social or other gains. Entrepreneurial knowledge or know-how is thus systemic in a particular meaning of the word, implying a capacity to see and manipulate various types of knowledge in an integrated whole.

Entrepreneurs become rather active in the linking process: they induce encourage, promote spontaneous feedback and feedforward loops in the depicted process. As a part of this feedback and feedforward of information, improvements in the involved subsets of knowledge and skills may be developed and materialized. Such improvements are a major source of economic progress. Improvement innovations are a specific kind of innovations, although as a rule not being very dramatic and visible. Taken together they are of very substantial economic importance. The entrepreneur may essentially be labelled as an information broker and gamesman.

The centrally planned economy

Figure 3 (about here) shows knowledge transfer in a centrally planned economy and is meant to correspond with that of the Soviet Union. In the right hand corner of the boxes of Figure 3 are the planning periods imposed by the formal planning hierarchy. The arrows between the boxes of Figure 3 rather correctly depict how the transfer of knowledge is assumed to take place in the formalized planning hierarchy. To the right in Figure 3 are depicted different organizational arrangements (areas of functional responsibility) of the context for innovations in the Soviet Union. The first column comprises production units: NPO, PO, 1) experimental enterprises like Electrosila. 2)

The column next to the right comprises the realm of competence of the industrial ministries and their subordinate institutions:

a. NII, industrial scientific research institutions (applied research related to the industry in question).

b. Design Bureaux, which, at the request of their ministry or of an enterprise, will produce drawings for buildings, production and production related premises, production machinery, as well as factory lay-outs.

c. Product Bureaux, which, at the request of the ministry or of an enterprise, will design new or improved/changed products.

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1) NPO = Scientific production organizations, essentially science based test or pilot installations
   PO = Producing organizations, the normal type factory or "enterprise".
2) Electrosila of Leningrad, an experimental factory with immediate access to research, development, and production engineering staff.

The organizations a), b), and c) are independent of each other, but under the immediate supervision of the ministry.

The use of solid versus dashed brackets demonstrates where the principal responsibility or activities may apply/take place. The dashed line along the PO and the industrial ministries also reflect the extent of reforms during recent years, implying i.a. the introduction of coordinating committees. The cooperation of export organizations in relevant cases is indicated, towards the marketing end.

Further to the right side some selected superordinate organizations' realms of activity are depicted, such as Ac. Sc. (for the Academy of Sciences), GKNT (for the State Committee for Science and Technology), GOSPLAN (for the Central Planning Authority), GOSSTAN (for the Standardization Office). GOSSNAB, (State Committee for Materials and Technical Supplies, the authority for inter-ministry = inter-industry supplies) acts essentially at level 5, the State Commission of Inventions and Discoveries, a patent office, at level 2. VINITI (the All Union Institute for Scientific, Research and Technical Information) is given the task to collect and disseminate scientific and technical information to relevant ministries.

To the left of the boxes of Figure 3 planned or spontaneous flows of information in the opposite direction are indicated, that is, feedback of information. The dashed lines indicate voluntary or occasional information flows, whereas the solid lines show where request for information normally is a regular procedure.

The mixed economy

The mixed economy (Figure 4, about here) does not entirely rely upon the capacity or presence of entrepreneurs arranging for information feedbacks. Another feature of the mixed economy is that central authorities will set priorities to different types of technology e.g. by means of so called positive or negative lists, depicting desirable or non-desirable industrial, economic, or social developments. Such lists are useful to smaller countries, regarding the inability of a smaller country to follow technological and other developments in all kinds of spheres, thus concentrating on certain, more or less narrow fields. Governments, or whoever is acting in lieu of a government, is both setting priorities and in many cases inducing a flow of information in particular to boxes 2 and 3.

The mixed economy through such selective processes (which may make the economy more or less vulnerable) introduces elements, which may be characterized as "soft planning". They imply no strict regulation, e.g. only permitting certain sectors to be developed. Anyone who wants and has access to the necessary resources, information and knowledge, may enter into fields not comprised by the outlined priorities.
(See also "The Bandwith of the Technology Spectrum" below).

The MITI-economy of Japan

The MITI-economy (Figure 5, about here) is essentially a market economy, with some guidance of similar type as described above under the heading "mixed economy". The real effect of the guidance, however, is stronger

than in the mixed economy, because of cultural and institutional peculiarities.

The "cultural" context gives Japan a much stronger cohesion and "in-group" character than elsewhere is to be expected in the highly developed industrialized countries. This certainly is also reflected in the institutional context:

a. Strong cohesion and cooperation coexist with fierce competition;

b. Loyalties to groups as well as agreements in and between groups are strong;

c. Large scale industry is essentially owned by - market oriented - trade houses (zaibatsus);

d. Voluntary developed and accepted cooperation under agreements prepared and negotiated by MITI (and the Bank of Japan) have proven to be very favourable and successful and have led Japan to a position in the top league of the foremost industrial nations. MITI has, together with its partners, chosen fields of emphasis, promoted worldwide information collection on such focal issues and triggered pertinent research efforts. Once a development in an area of emphasis is under way, however, competition amongst potent firms is free and fierce.

It should be mentioned that information collection, analysis, and dissemination on focal technologies have played and are playing a central role. Japan has been rather scarcely developed in box 1 (fast progress, however, is changing the picture). Japan's strength has been not only the strong emphasis on promoting information flows between the levels, but deliberately emphasizing systematic coupling of information between all of the levels 2 to 10.

As successful strategies tend to become well established and even further developed, it is to be expected that this coupling will be further strengthened. It is also obvious that Japan's perhaps one and only weakness until recently, that is domestic development of basic knowledge and genuinely new advanced technology, is to-day past history only. Recent outstanding successes in overcoming obstacles to scaling down of micro-electronic elements, will most likely boost Japan's efforts in this direction quite strongly.

The bandwidth of the technology spectrum

Market economies

Only the very large countries have the resources and possibilities to cover the bandwidth of technology in its entirety. Figure 6 (about here) is aimed at showing what is meant by the bandwith of technology.

On top of the figure (above box 1) a box "general education" has been introduced, deliberately stretching beyond box 1, basic knowledge, "laws". The reason is that general education goes beyond them in a range of issues like ethics, citizen education a.s.f. Deliberately also the box for general education is much flatter than the other boxes are, indicat-

ing that general education is stretching over broad fields at constrained depth.

The spectrum boundaries are then narrowing down over the first three to four boxes. This is meant to indicate that no country, not even a large one, has complete knowledge over basic laws in all fields, full coverage in knowledge about how to do research and how to develop new products and processes or how to implement them. The gaps left are covered by international exchange of information and knowledge. In some of the covered fields there are international markets on which knowledge is traded between countries, between industries and enterprises. There are also international institutional arrangements (in particular the international patent system), which, in turn, structure the international trade of knowledge and information, e.g. by means of licensing, leasing and other agreements.

At the bottom of Figure 6 are indicated broad areas of application, related to consumption, which in the market economy occupies a major sector of applications; the physical investment sector, comprising production, machinery, processes and related know-how; and, at the other end, public sector applications, comprising both public sector consumption, public sector physical investment and "soft-ware", related to both (public sector) consumption and physical investment. The public sector segment is the smallest of the three sectors mentioned. It, however, seems to be the fastest growing one during recent decades. (It includes also defense).

Figure 6 symbol ically indicates that areas of application comprise much broader sectors, and pertinent exchange of information and know-how knowledge than those covered by basic and applied research. This has i.a. to do with the fact that basic and applied knowledge is applicable to many and diverse areas of application.

The planned economy

The bandwidth of the technology spectrum for a planned economy (Figure 7, about here) differs from the one outlined for market economies, because it is planned and consequently focused on areas of emphasis. The reader should be reminded of the three cornerstones of the socialist economy:

a. public/collective ownership of the means of production,

b. the planning system (replacing the market in most or all places of the economy) and

c. the Socialist/Communist Party's responsibility for the welfare of the people.

By means of planning, the Party is capable to emphasize and assign priorities to sectors of the welfare system in a way which the market economy is not potent of achieving, not even in mixed and MITI-type economies.

The figure intends to indicate this. The reference figure "market economy" is shown by dashed lines. The areas of emphasis in the planned economy are shown in the shadowed area (the figure intends to reflect the situation in the Soviet Union).

The area of general education is represented in a similar way as for the market economy. This, however, should not be interpreted as an assumption of identity between the general education in the both systems. Certainly, there are very drastic differences.

Another mayor difference applies to the area of basic knowledge creation. Science in the Soviet Union in certain sectors is superior to the organization and performance of the science community in most market economies, but also in the market economies taken together. Because of the planning system it is possible to emphasize areas of research, which are extremely capital intense and thus require capital investment into laboratories to an extent which is simply not feasible in a market economy.1)

The science community of the Soviet Union is also superior in certain more abstract fields of basic knowledge and of laws.

The second major difference is also a consequence of the planning system: the knowledge production is essentially centered to (somewhat constrained) parts of the physical investment segment and to certain areas of the public sector.

The consumption sector, which plays a dominate role in a market economy, is not an area of emphasis (although the figure may slightly exaggerate this fact). This also implies that the emphasis on the knowledge/information production and handling concerning markets and products is much more concentrated but also limited. Further it implies that both research, development, implementation, production and process knowledge, production control and maintenance-/servicing knowledge is directed and constrained to the sectors of emphasis.

It deserves emphasizing that the entrepreneur is non-existent in a strict socialist economy environment. There is neither need nor action space for entrepreneurs. Their tasks are being fulfilled by the different institutional arrangements, in particular the planning commission and the Party.

Some differences may also be observed when it comes to the public sector in so far as it, by the very nature of the planning dogma, is much more targeted than ever to be expected in a market economy.

Impacts on development of knowledge of various types, as a consequence of differing strategies of international economic cooperation

Flows of consumption goods

A country importing consumption goods in early phases of development (to some limited extent even later) will stimulate learning and gaining experience in rather constrained ways. (Figure 8, about here). Essentially product knowledge will increase and, triggered by increasing product knowledge, also market knowledge on the one side and maintenance/servicing knowledge on the other. This however will happen in very narrow sectors of the economy only. In the continued development the experience which is being gained through handling imported products, also will exert certain, more or less indirect, influence upon development knowledge and, very remotely, there will gradually emerge a certain pull for research knowledge.

1) The European Community is undertaking efforts to improve the relevant capacity of its members by means of EC research and technology programs.

Technology transfer

Technology transfer is a much more diversified strategy (Figure 9, about here). Depending upon what type of technology is being transferred and where the emphasis is put, gaining of experiences will be stimulated and learning will take place. Figure 9 assumes that technology transfer is taking place into development knowledge. From there it will then quite naturally disperse in the following sequences: implementation knowledge and production/process knowledge, but also maintenance and servicing knowledge, later even product knowledge. It may also trigger a feedback loop between development knowledge and research knowledge as the development functions may need new inputs, thus stimulating targeted research.

Depending upon the stage of development in a system, the possibility develops to use the learning occurring and the experience gained through technology imports to a more deliberate development of knowledge in different phases, as indicated by the dotted lines and arrows to the left of the boxes in Figure 9. Here we have refrained from assigning priorities to different types of stimulation. The figure essentially aims at demonstrating what may happen in an economy to which technology is being transferred.

Joint ventures (technology and management contracts)

A third strategy of importing know-how from the outside is to enter into joint venture arrangements, which may be of different types (Figure 10, about here). Here the development and conclusions of technology and management contracts is being envisaged as a more advanced form of joint ventures (Figure 10a).

The exhibit is being left empty with a note indicating that joint ventures eventually may induce the development of entrepreneurial know-how (Figure 10a) or, in a planned economy, of planning knowledge (Figure 10b).

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KNOWLEDGE REQUIRED FOR INNOVATION

	Knowledge types	Availability
1.	Basic knowledge, "laws"	P
2.	Knowledge on how to perform research (professional)	SP (C)
3.	Knowledge for the development of products/processes	SP (C)
4.	Knowledge on how to implement new products/processes	SP (C)
5.	Production and process know how	SP (C)
6.	Knowledge on how to manage/control producing enterprise	SP (C)
7.	Maintenance and servicing know how	SP (C)
8.	Product related knowledge	PP (C)
9.	Market related knowledge	P
10.	Entrepreneurial know how	
	a) private enterprise economy	E
	b) centrally planned economy	SP
	c) mixed economy	E&P
	d) Japan (MITI-economy)	SP&E

Availability forms:

P. = Public

SP = Institutional, individual, partly public, partly secret

E = Individual, partly secret, becomes public as consequences of strategies applied, actions taken is discernible.

C = Classified.

Figure 1 Principal sources of data, information and knowledge related to innovations

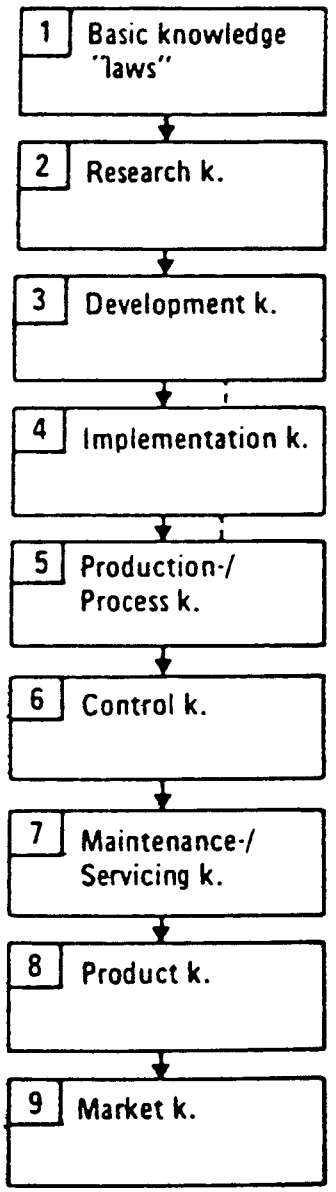
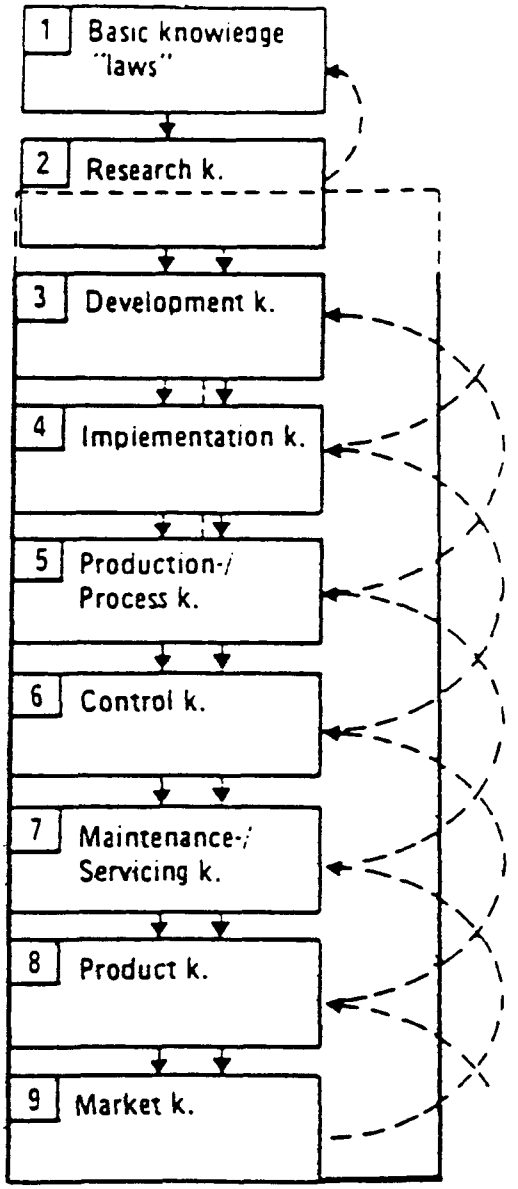


Figure 2 Knowledge transfer initiated by entrepreneurs - the case of the market economy

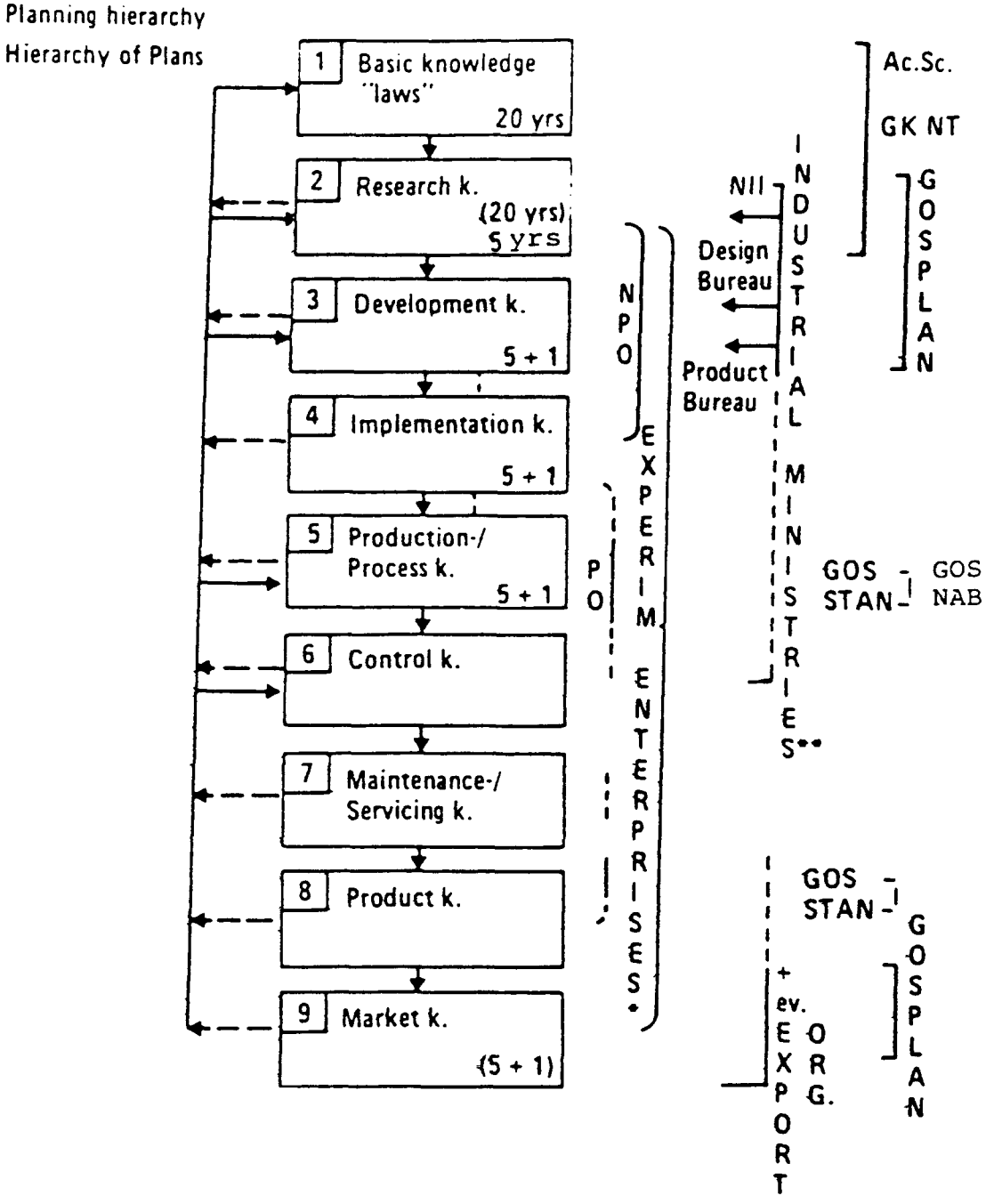


10 ENTREPRENEURIAL KNOWLEDGE (KNOW-HOW)

Spontaneous Feed-back and Feed-forward + Improvement effects at many levels (cf. Sahal)

Entrepreneurs induce, encourage spontaneous feed-back and feed-forward loops

Figure 3 CENTRALLY PLANNED ECONOMY (SU)



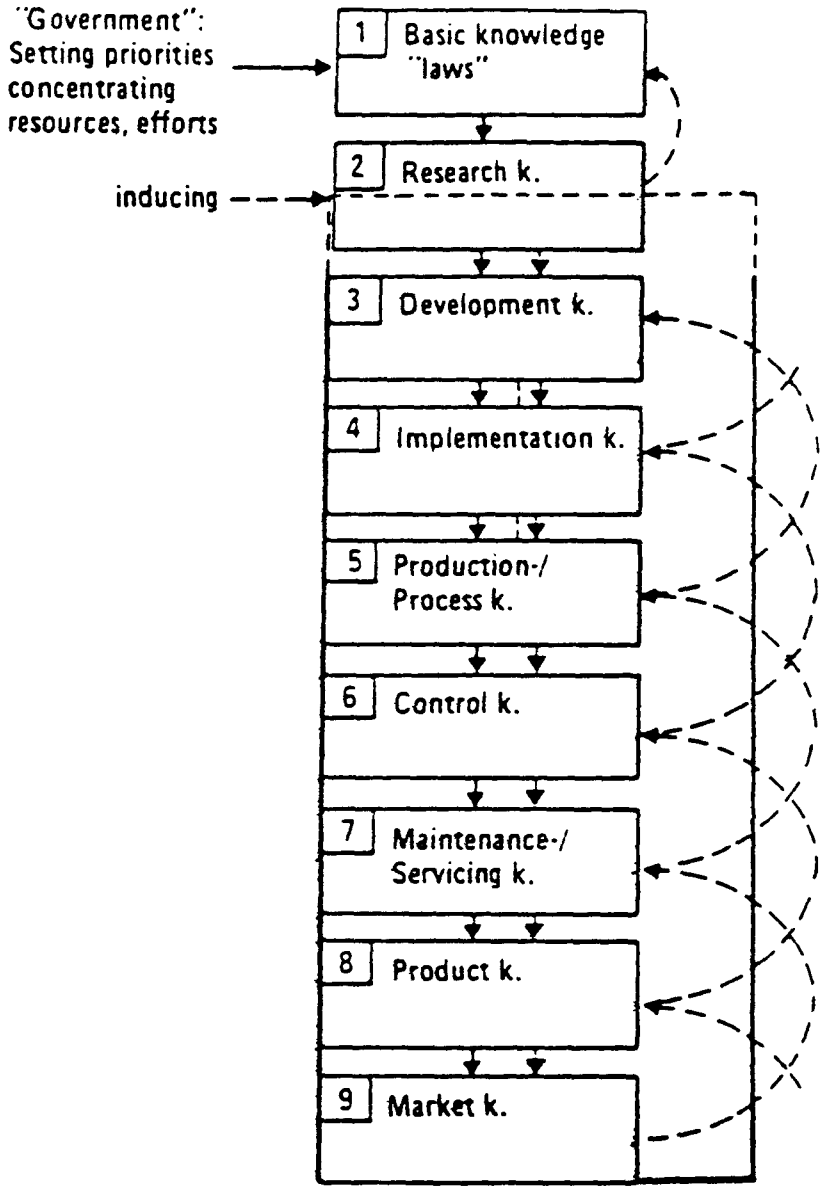
*e.g. Electrosila (in GDR and some other countries: the rule in Combines–Kombinate)

**The reforms of 1982, 1985 introduce coordinating committees on top of groupings of industrial ministries

←– – possible (if requested) flow of information

Figure 4

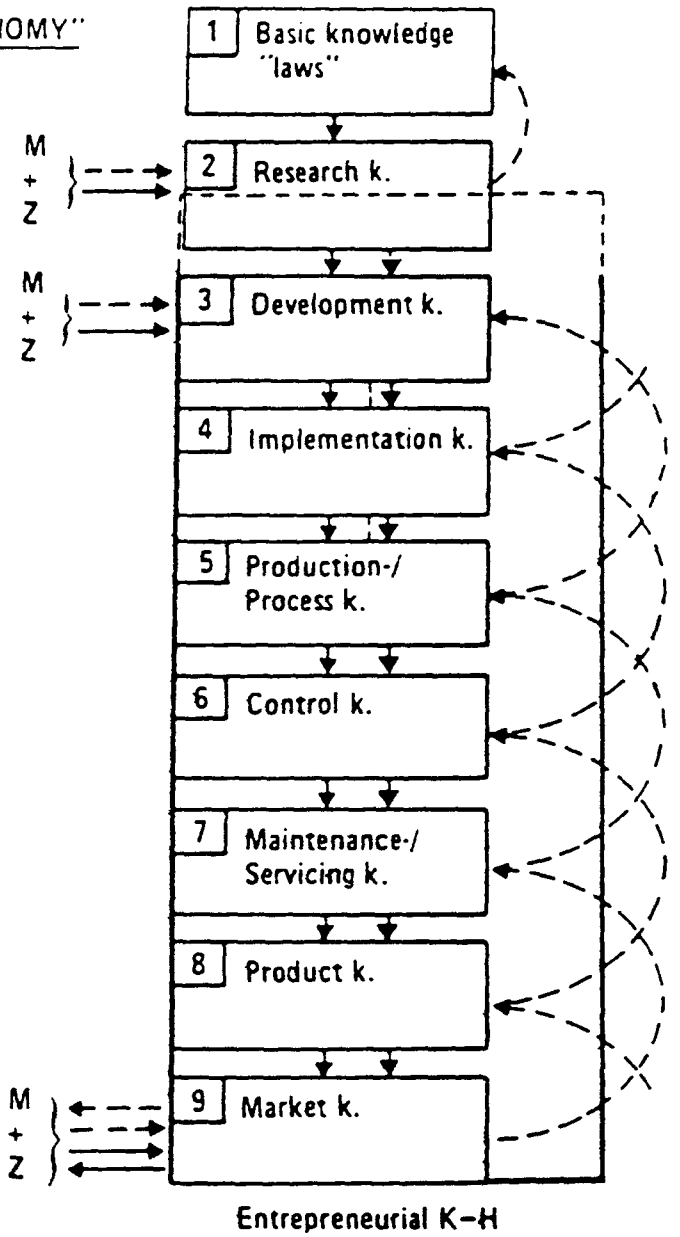
"MIXED ECONOMY"



Entrepreneurial K-H

Figure 5

"MITI-ECONOMY"



M = MITI (equivalent)
Z = Zaibatsus (+ banks)

Figure 6

BANDWIDTH OF THE TECHNOLOGY SPECTRUM, COMPRISING THE BANDWIDTH OF THE TECHNOLOGY FEEDBACK: MARKET ECONOMIES

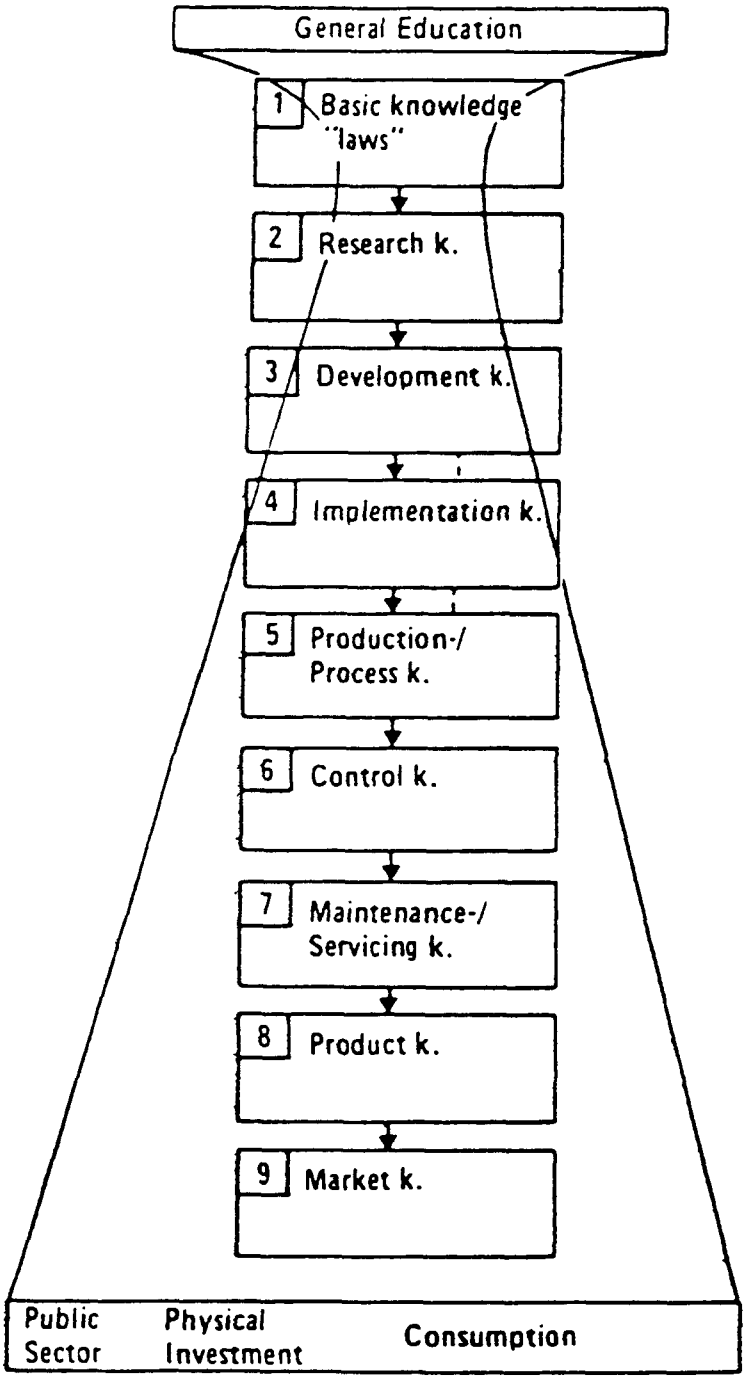
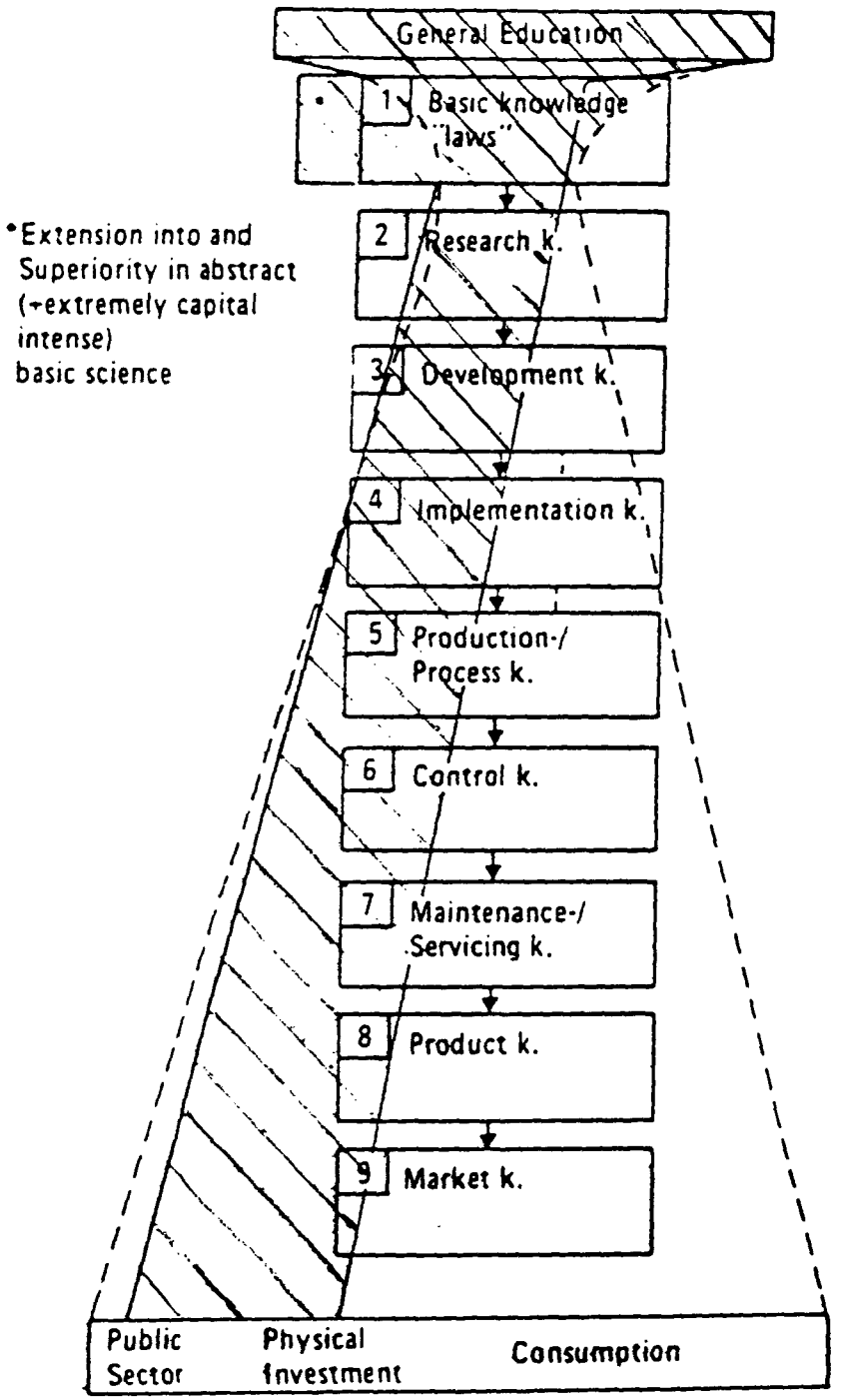


Figure 7

BANDWIDTH OF TECHNOLOGY SPECTRUM

THE PLANNED ECONOMY (SU)



— — — reference line only

Figure 8

STIMULATION OF LEARNING - GAINING EXPERIENCE

a) Flow of Consumption Goods

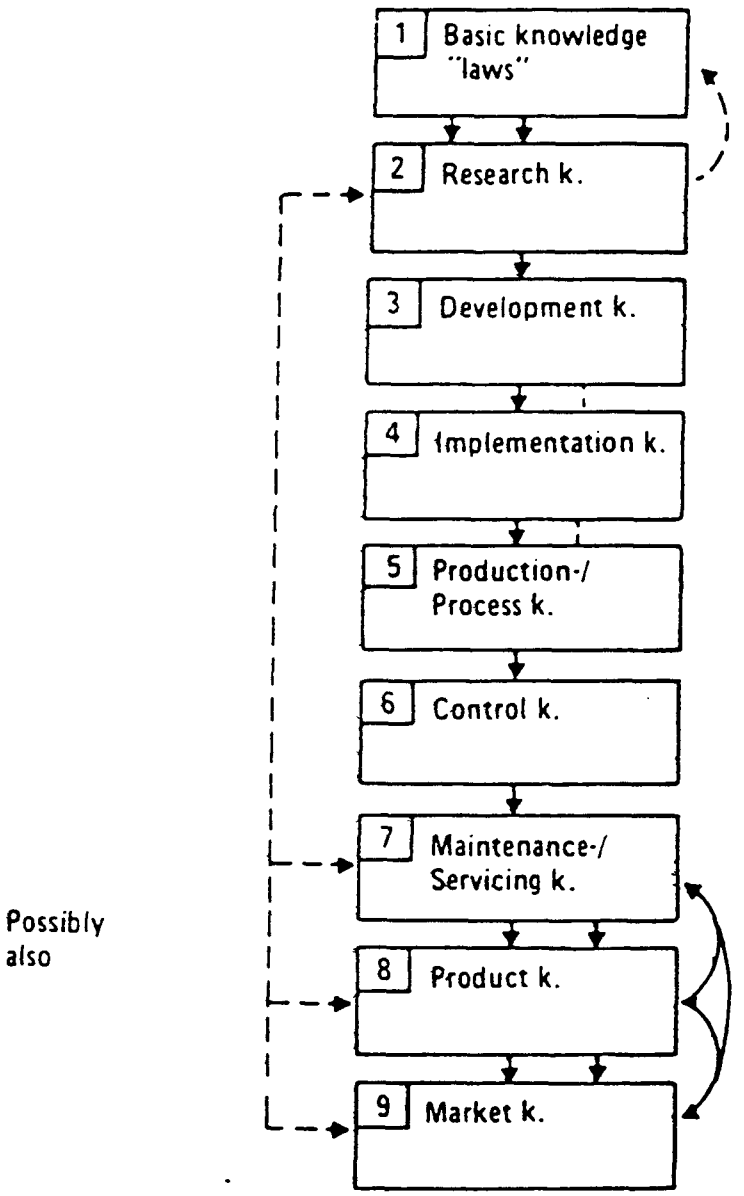


Figure 9

STIMULATION OF LEARNING - GAINING EXPERIENCE

b) Technology Transfer (TT)

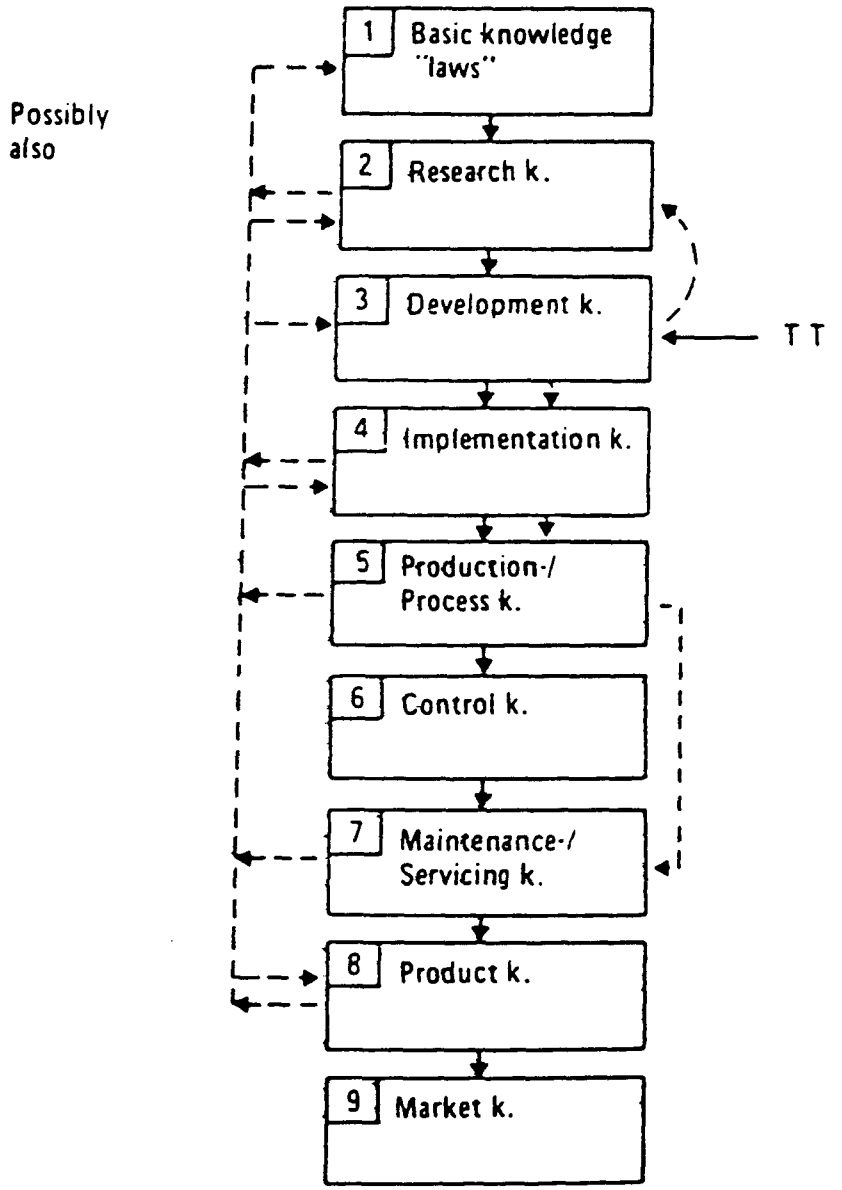


Figure 10a

STIMULATION OF LEARNING - GAINING EXPERIENCE

c) Joint Ventures (Technology and Management Contracts)

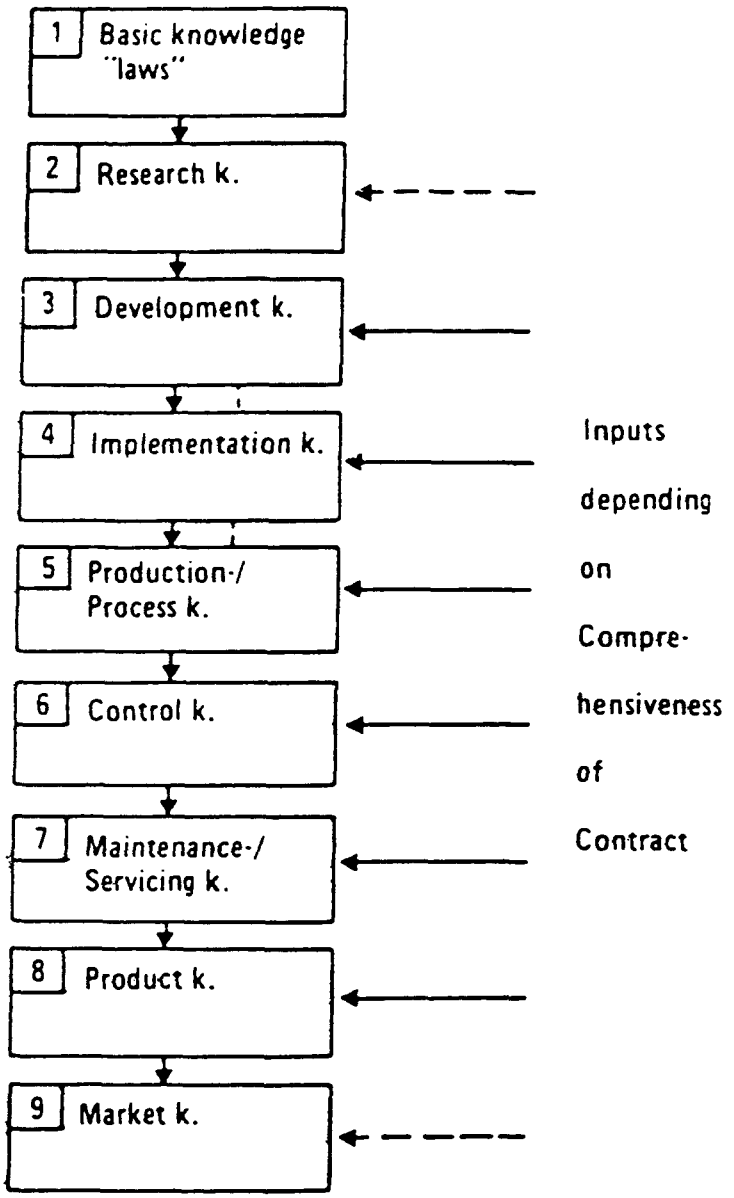
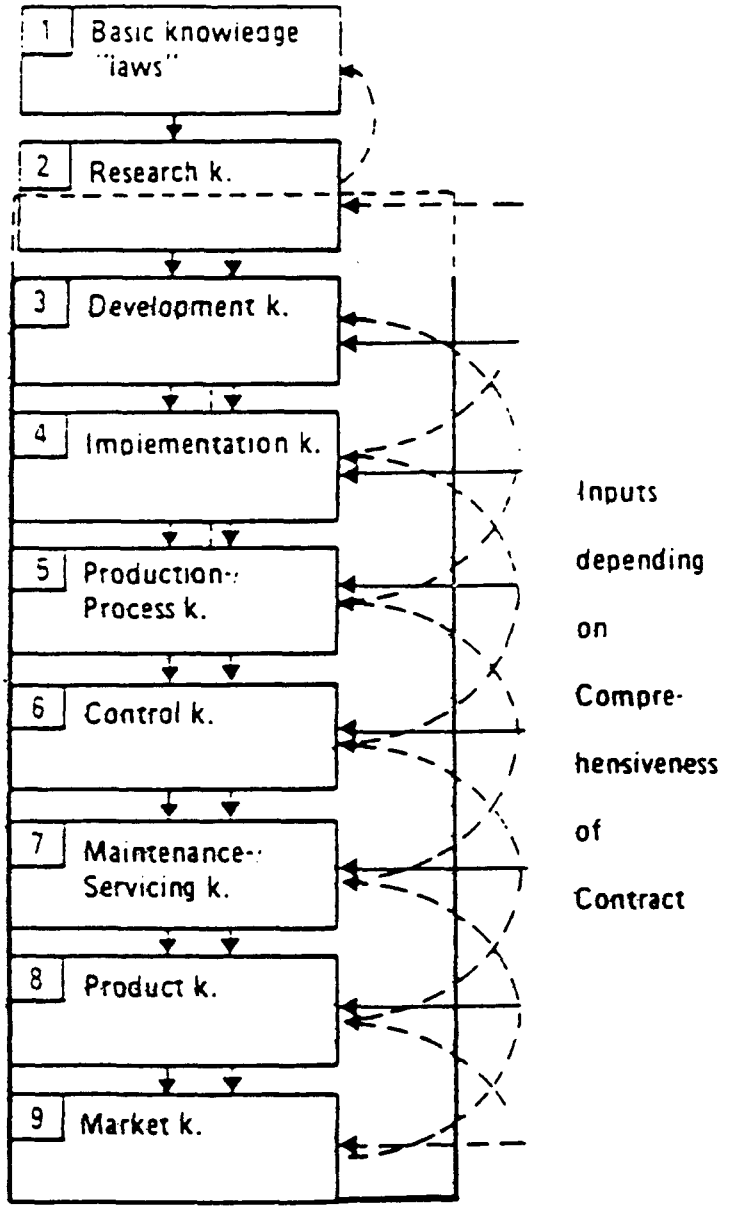


Figure 10b

STIMULATION OF LEARNING - GAINING EXPERIENCE: Market Economy

c) Joint Ventures (Technology and Management Contracts)



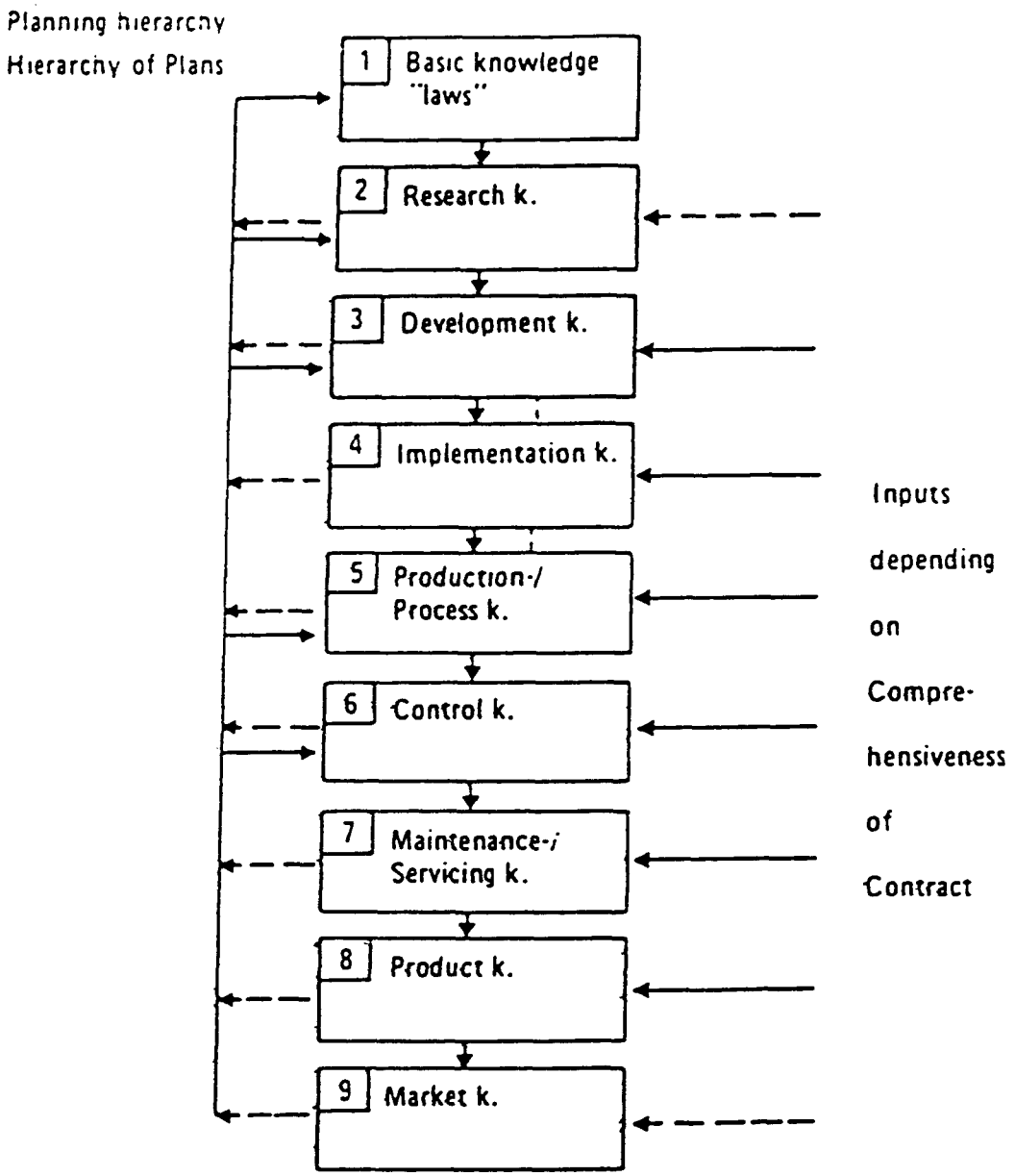
10 ENTREPRENEURIAL KNOWLEDGE (KNOW-HOW)

May eventually lead to development of
Entrepreneurial know how (cf. Fig. 2)

Figure 10c

STIMULATION OF LEARNING - GAINING EXPERIENCE : Planned Economy

c) Joint Ventures (Technology and Management Contracts)



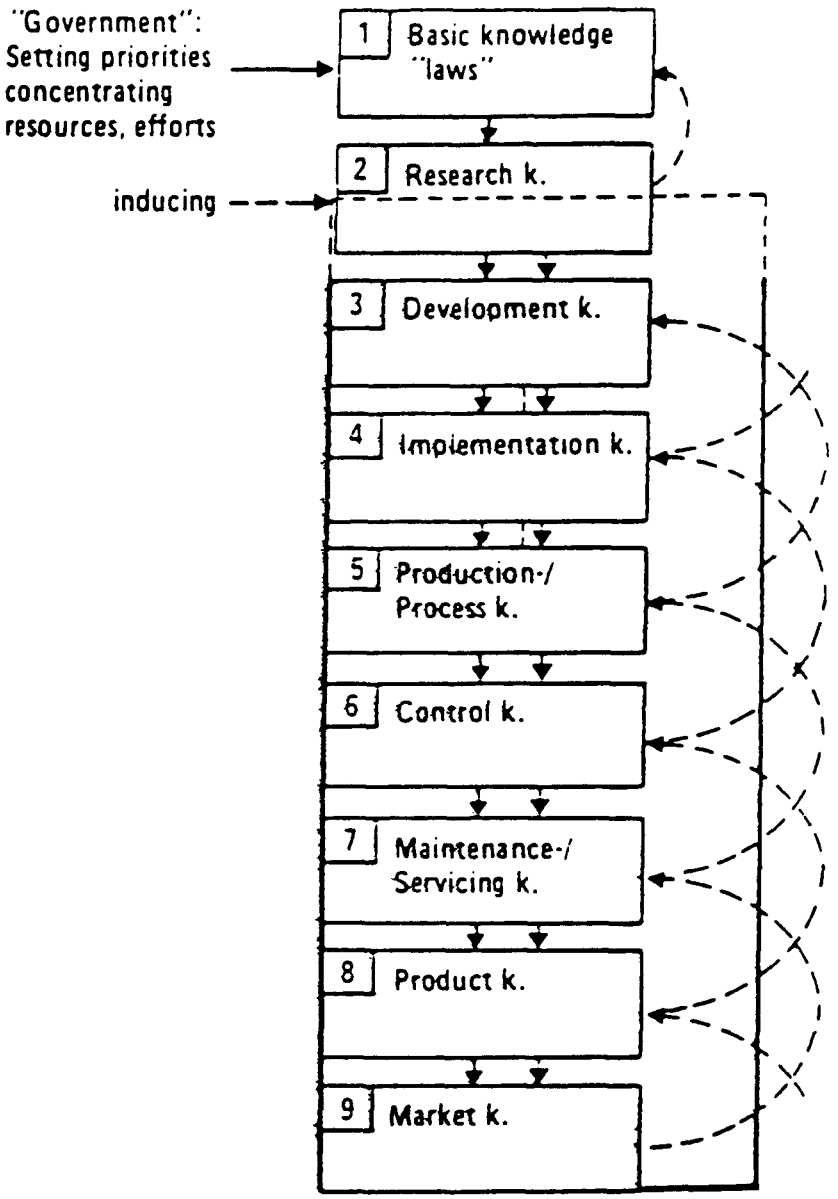
May eventually lead to development of

Planning knowledge (cf. Fig. 3)

←- - possible (if requested) flow of information

Figure 11:

"MIXED ECONOMY"



Entrepreneurial K-H