HUMAN RESOURCES, CREATIVITY AND INNOVATION--THE CONFLICT BETWEEN HOMO FABER AND HOMO LUDENS

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It is rightly said, that joint development of human powers is desirable and most preferable. But man is not born to that; indeed every person must form his own special character and must also try to seek the concept of what we all are together.

Goethe 1825
(Conversation with
Eckermann)

CONTENTS

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HUMAN BRAIN VERSUS DEVELOPMENT OF PRODUCTIVE FORCES

When we look at the long history of productive forces we can perceive the predominant role of human individuality and capability in all technological progress. In the working process all human labor functions were developed in two main classes: the technical, and the creative functions. Technical functions are the energetic, the operational, the control, and the logic (or preparatory) functions, and the creative functions are, empirical improvement, invention of new techniques, and theoretical analysis and goal setting. Technical functions of labor are replaced by technical means in various directions, starting with the lowest level (energetic functions) up to higher functions and giving man more opportunities for creative work. And so a feedback to human abilities is realized.

According to archaeological studies we can compare technological development with an increase in the volume of the human brain (Figure 1). 1,800,000 years ago when production of clumsy flint weapons and instruments began, an increase in brain volume from 500 to 800 cm^3 occurred. 75,000 years ago the homo sapiens neanderthalensis reached a maximum with 1500 cm^3 upt to 1700 cm^3. At present, the human brain has an average volume of 1400 cm^3. The great memory requirements needed for acting without any background of abstract or theoretic thinking may be the reason for the enormous brain capacity of the homo sapiens neanderthalensis. On the other hand, the transition to abstract thinking was enabled by the quantitative growth of the human brain. Physiologists say that we use only 5 or 10 percent of the capacity of our brain. At present under the conditions of the information explosion, we again have high memory requirements. But this is also a question of further progress in theoretical thinking. Discovery of new laws and theorems frees us from the necessity of remembering large numbers of facts. To give an example; at the time when electricity

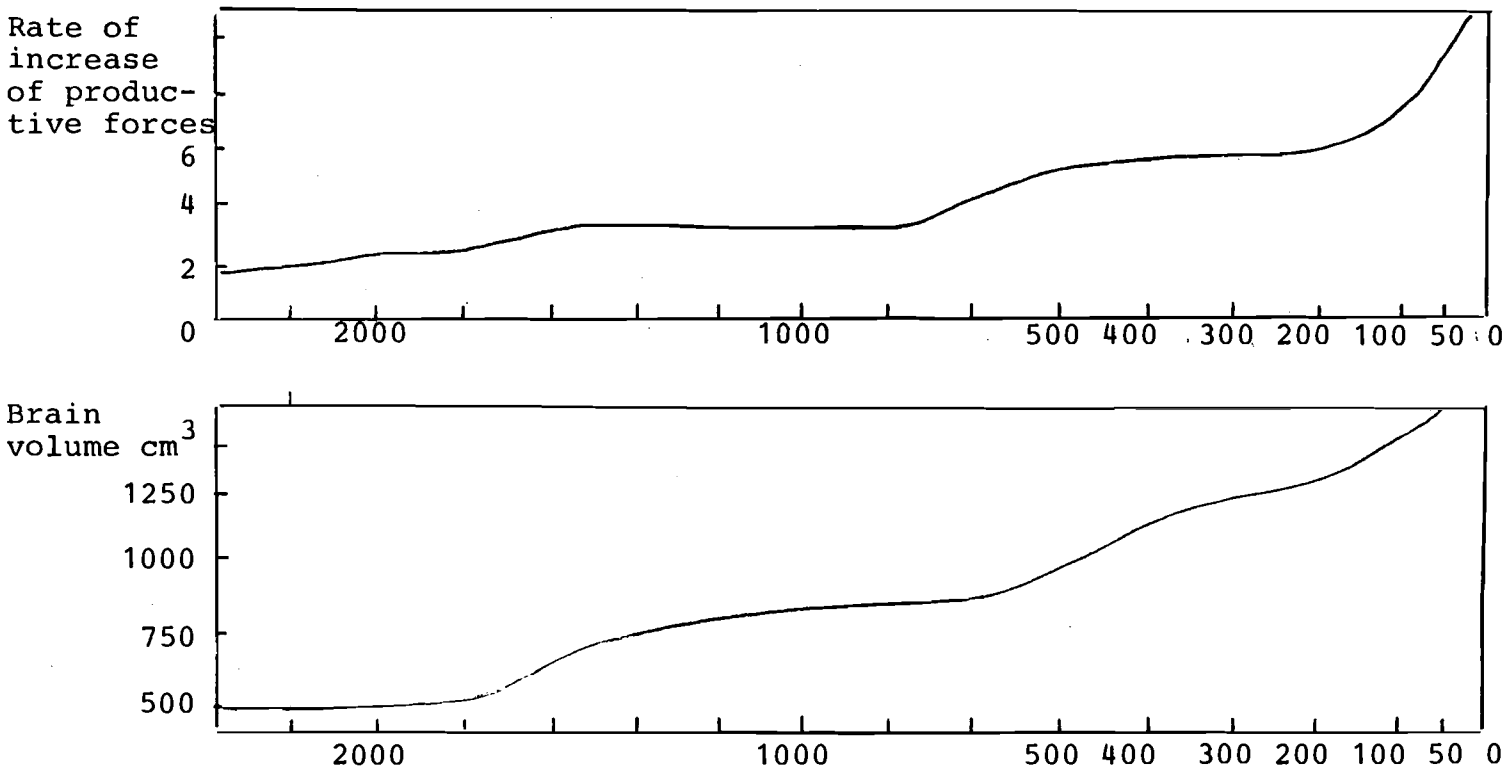


Figure 1. Development of productive forces and brain capacity over a period of 2 million years.

Source: Herrmann, J, Spuren des Prometheus, Urania-Verlag, Leipzig, Jena, Berlin. Page 33.

was a well-known but not a theoretically explained phenomenon, the old textbook of Wiedemann had more than 1000 pages about galvanism. After Maxwell's theory the same information could be given without unnecessary detail and was more applicable, and took up only 50 to 100 pages.

GENERAL INTELLECT--THE MOST WASTED RESOURCE

When considering the individual brain, I mentioned their high capacity utilization gap. However, we find a greater gap if we investigate the general intellect of mankind. General intellect of mankind is not as simple as the sum of 4000 million brains. It is a social resource potential which is realized through socio-economic interaction of people. The social character of creativity is the most important point in studying the economic implications of creativity. Most of the material resources could be used in the past in an economic efficient social way, that was connected with ownership rights. Fixed capital, like other physical capital can be owned, bought and sold. Ownership rights are well defined with fixed capital, but the output of creativity is new knowledge and ownership rights are imperfect in new knowledge.

Creative work is general work, using the results of a long chain of predecessors and having far reaching, often incalculable, social consequences. If we include in creative work not only the efforts of basic research, but also the new and helpful thoughts on all stages of the innovation process, we can also realize the social dimension of creativity. Thus creativity as a social potential is not the same as the creativity of an individual. In reality there is no homo ludens, but an interaction of people with creative and routine abilities under given socio-economic relations towards social goals and objectives.

If one wants to talk about the present creative potential of society or of mankind it is not quite exact to speak about a human gap, because this is liable to misinterpretation. Individual learning ability and creativity is only a single element and not the main point in changing social creativity potential. Otherwise it would be enough to state that if we taught mankind better than all problems would be solved.

Therefore our conceptual approach is the following: if we look at societal development from the standpoint of human forces, we can distinguish between societal learning and societal creativity push (Figure 2). Societal learning is a very complex phenomenon, which is very generally defined as adaptation of social man to a changing environment. Societal learning consists of a dynamic and a static element. The static element is called by the authors of "The Human Gap" (The Club of Rome, 1979) "maintenance learning" or acquisition of fixed outlooks, methods, and rules for dealing with known and recurring situations. The dynamic element is also called by these authors "innovative learning", a type of learning that can bring change, renewal,

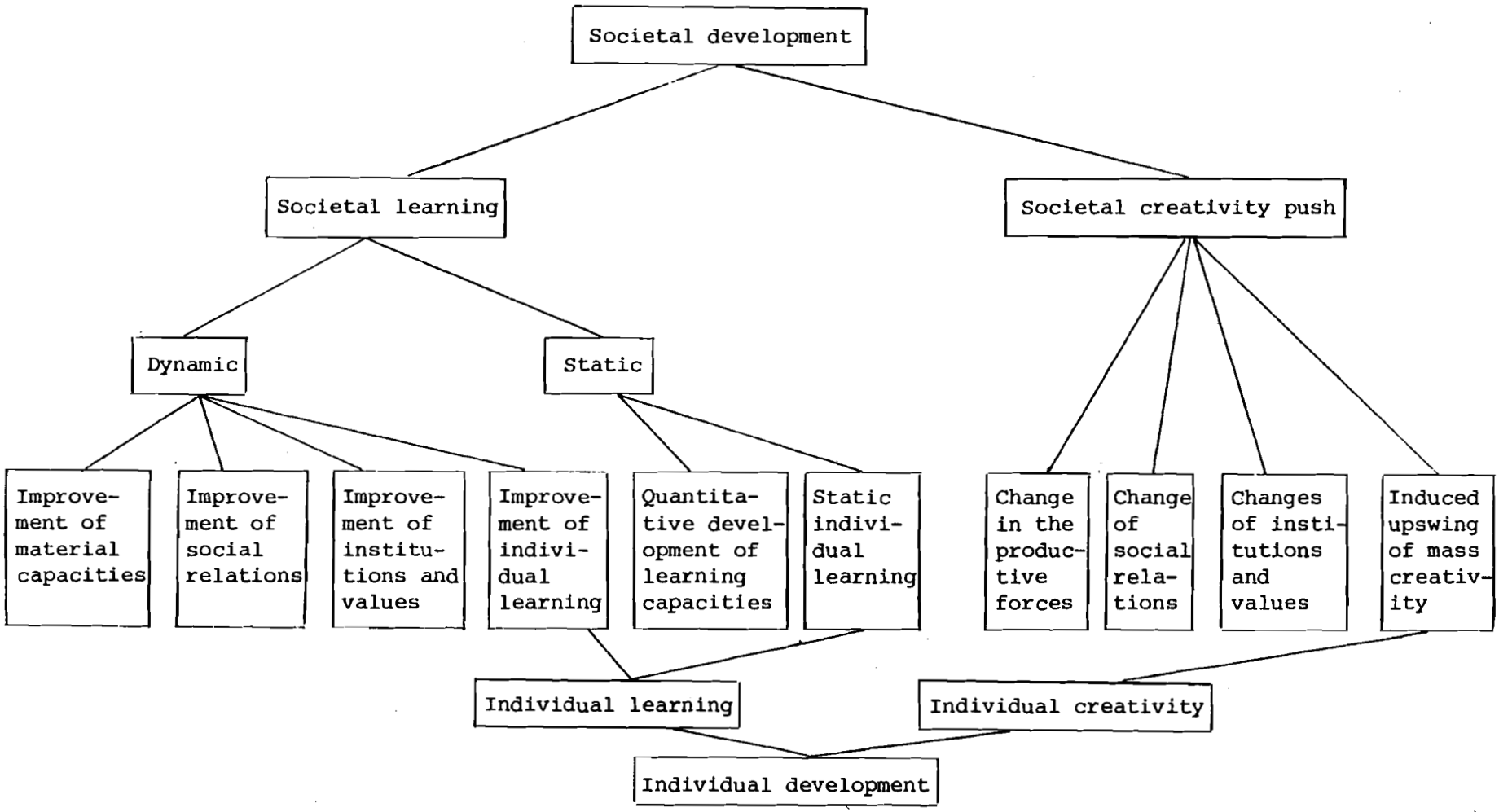


Figure 2. Societal learning and societal creativity push as two sides of societal development.

restructuring, and problem reformulation. This is a very useful distinction within the learning process. But of course we cannot reduce the 'human gap' to a 'learning gap' and also not extend the learning term on all human activities. As we stated in another context, the 'learning boom' in literature is only a mental reflection of the 'improvement approach' in general. Human activity is closely connected with learning, but at the same time it has a creative component leading to breakthroughs and to the beginning of entirely new learning curves, not comparable with the former.

Societal learning cannot be reduced to a certain sum of individual learning. Dynamic societal learning is connected with improvement of material capacities, of social relationships, institutions and values as well as the improvement of individual learning.

Another side of human activity is creative change in productive forces, in social relations and in institutions and values, connected with an upswing in societal creativity. A societal creativity push cannot be reduced to a small number of Nobel Prize winners or representatives from basic research. It can be a very complex phenomenon in science, in arts or in technological progress. The elitist approach to creativity gives main attention to leading key people in creative change, but this approach does not take into account the social background of the individual forerunners, as well as the social backing and implementation of their ideas which is also a process which needs the creative support of many people.

Societal learning is a very powerful means of adjusting societies to evolution of needs and natural conditions, but it is not enough to overcome global resource crises and other global problems. For this we need a real societal creativity push connected with overcoming social barriers which inhibit the solution of global problems.

When we pay most attention to the creativity push this does not mean that we can forget about the interdependence of creativity and learning. There is no creativity without learning and conversely learning is influenced in many ways by creative pushes. In various societies the relationship between learning and creativity was quite different. The birth and upswing of a society brought an important creativity push, mainly on the side of the leading forces, further progress was supported by less creativity, and more by dynamic learning; and a lack of creativity and dynamic learning was the environment for stagnation and decline for a given social structure. Learning and creativity can be realized in a conscious or in an unconscious way, from the standpoint of a societal or historical consciousness.

Unconsciousness, or not being aware of global problems which threaten mankind's existence, is a great danger today because it leads to a long delay in feedback and reaction time. Therefore the authors of "The Human Gap" are right when they call for more anticipation and participation activities.

In our opinion only a real creativity push in accordance with fundamental changes in societal goods and values can solve the problems that mankind is now faced with. This means a co-evolution of social relations, goals and values on the one hand and means of production on the other, not only by adaptation but also through creative restructuring of the whole system (Figure 3). This is the logical conclusion which we can draw from the statement by the Club of Rome, that the problems of mankind are now fundamental.

We cannot say that great philosophers of the past have not foreseen the danger for mankind, it had an important anticipatory power, when for example, Marx stated "the devaluation of the world of Man increases in direct proportion to the overvaluation of the world of things" (Marx 1844). Similar statements were made by Rousseau, Diderot and Saint-Simon before Marx..

It is indeed a great paradox, that human creativity can bring about at the same time both positive results and those which are socially devaluating such as the arms race, unemployment and social and mental degradation. Over 500,000 scientists (nearly half the world's total) are engaged in anticreative weapons research.

One of the most striking problems is the world's illiteracy rate and the disproportionate distribution of rational knowledge and learning capabilities over countries, races, sex and social strata. This can be measured by simple statistical data. Table 1 shows the share of groups of countries in material resources, but also in human resources and their utilization. Developing countries which have a 48% share of the population and 49% of the world's surface can use their human capital only 4-12 times lower than their raw material, if we look at their numbers of scholars and engineers and their patent notifications. In 1970 the world had more than 670 million illiterate people of age fifteen and over. (The population age 15 and over was roughly 2200 million.) Most of these live in the developing countries and UNESCO estimates that in 1980 there will be 820 million illiterate adults, a full one-fifth of the world's total population. In addition to this, we have the phenomenon of the brain drain from developing countries to developed market economies. Within various developing countries we also have large differences (Table 2). Education enrollment ratios for the 3rd level differ from 0.13 for Benin up to 14.23 for Argentina. On the other hand enrollment ratios for developed market economies are not an exact measure. They do not show the so-called functional illiteracy--the inability to read or write well enough to apply for a job. In the US where public expenditure on education is twenty times higher than in the African states (Table 3) some 23 million adults (10% of the population) seem to be functionally illiterate.

Human intelligence and human creativity are the main economic resources. But we can state that their utilization level is very low according to formal measures (enrollment ratios, expenditure on education, unemployment ratios and others).

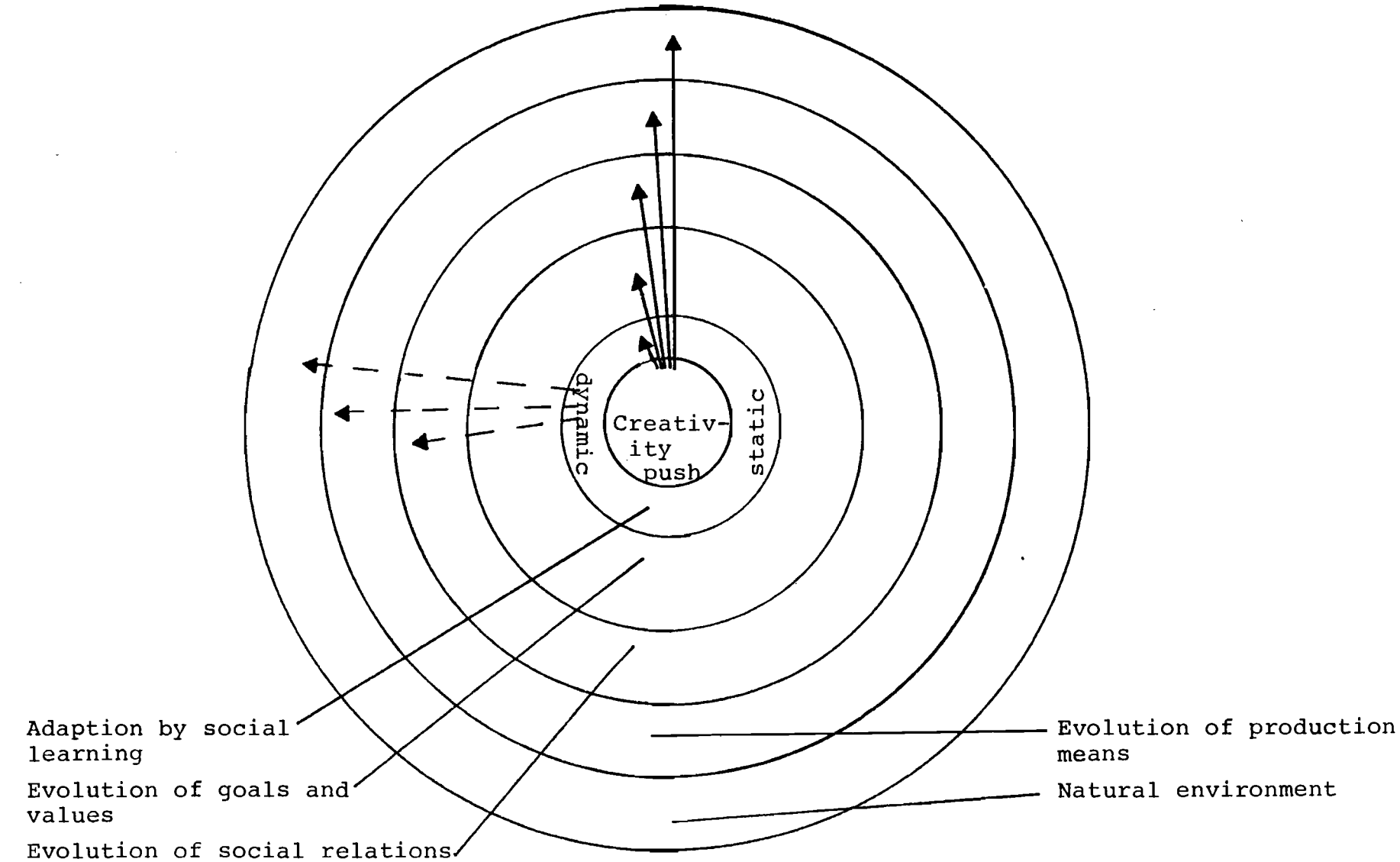


Figure 3. Creativity push and necessary co-evolution of production means, social relations, goals and values.

Table 1. Share of groups of countries in surface, population, raw materials, energy consumption, industrial production, illiteracy, scholars and engineers, R & D personnel, and patents (%).

	Surface 1977[1]	Population 1977[1]	Raw material production 1970[2]	Illiteracy 1970[6]	Industrial production 1975[4]	Energy consumption 1976[3]	Scholars & engineers 1970-3[5]	Patent nnotification 1974
Planned economies	26	33	28	11	40	31	49	30
CMEA countries	18	9	--	0.5	35	23	--	--
Developing countries	49	48	27	87	10	13	6	2
Developed market economies	25	20	45	2	50	56	45	68

[1]Statistisches Jahrbuch der DDR 1978, p.29.

[2]Spröte, W., Thiele, G. Internationale Wirtschaftsbeziehungen und Entwicklungslander, Staatsverlag Berlin 1978, p.24.

[3]UNESCO Statistical Yearbook, 1977.

[4]Kuczynski, J., Die Krise der kapitalistischen Weltwirtschaft, Dietz Verlag Berlin 1976, p.10.

[5]East-West Technological Cooperation, Brussels 1976, p.207.

[6]Estimation according to UNESCO Statistical Yearbook, 1977.

Table 2. Education enrollment ratios in various countries.

Country	Education enrollment ratios 1970		
	1st and 2nd levels		3rd level
	Refer. years	Per-cent	Percent (20-24 years)
Planned economies			
Bulgaria	7 - 17	95	14.47
USSR	7 - 17	92	25.30
GDR	7 - 18	93	32.77
Cuba	6 - 18	74	3.69
Developing countries			
Argentina	5 - 17	75	14.23
Brazil	6 - 18	55	5.26
India	5 - 15	50	6.39
Algeria	6 - 18	45	1.70
Angola	10 - 14	38	0.47
Benin	6 - 18	23	0.13
Egypt	5 - 16	52	7.92
Ethiopia	7 - 18	11	0.21
Somalia	6 - 17	6	0.38
Developed market economies			
US	6 - 17	101*	49.43
Japan	6 - 17	93	17.01
Canada	6 - 19	88	34.59
UK	5 - 17	88	14.07
Austria	6 - 17	84	11.76
FRG	6 - 18	78	13.41

Source: UNESCO Statistical Yearbook, 1977.

*The number of 101 is not so surprising if we take into account the so-called secondary illiteracy. So the numerator can be higher than the denominator, which includes only the number of people between 6 and 17 years.

Table 3. Estimated public expenditure on education per capita, in US dollars.

Region	1965	1975	Index (1965 = 100)
1. Northern America	187	480	257
2. Europe	62	230	371
3. Arab States	9	57	633
4. Latin America	13	46	354
5. Africa (excluding the Arab States)	5	17	340
World total	38	109	287

Source: Statistical Yearbook, UNESCO 1977, p.103.

It is a great paradox that human abilities are the most important economic resource, but at the same time they are the most wasted resource of all. There are many studies and books written about the energy gap, but far fewer studies about the creativity usage gap. In the long period of human history, only in the earliest times of new progressive societies was there a clear tendency to improve the use of creativity. Alternatively we know of the excesses in wasting human creativity over long periods in wars or in unproductive work. According to Herodot, 100,000 men worked for 20 years to erect the Cheops Pyramid. This enormous expenditure and loss weakened the economic power of the first ancient class structured society and led to a deep social crisis in the 22nd century B.C.

ECONOMIC DIMENSIONS OF CREATIVITY--A PARADOX?

Human intelligence is generally assumed to be a normal distribution in a given population. Some empirical studies found a standard deviation of 16 in the American IQ. So 68.26% may have an IQ of 100 ± 16, 95.44% an IQ of 100 ± 32, and 99.74% an IQ of 100 ± 48. The real frequency distribution of intelligence is very difficult to determine. It is only possible by special tests, having limited importance for the phenomenon as a whole. But the concrete parameters of the frequency distribution as a whole are mainly determined by social and educational factors. It is much more difficult to estimate any frequency distribution of creativity. It may be possible by special creativity tests. The IQ tests are not appropriate for this purpose. It was found that people with a relatively high IQ were not as creative as people with a lower IQ.

It is more difficult to make an economic measurement of creativity. One knows how a mechanic calculates for instance,

For work done	$ 5.00
For knowing how	$ 45.00
Total	$ 50.00

and of a lawyer,

Woke up in the night and thought about your case:

Say $500.00

By this illustration one can humorously show the fundamental problem of measuring creativity in economic terms. Creativity is in general the human ability to find new thoughts, which are goal-oriented and directly or indirectly connected with the improvement of human existence. So we consciously define creativity in a positive sense. The question is, is there any possibility of measuring creativity in economic terms? Measurement in market terms presupposes comparability and exchangeability, but creative results are not comparable per definitionem. There is no strong correlation between labor time, labor value and creative results. There is only a social correlation between free or disposal time and other conditions for creative work, and the probability of creative results. But this correlation includes a lot of social factors. Having free time at ones disposal, creative work is often not the main option for people. For example the mass media, led by profitability goals have strong anticreative influence. Today's average 17 year old American has seen a total of 350,000 advertisements and witnessed 20,000 televised muders. The poor do not use their free time in a creative way. They watch proportionally more television than the rich. It is sometimes said that the human brain is the only substance having a steady rising value. But what is meant by this? The social value of the human brain is decreasing if we look at the modern world. An economic value of the human brain in terms of profit is plausible, but this is the extension of the world of possessions to the human world, which is so dangerous for the future of all social creativity.

A wide range of hopes is connected with the future of communication systems. The use of mini-computers at home could be a perspective for learning and creative gaming. But at the same time it might be a way of restricting homo faber to homo ludens, to pure man-the-player. Development of societal and group relations between learning and becoming creative people is much more important than any isolated game with nature in the way Robinson Crusoe acted, and even Robinson Crusoe needed a colleague.

Despite the complexity we believe that an economic measurement of creativity is possible. Our main idea is that active participation of working people in the innovation field is a fairly good indication of creativity in the production area. In this area we have to differentiate between the following eight fields of creativity.

	Direct process (Hardware and software) a	Management (Including orgware) b
1. Research		
2. Creation of new practical devices or processes (Invention)		
3. Introduction of new practical devices or processes		
4. Improvement of given technologies		

Creativity in research in an economic and social phenomenon can be indirectly measured by the number of discoveries, the number of Nobel prize winners (a very limited approach!), the share of fundamental research or the time-structure of research work. But most of these measures are very weak. For example, a forecast of 1969 gave the following figures for the time-structure in R & D in the GDR (percent).

	1970	1990
Man-machine dialogue	0	16(12...20)
Creative work without modern auxiliary means	30	32(20...50)
Planning and management	10	15(10...20)
Reading, qualifying	12	20(15...25)
Routine work without modern instruments	48	17(10...40)

However, such figures are very vague. The problem is that creative work and routine work are closely interconnected. We can say that for complex practical problems there is always a certain mixture of routine or simple know-how and creativity needed. Figure 4 shows the situation. Without routine there is no success in practical problems, and without creativity there is only little or diminishing success. Lord Rutherford mentioned:

> Every man depends on the work of his predecessor. When you hear of a sudden unexpected discovery--a bolt from the blue as it were--you can always be sure that it has grown up by the influence of one man on another, and it is this mutual influence which makes the enormous possibility of scientific advance.

The mutual influence of know-how and creativity is a great driving force. But at the same time creativity is the opposite of routine. Through creativity it is possible to substitute a great amount of routine work.

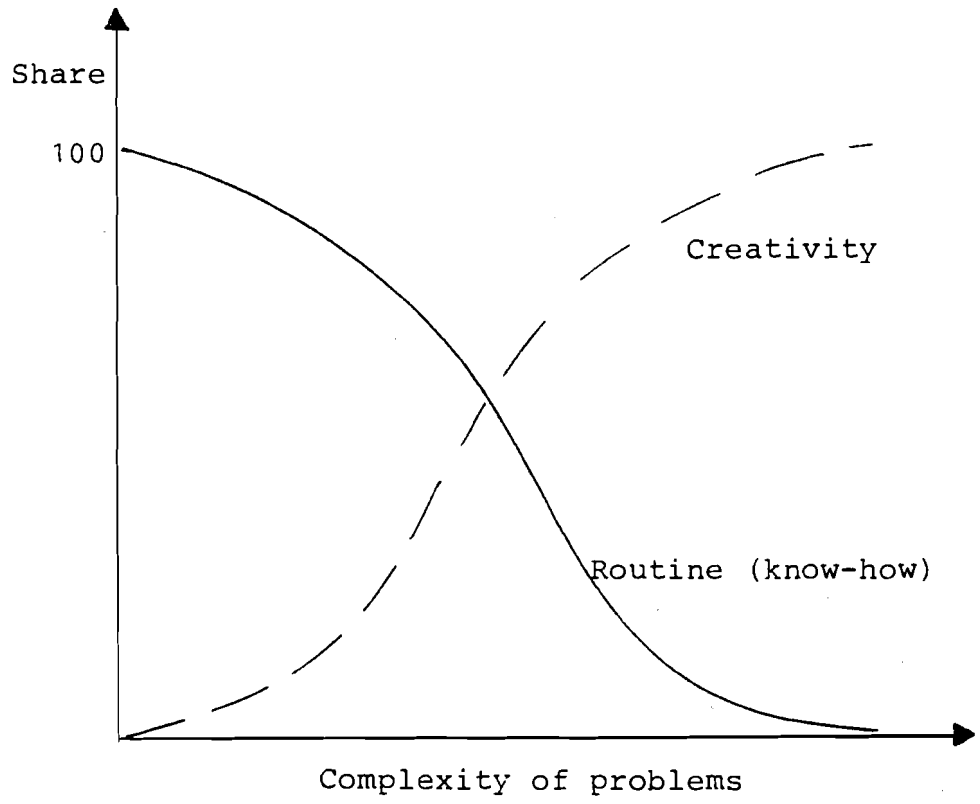


Figure 4. Relation of creativity and routine in problem-solving.

Economists very often say that creativity is a nonexhaustible resource, not having diminishing returns. However, I think that historians would not agree with this. Social creativity is not only the sum of individual creativities, it is an historic phenomenon having the same ups and downs as economic activity. We cannot assume that social creativity is simply a nonexhaustible resource. It has its inner conflicts leading to positive or negative feedbacks.

1. The conflict between the given level of qualification and creativity and the given level of technology and equipment.

2. The conflict between our knowledge about nature or our creative activity towards nature and our knowledge about society, or our creative activity towards society.

3. The conflict between the productive and the destructive consequences of creativity. Creativity accelerates technological progress, but at the same time it leads to the devaluation and obsolescence of former advanced devices.

4. The conflict between homo faber and homo ludens, or between social power and creativity.

These conflicts play a decisive role in paving the way for new configurations of social creativity.

Let us first look at the conflict between technological base and creativity.

THE CONFLICT BETWEEN TECHNOLOGICAL BASE AND CREATIVITY--A SOCIAL PROBLEM

We all know the situation; the first generations of mechanization and automation freed man from operational work, leading at the same time to a higher demand in lower qualified personnel. For example the share of skilled workers in GDR industry in 1962 was 44.4% of all workers and only 40.1% of machine workers. The same figures in 1970 were 52.3% and 50%, and in 1977 61.4% and 59%.

Higher levels of mechanization and the first steps of automation are connected with mass production, and conveyor belt production offers less opportunity for qualified work. This is true for the operator, and to a certain extent for other employees also. The increasing capital intensity leads to a strong orientation towards improvement of given technological systems connected with changes of a lower order. Nobody is interested in essential changes if they are interlinked with big losses in advanced capital funds. On the other hand, in the last 30 years there was a real education revolution in the GDR as in several other countries (Table 4). In connection with the reduction of labor time, real emancipation of women, and introduction of polytechnic education, these measures led to greater opportunties, but also to greater expectations in creative self-realization.

It is not so easy to determine the education effect on productivity. It is closely linked with other effects from scientific-technical progress and substitution of labor by fixed capital.

Table 4. Qualification level in the GDR economy 1950-1990 (%).

Year Year	Unskilled and semi-skilled workers	Skilled workers	Technical school graduates	University graduates
1950	71.0	27.5	1.1	0.4
1970	24.6	58.2	11.1	6.1
1990 (Forecast)	10 - 15	64 - 68	14 - 16	9 - 12

On the national or macroeconomic level we analyzed the production function between gross product P*, capital funds C, educational funds E, and research and development funds R. We found, for example, in the GDR economy of 1950 to 1972

$$\lg P^* = 1{,}6238717 + 0{,}3744 \lg C + 0{,}1787 \lg E + 0{,}0525 \lg R + 0{,}1729\, t$$

with a very good statistical significance.

C = capital funds (fixed capital and circulating capital)

E = cumulative educational costs, needed for qualifying the existing manpower to the given level (educational funds)

R = research and development costs, added over a period of 12 years (R & D funds).

One can see that educational funds have only a less important influence on production growth than technical funds represented by capital, measured through this method. We found the same result for the period 1960-1975 using four functions:

$$P = C\, E^{\alpha} F^{\beta} \qquad (1.1)$$

$$P^* = C\, E^{\alpha} F^{\beta} e^{pt} \qquad (2.1)$$

$$N = C\, E^{\alpha} F^{\beta} \qquad (1.2)$$

$$N = C\, E^{\alpha} F^{\beta} e^{pt}$$

P = net value of production at constant prices,

E = educational funds,

F = fixed capital at constant prices,

N = benefits from inventions and proposals.

The results for national economy, industry, construction and agriculture showed that educational funds played a smaller role in production growth than fixed capital. This is also true for the function, showing the dependency of benefits from inventions and proposals. But the production function is only a very general and diffuse indicator. It could be useful to estimate these functions for product groups, identifying by this a kind of intelligence coefficient of production, which is an indicator for a structural policy aiming at best utilization of societal intellect.

However such an indicator is only a kind of input measurement. For an economic creativity analysis we should also use other indicators. In socialist industry great attention is given to increasing active participation in technological change. This active participation is a kind of self-realization which is able to overcome negative impacts of mass production under conditions of inflexible mechanization.

In Table 5 and Figure 5 we analyzed the development of educational funds per head in percentages (in relation to 52,000 marks needed in 1975 for the level of higher education--university level) to the share of persons who have put forward inventions and improvement proposals over all employees.

The most important advances in creative participation are found in agriculture and in construction, where the growth rate of technical equipment per employee was the highest (from a very low level). Alternatively, the creative participation is rising over the qualification level to a certain point only, and then has a tendency to saturate. Therefore in the GDR the main problem in the future is not the quantitative increase in participation. It is far more important to improve participation qualitatively. However this is a process with difficulties and problems. If we look at Table 6 we find that the benefits from inventions and proposals per 1000 marks of educational funds have risen from 21 in 1961 to 41 in 1971 and then declined to 32. What is the reason for this? It is obviously the enormous increase in educational funds after 1970. Educational funds per head have grown from 9724 marks in 1961 to 13678 marks in 1971 and then up to 19012 marks in 1975. Therefore it is important for the GDR economy in the 1980s to utilize this advance in education by mobilizing and introducing more creative ideas into the production field. There seems to be a tendency towards saturation in participatory activity at higher qualification stages. To overcome this and to improve creative activity of higher graduate people is a very important task for socialist enterprises.

CAPABILITY PROFILE OF LARGE ORGANIZATIONS

Larger and smaller organizations such as enterprises, firms and corporations, have a great role in mobilizing social creativity. But the creativity potential of industrial organizations cannot be considered as the main factor of success.

We distinguish four main capabilities of organization which interact very closely:

-- innovation potential,

-- strategic orientation,

-- capability for ongoing processes,

-- cooperation and coordination.

Table 5. Development of educational funds per head and share of persons with inventions and proposals in all employees in the GDR economy.

Year	National economy		Industry		Construction		Agriculture		Transport communication		Trade	
	a	b	a	b	a	b	a	b	a	b	a	b
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1961	18.7	12.7	19.6	14.4	21.0	9.7	16.1	2.8	19.0	2.6	18.7	5.1
62	18.4	14.2	19.2	15.5	20.5	10.2	16.3	3.5	18.6	3.3	18.4	5.9
63	18.2	14.9	20.9	16.5	20.2	10.7	16.5	4.2	18.4	4.0	18.1	6.6
64	19.6	12.9	20.3	17.6	21.5	11.2	18.2	5.0	19.7	4.8	19.4	7.3
1965	20.6	13.4	21.4	18.6	23.2	12.1	20.3	5.7	20.7	5.5	20.4	8.0
66	21.2	13.8	22.0	18.6	23.2	12.1	20.3	6.4	21.3	6.2	21.0	8.8
67	21.9	14.1	22.6	18.9	23.8	12.6	21.3	7.1	21.8	6.9	21.5	9.5
68	21.9	13.7	22.5	21.7	23.9	13.1	21.6	7.8	21.8	7.6	21.5	10.2
69	21.9	14.8	22.3	22.5	23.8	12.6	21.8	9.2	21.6	7.7	21.3	11.8
1970	24.2	15.5	24.4	23.3	26.1	14.0	24.3	10.6	23.6	7.8	23.4	12.5
71	26.3	19.2	26.5	26.6	27.6	20.0	26.5	14.7	25.6	11.7	25.3	15.8
72	27.6	23.3	27.6	33.1	28.9	26.3	28.3	19.9	27.1	17.5	26.9	24.1
73	30.9	26.4	31.0	34.8	32.3	29.6	31.7	22.9	30.4	21.3	30.0	27.9
74	33.6	27.9	33.7	36.8	35.0	30.1	34.6	25.8	33.2	21.9	32.4	29.8
1975	36.5	29.4	36.6	38.5	37.9	31.7	37.6	26.0	36.1	24.5	35.2	28.4
76		30.8		40.0		32.2		28.1		27.5		30.9
77		32.1		39.2		29.1		28.7		27.0		28.0
78												
Fixed capital per employee M1975	57494		74492		18335		51624		100421		22123	
Growth rate 1961-1975	5.61		5.28		8.20		7.97		3.55		5.62	

a = Educational funds per head percent.
b = Persons with inventions and proposals share percent.

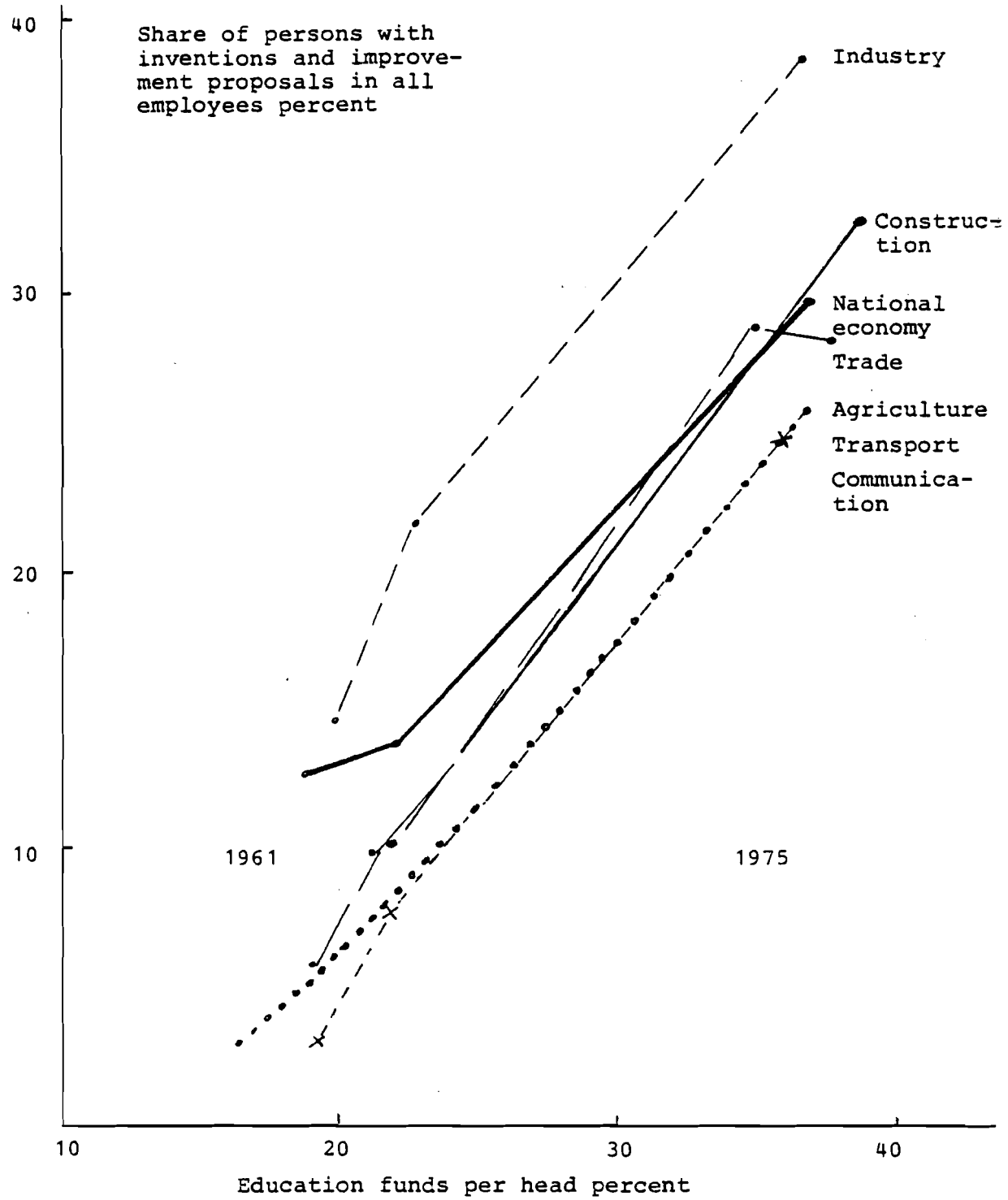


Figure 5. Development of invention and improvement activity in the GDR economy 1961-1975 over educational funds per head.

Table 6. Benefits from inventions and proposals per 1000 marks educational funds in the GDR economy.

Year	National economy (1)	Industry (2)	Construction (3)	Agriculture (4)	Transport communication (5)	Trade (6)
61	21.0	24.2	33.6	5.1	11.1	1.4
62	23.7	32.2	27.3	7.1	13.8	1.7
63	25.2	35.4	40.5	6.8	13.2	1.8
64	21.8	32.3	36.7	4.2	10.8	1.8
1965	22.3	34.6	39.4	5.0	14.9	2.2
66	23.5	37.2	31.8	2.7	13.1	3.0
67	26.0	40.1	32.7	3.2	15.9	4.5
68	32.2	44.7	38.1	7.3	17.4	6.1
69	34.7	48.2	40.0	12.5	21.6	6.1
1970	37.2	51.4	45.0	13.3	18.4	7.2
71	40.8	55.7	28.7	7.3	16.8	7.5
72	38.6	46.6	24.7	8.1	18.2	7.8
73	37.7	47.1	26.0	7.6	18.8	3.0
74	34.9	42.1	23.0	7.2	16.3	2.7
1975	32.0	39.5	20.0	3.7	15.3	1.8

Innovation potential is the ability of effectively introducing new technical devices and organizational solutions into the production process and subsequently the market. Strategic orientation is the concept of long-term activity, which is therefore used in all main operations.

Capability for ongoing processes is very closely connected with innovation potential. If we have a lot of difficulties with the ongoing, older processes, we have neither the time nor resources to master all the troubles which come with innovations. A more external factor is cooperation with other organizations and coordination on the industry or national level. This factor is very important for the success of innovations. We studied these four factors in the example of 32 innovations in various organizations of GDR industry, using the scheme in Table 7. The results are given for one firm in Figure 6. The figure shows us a profile of the capability of the firm in overcoming barriers to innovation by their own ideas and measures in the fields of R & D, production, marketing, and management.

In the case of this firm the capability is on average equal to the influence of blocking factors. But it is more interesting to look at the profile of capability. The firm is obviously successful in the marketing area, but not so successful in the production and R & D field. Concerning the main factors it has most trouble with innotvation potential and with cooperation and coordination.

In a second case we found a profile where all the firm's own ideas and activities were stronger or as strong as the negative influences. But here the cooperation and coordination problem was also the most critical.

In the third case, the firm's own ideas and measures could not overcome the difficulties. Only in the marketing field was the relation a little bit better. The main critical factor here was the absence of a clear strategic orientation.

I think that these profiles could, used in a more sophisticated manner, also be a good means for comparisons between enterprises. This would be useful for the firm as well as for state programs in stimulating innovations.

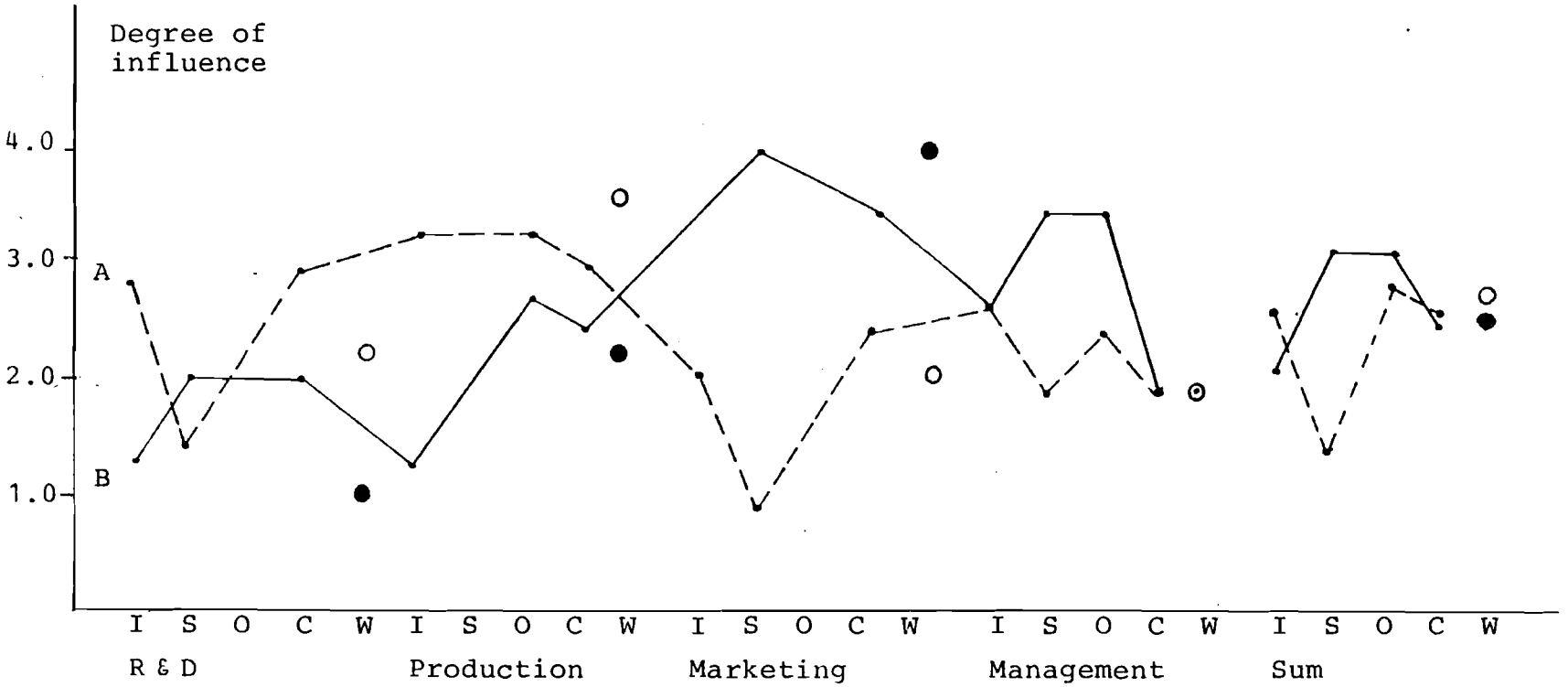
SOME CONCLUSIONS

To bring creativity into an economic connection may be somewhat surprising. "Economics of creativity" is a paradox indeed. Homo ludens (man the player) cannot be measured by pure economic terms. But in reality there is no more "homo ludens" than there is "homo economicus". We tried to show that creativity is closely interlinked with the know-how factors and the routine activity of man. We do not share the standpoint which reserve creativity only for the elite of society, working in fine arts and in fundamental sciences. Creative abilities are necessary in all stages

Table 7. Scheme for analysis of a firm's capabilities.

	R & D	Production	Marketing	Management
Innovation potential	2,5,7 11,12 14	2,6,23	18,25	8,10,15
Strategic orientation	16 17	-	18	9,15
Capability for ongoing processes	-	3,4,13		21,8
Cooperation and coordination	1,20 24	1,4	22,25	19

The figures show the variables used for the estimation, from a sample of 26 variables of influence.



A Inhibiting factors
B Firm's own ideas and measures
O Sum of A
● Sum of B

Figure 6. Profile of the capability of a firm to overcome barriers to innovations by their own ideas and measures. Case 1 (27).

of innovation processes, and we have to think how we can enable more people to work creatively by social, organizational and technological measures.

"Thinking is the greatest pleasure for the human race" wrote Bertolt Brecht, but unfortunately this is not true for people such as those who have neither the possibility nor the time and conditions to think. Or for those people who prefer more primitive pleasures and amusements. So the quality of education is also under question from the standpoint of creative stimulation of people.

It is very important to overcome the narrower standpoint of several economists who consider the resources of society only in connection with energy, materials, equipment, and the subsequent necessary manpower. The economists of the 17th and 18th centuries often had a clearer understanding of the problem. For example it was William Petty who first tried to give an economic evaluation to the population. It may be that at that time the human factor was not so hidden by material resources as it is today. On the other hand, the developed absolutism needed such calculations for a very anticreative purpose.

Creativity is a social phenomenon of various dimensions. We cannot connect it so easily with expenditures as the other social phenomena. We think that real participation in the change of the production and working process is a possible social indicator for creativity. Together with emancipation of women, reduction of labor time, planned job enrichment, and polytechnic education were all important factors in the GDR for a higher level in self-realization of the working people. The precondition for this was a new setting of social goals and values. On the other hand it was shown that this process is a very complicated one, because of the existing type of technology.

There is another indicator which has much to do with creativity, this is the time factor. Creativity depends on the time factor and so it is also influenced by the economy. At the same time creativity changes the time dimension. It is the only thing which can transform time. The question is, who can and cannot use this opportunity. And so again we must stress the social dimension of creativity.

A key problem of the present economy is the right connection between national innovation policy and firm strategy. National innovation policy and firm's strategy are very one-sided if they does not take into account the creativity problem. This is also correct for the analytical and planning tools of innovation policy. A pure technology assessment for new technical devices created by market mechanisms is not enough. In addition to this we have to develop a socio-economic opportunity analysis (SOA), which includes the conditions of creativity at various levels of society.

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