# HUMAN RESOURCES, CREATIVITY, AND INNOVATION: THE CONFLICT BETWEEN *HOMO FABER* AND *HOMO LUDENS*

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# FOREWORD

This article on human resources, creativity, and innovation by Professor Haustein addresses the important problem of the place of creativity in the life of society and in relation to its productive activity. The article hints at the difficulty of devising metrics that are applicable to creativity. For centuries it was clear to philosophers and economists that creativity defies the "bookkeeping" character (cause and direct effect) of most economic theories. Therefore it is comprehended as a hidden parameter or is covered up in residuals. Certainly this issue is worth an interdisciplinary approach; solutions can be hoped for only on the basis of results from several disciplines.

Professor Haustein points out the growing economic and social importance of creativity as a human resource. This became particularly clear during the course of the work in the Innovation Management Task at IIASA. Several of the many reasons for this are mentioned below.

Modern information technology, if properly implemented and used, can enhance the creativity of man significantly and lead to social and economic benefits. In designing modern production systems a new imperative is emerging – preserving human creative potential as a barrier to dequalification and deprofessionalization. In fact, some countries are quite heavily basing their long-term visions for development on the creativity of their populations (e.g., Japan).

These issues and many others are causing a renewed interest in the questions of creativity, which are so well explored in this article.

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# HUMAN RESOURCES, CREATIVITY, AND INNOVATION: THE CONFLICT BETWEEN *HOMO FABER* AND *HOMO LUDENS*[1]

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**This paper deals with the socioeconomic dimension of creativity in technology organization and economy. Creativity is decisive for the development of social systems, but one finds evidence that creativity is a wasted resource. Obstacles to creativity have been identified over the following stages: formation of creative personalities, creation period, and realization period; and on four levels: growth of productive forces, economic relations and interests, institutions, and mental or ideological factors. World, society, organizations, groups, and individuals and their interaction are the objects of social creativity research. Measurement of creativity in the stages research, development, and introduction and improvement uses four dimensions: results, process, personal characteristics, and level of participation. Creativity is closely connected with its counterpart: routine experience. In an organization the innovation potential plays an important role, together with such determinants as strategic orientation, capacity for current production operations, and level of cooperation and coordination.**

KEY WORDS: organism, organization, society, decision making, associative learning, memory.

*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, in conversation with Eckermann, 1825)

## INTRODUCTION

AT PRESENT the world seems to be much more worried about the price of oil than about the tremendous losses in creative potential. It is somehow strange that economic theory is still much more interested in production factors like capital, soil, and labor and forgets about the spirit of invention. Psychological theory is much more advanced in this field, but mainly concentrates on the individual phenomenon of creativity. There is really a gap in a broader systems approach to creativity which comprehends socioeconomic dimensions of human creativity on international, societal, organizational, group, and individual levels.

It is interesting to note that the social background of creativity played a role in theoretical thinking already before the first world war, when the Japanese Board of Education applied to the famous German scientist, Wilhelm Ostwald, for an explanation of the creativity push in German science and industry at that time. Both the question and the answer were creative, and Ostwald's book is recognized as one of the first contributions to creativity theory (Ostwald, 1909).

In the future, creativity should find that more attention is being paid to it from social sciences and systems science. In economic terms creativity is the most wasted resource, and it would be very useful to draft a world report on this topic. Economists should not surrender in trying to measure creativity, although this is raising fundamental questions of social measurement.

Thus, this contribution is actually a call for a better socioeconomic understanding of human *productivity* in the sense in which Goethe used this term as a word for creativity. In this connection a duality between *Homo faber* (man the maker) and *Homo*

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*ludens* (man the player) is often mentioned, identifying the creative man with *Homo ludens.*

I shall discuss this duality, but in concrete economic terms rather than in philosophical constructions. A creative man seems to be rather a combination of *Homo faber* and *Homo ludens*, and gaming is not the ideal social creativity.

## HUMAN BRAIN VERSUS DEVELOPMENT OF PRODUCTIVE FORCES

When one looks at the long history of productive forces the predominant role of human individuality and capability in all technological progress can be perceived. 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 logical (or preparatory) function; 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 tools, starting with the lowest level (energetic functions) up to higher functions, and give man more opportunities for creative work; so a feedback to human abilities is realized.

According to archaeological studies, technological development can be compared with an increase in the volume of the human brain. When production of clumsy flint weapons and instruments began 1,800,000 years ago, an increase in brain volume from 500 to 800 $cm^3$ occurred. The *Homo sapiens Neanderthalensis* reached a maximum of 1,500 $cm^3$ to 1,700 $cm^3$ 75,000 years ago. At present, the human brain has an average volume of 1,400 $cm^3$. The great memory requirements needed for acting without any background of abstract theoretical 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. At present, because of the information explosion, we again have high memory requirements. What these requirements would be in the future depends upon how theoretical thinking develops. Discovery of new laws and theorems frees us from the necessity of remembering a large number of facts. For example, at the time when electricity 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 it took up only 50 to 100 pages.

## GENERAL INTELLECT—THE MOST WASTED RESOURCE

The general intellect of mankind is not simply the sum of four billion brains of the four billion people alive today. It is a social resource potential which is realized through socioeconomic interaction of people.

Creativity is the ability to find an idea which is both new and useful from the social standpoint. It has a highly concentrated social dimension both with respect to its emergence and genesis and with respect to its consequences.

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 economically 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 with respect to knowledge.

Creative work is general work. It uses the results of a long chain of predecessors and has 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 at 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 with given socioeconomic relations toward social goals and objectives.

If one wants to talk about the present

creative potential of society 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, then 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 (see Fig. 1). 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 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, 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 cannot extend the learning term to all human activities. 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, the arts, or 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

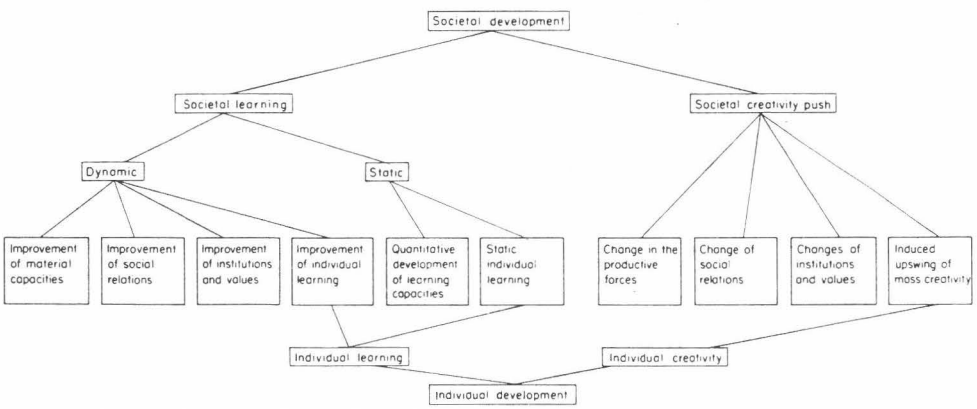


FIG. 1. Societal learning and societal creativity push as the continuous and discontinuous sides of societal development.

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 creative push, mainly on the side of the leading forces; further progress was supported less by 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 with which mankind is now faced. This means a coevolution 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 (Fig. 2). This is the logical conclusion that can be drawn from the statement by the Club of Rome, that the problems of mankind are now fundamental.

Great philosophers of the past have 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). Before Marx similar statements were made by Rousseau, Diderot, and Saint-Simon.

It is indeed a great paradox that human creativity can bring about at the same time both positive results and those which are socially devaluing, such as the arms race, unemployment, and social and mental de-

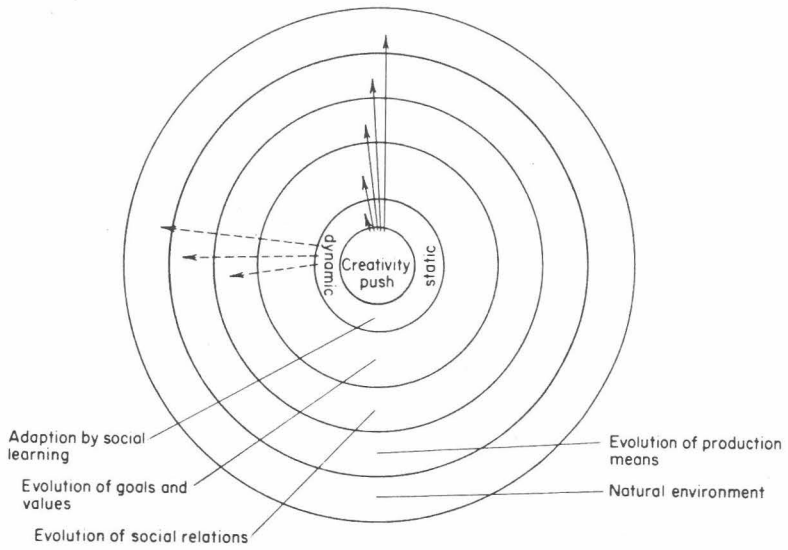


FIG. 2. Creativity push and necessasry coevolution of production means, social relations, goals, and values.

gradation. Over 500,000 scientists (nearly half the world total) are engaged in anti-creative weapons research.

We have to look at the obstacles to creativity in three stages and on four levels (see Table 1). The three stages are:

formation of creative personalities;
creation period; and
realization period.

The four levels are:

growth of production forces;
economic relations and interests;
institutions; and
mental and ideological factors.

In the formative period of creativity it is very important that the human being is properly fed during the first two years of his life, as well as the nine months before birth. In many developing countries, more than 50% of the population have suffered from nutritional deficiencies and, therefore, as societies, lose a large part of their creativity potential.

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 2 shows the share in material resources of groups of countries and their share and utilization of human resources.

Developing countries, which have a 48% share of the population and 49% of the world's surface, have a human capital use that is 4–12 times lower than that of their raw material production, if human capital use is defined as the number of scholars and engineers and their patent notifications. In 1970 the world had more than 670 million illiterate people 15 years of age and over. (The population 15 years of age and over was roughly 2.2 billion.) 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 population. In addition to this, we have the phenomenon of the brain drain from developing countries to developed market economies. Education enrollment ratios for the third age level differ from 0.13 for Benin up to 14.23 for Argentina (see Table 3). On the other hand, enrollment ratios for developed market economies are not an exact measure. They do 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 20 times higher than in African states (see Table 4), some 23 million adults (10% of the population) seem to be functionally illiterate.

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

In the creation period, which follows the formation of creative personalities, the main negative factors are unemployment, the brain drain, insufficient material conditions, monotonous work without creative requirements, and all kinds of alienation of productive people. But at the moment the world seems to be more concerned about the oil crisis than about the tremendous losses in creative potential.

TABLE 1
OBSTACLES TO CREATIVITY OVER THREE STAGES AND FOUR LEVELS.

| Stages | Level Obstacles | | | |
|---|---|---|---|---|
| | Level and Growth of Productive Forces | Economic Relations and Interests | Institutions | Mental and Ideological Factors |
| Formation of creative personalities | Nutritional deficiencies. | No economic interest in formation of creative personalities. | Insufficient educational system; illiteracy. | Elitist theories and ideologies. Ignorance about creativity. |
| Creation period | Unsatisfactory material conditions. Too little free time. | Economic incentives leading to brain drain. Economic conditions leading to frustration. Unemployment. | Socially anticreative goals and tasks of institutions. Organizations in the saturation stage. | Attitudes against creative people. Uncreative atmosphere. Anxiety about the future. Alienation. |
| Realization period | Material constraints for realization. | Not enough incentives for the innovation. Too narrow division of labor. Unemployment. | Institutions inhibiting innovation. | No understanding between research and development and production. |

TABLE 2

RESOURCE DIVISION AMONG GROUPS OF COUNTRIES.

Share of groups of countries in surface area, population, raw materials, energy consumption, industrial production, illiteracy, scholars and engineers, research and development personnel, and patents.

| | Surface 1977* 1977* | Population 1977* | Raw material production 1970** | Illiteracy 1970† | Industrial production 1975†† | Energy consumption 1976‡ | Scholars and engineers 1970–1973‡‡ | Patent notification 1974 |
|---|---|---|---|---|---|---|---|---|
| Planned economies | 26% | 33% | 28% | 11% | 40% | 31% | 49% | 30% |
| COMECON 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% |

* From *Statistisches Jahrbuch der DDR*, 1978, p. 29.

** From Sprote & Thiele, 1978, p. 24.

† Estimation according to *UNESCO Statistical Yearbook*, 1977.

†† From Kuczynski, 1976, p. 10.

‡ From *UNESCO Statistical Yearbook*, 1977.

‡‡ From East-West Technological Cooperation, 1976, p. 207.

TABLE 3

EDUCATIONAL ENROLLMENT RATIOS IN VARIOUS COUNTRIES.

| Country | Education enrollment ratios 1970 | | |
|---|---|---|---|
| | 1st and 2nd levels | | 3rd level |
| | Reference years | Percentage | Percentage (20–24 years) |
| **Planned economies** | | | |
| Bulgaria | 7–17 | 95 | 14.47 |
| USSR | 7–17 | 92 | 25.30 |
| German Democratic Republic | 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 |
| Eqypt | 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 |
| Federal Republic of Germany | 6–18 | 78 | 13.41 |

Source: *UNESCO Statistical Yearbook*, 1977.

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

TABLE 4

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: *UNESCO Statistical Yearbook*, 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 resources 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 twenty-second century B.C. When analyzing creativity the question arises: To what extent can this social phenomenon be measured at all?

## 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 to measure it by special tests which have 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 to do so by special creativity tests. The IQ tests are not appropriate for this purpose. It was found that people with a relatively high IQ were sometimes 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 a fee, for instance: for work done $5.00, for knowing how $45.00, total $50.00; and how a lawyer does so who wakes up in the night and thinks about your case: fee $500.00.

From this illustration one can 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 by definition.

There is no strong correlation between labor time, labor value, and creative results. There is only a social correlation between free time and other conditions for creative work, and the probability of creative results. But this correlation includes a lot of social factors. Creative work is often not the main option for people who have free time at their disposal. For example, the mass media, led by profitability goals, have a strong anti-creative influence. Today's average 17-year-old American has seen a total of 350,000 advertisements and witnesses 20,000 televised murders. The poor do not use their free time in a creative way. They watch proportionally more television than do the rich.

It is sometimes said that the human brain is the only substance having a steadily 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 minicomputers 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* or *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 a social 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 fields of creativity (see Table 5).

Creativity in research is an economic and social phenomenon that 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 gives figures for the time-structure percentage in research and development in the German Democratic Republic (Table 6). 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. Without routine there is no success solving practical problems, and without creativity there is only little, diminishing success.

The mutual influence of know-how and creativity is a great driving force. But at the same time creativity is the opposite of

TABLE 5
DIMENSIONS FOR MEASUREMENT OF CREATIVITY.

| Stages | Dimensions | | | |
|---|---|---|---|---|
| | Results | Process and organization | Personal characteristics | Participation |
| Research | Number of discoveries. | Time structure. | Psychic and intellectual features of personnel. | Share of prize winners. |
| Development | Patents. | Time structure | Psychic and intellectual features of personnel. | Share of inventors with high productivity. |
| Introduction and improvement | Number of innovations. | | Psychic and intellectual features of personnel. | Share of innovative group. |
| TOTAL | Share of new results in all technological changes. Benefits from inventions. | Creative potential of an organization. | Psychic and intellectual features of personnel. | Share of employees with inventions and proposals. |

TABLE 6
TIME-STRUCTURE FORECAST OF RESEARCH AND DEVELOPMENT IN THE GERMAN DEMOCRATIC REPUBLIC.

| Time Structure | 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%) |

routine. Through creativity it is possible to substitute a great amount of routine work.

This interconnection was analyzed using the example of 35,945 technological changes in four industries on the basis of published data of the Institute for Labor Market and Vocational Research, Nürnberg (Dostal, Lahner, and Ulrich, 1977). We defined a creativity coefficient as the share of changes with new tasks and results and compared them with such indicators as economic effectiveness, routine experience, and the labor-saving factor (see Fig. 3).

It is very interesting to note that the demand for routine experience is increasing with higher creative requirements. In this way the assumptions made on the relation between the two indicators could be checked. There is no sense in underestimating the importance of routine experience even in creative tasks. Economic effectiveness is obviously the highest with less creative technological changes. This is a well-known phenomenon. We can describe this also in terms of innovation theory. In the saturation stage we found the highest absolute benefits and technological changes are of a minor, incremental type. In the stage of rapid growth and increasing imitation, relative efficiency is very high, and the absolute benefits are increasing very quickly. In this stage we find relatively high creativity requirements and the highest need for routine experience. It may be the special mixture between routine experience and creativity which makes the Japanese industry so powerful a competitor at present.

The innovation and reinnovation cycle of an industry requires an appropriate combination of creativity and routine experience in research and development and in the introduction and improvement phases in stages: take-off, rapid growth, imitation, maturation, and saturation.

Economists very often say that creativity is a nonexhaustible resource; it does not have diminishing returns. However, it is doubtful that historians would 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. One cannot assume that social creativity is simply a nonexhaustible resource. It has its inner conflict 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 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 look at the conflict between technological base and creativity.

### THE CONFLICT BETWEEN TECHNOLOGICAL BASE AND CREATIVITY—A SOCIAL PROBLEM

The situation is well known: The first generation 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 the German Democratic Republic 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 German Democratic Republic (GDR), and in several other countries (see Table 7). In connection with the reduction of labor time, real emancipation of women, and introduction of polytechnic education, these measures led to greater opportunities, but also to greater expectations in creative self-realization.

It is not easy to determine the education

TABLE 7
QUALIFICATION LEVEL IN THE GERMAN DEMOCRATIC REPUBLIC ECONOMY, 1950–1990.

| 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% |

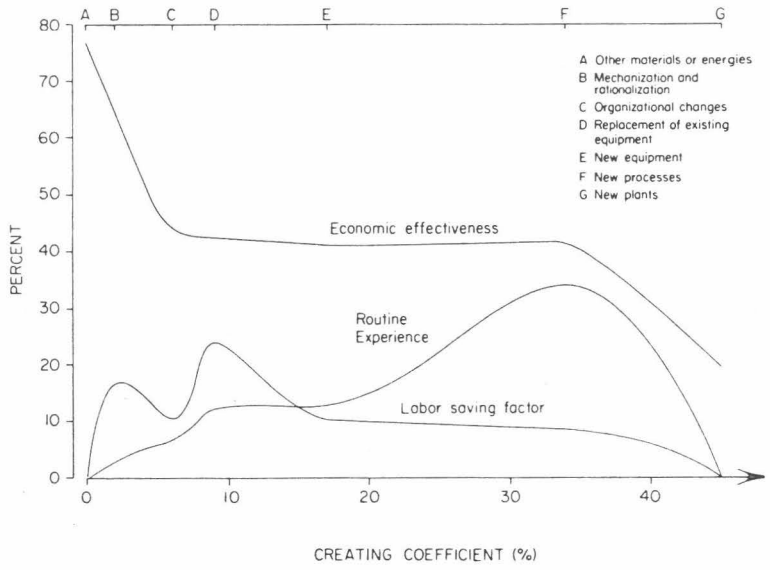


FIG. 3. Characteristics of 35,945 technological changes in four industries (metalworking, food, timber, and plastics).

effect on productivity. It is closely linked with other effects, from scientific-technical progress and substitution of labor by fixed capital.

On the national or macro-economic 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 German Democratic Republic economy of 1950 to 1972:

$$\lg P^* = 1.6238717 + 0.3744 \lg C + 0.1787 \lg E + 0.0525 \lg R + 0.1792\, t,$$

with a very good statistical significance.

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:

$$P = CE^{\alpha}F^{\beta}$$
$$P^* = CE^{\alpha}F^{\beta}e^{pt}$$
$$N = CE^{\alpha}F^{\beta}$$
$$N = CE^{\alpha}F^{\beta}e^{pt},$$

where the values are: $P$ = net value of production at constant prices, $E$ = educational funds, $F$ = fixed capital at constant prices, $N$ = benefits for 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 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 industries 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 8 and Fig. 4 we analyzed the development of per capita educational funds 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 9, 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 capita have grown from 9724 marks in 1961 to 13679 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 corporations have a great role in mobilizing social creativity. But the creativity potential of industrial organizations cannot be considered as the only factor of success (Nyström, 1979).

TABLE 8

DEVELOPMENT OF PER CAPITA EDUCATIONAL FUNDS AND SHARE OF PERSONS WITH INVENTIONS AND PROPOSALS IN ALL EMPLOYEES IN THE ECONOMY OF THE GERMAN DEMOCRATIC REPUBLIC.

| Year | National economy | | Industry | | Construction | | Agriculture | | Transport and communication | | Trade | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | a | b | a | b | a | b | a | b | a | b |
| 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 (1975) | 57494 | | 74492 | | 18335 | | 51624 | | 100421 | | 22123 | |
| Growth rate 1961–1975 | 5.61 | | 5.28 | | 8.20 | | 7.97 | | 3.55 | | 5.62 | |

a = Percentage of per capita educational funds.
b = Percentage of persons with inventions and proposls.

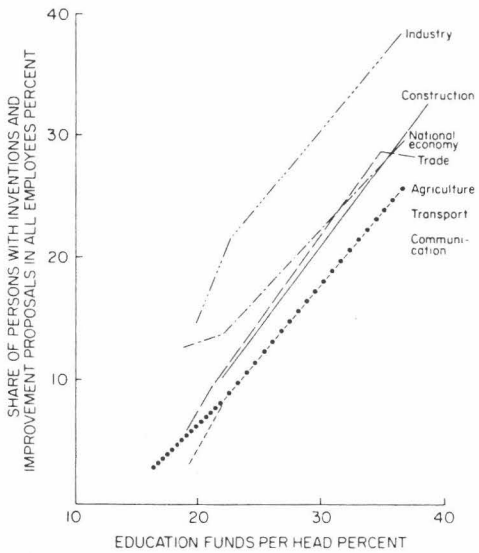


FIG. 4. Development of invention and improvement activity in the German Democratic Republic, 1961–1975, over educational funds per person.

We distinguish four main capabilities or organizations which interact very closely:

1) innovation potential,
2) strategic orientation,
3) capability for ongoing processes,
4) cooperation and coordination.

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. The results are given for one firm in Fig. 5. 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 research and development, production, marketing, and management.

TABLE 9

BENEFITS FROM INVENTIONS AND PROPOSALS PER 1000 MARKS EDUCATIONAL FUNDS IN THE ECONOMY OF THE GERMAN DEMOCRATIC REPUBLIC.

| Year | National economy | Industry | Construction | Agriculture | Transport communication | Trade |
|---|---|---|---|---|---|---|
| 1961 | 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 |

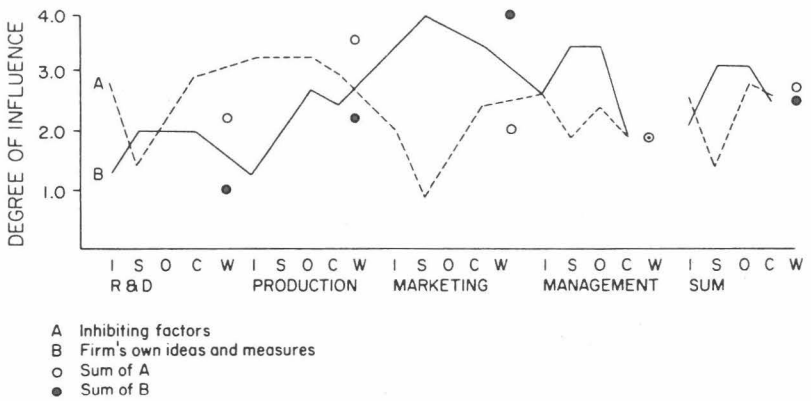


FIG. 5. Profile of the capability of a firm to overcome barriers to innovation by their own ideas and measures. I = innovation potential; S = strategic orientation; O = capacity for ongoing processes; C = cooperation and coordination; W = average

In the case of this firm, the capability is on the 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 research and development field. Concerning the main factors, it has most trouble with innovation potential and with cooperation and coordination.

In a second case we found a profile in which 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 better. The main critical factor here was the absence of a clear strategic orientation.

We 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.

## CONCLUSIONS

To bring creativity into an economic connection may be somewhat surprising. "Economics of creativity" is a paradox indeed. *Homo ludens* cannot be measured by pure economic terms (Braun, 1979). 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 view that reserves creativity only for the elite of society who work in fine arts and in fundamental sciences. Creative abilities are necessary in all stages of the 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. 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 anti-creative purpose.

Creativity is a social phenomenon of varying 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. 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 to determine the best relationship between national and innovation policy and corporations' strategies. National innovation policy and the stretegy of any firm are very one-sided if they do 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 which includes the conditions of creativity at various levels of society.

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