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The development of research in the field of biomedical technology: A role for economic appraisal?

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The development of research in the field of biomedical technology: A role for economic appraisal?

A. Brouwers, L.N.J. Verzellenberg

The Eindhoven University of Technology,

1. Introduction

The term biomedical technology (BMT) is to be understood as all the activities by means of which scientific and technical knowledge and skills are applied to problems in health care and biology. BMT elements in medical and biological research are those activities in which a certain technology predominates:

- Where new technological developments can create new possibilities for medico-biological research
- Where the research is largely determined by difficult experimental facilities from the technological point of view
- Where the applications of new fundamental knowledge to diagnostics, therapy, rehabilitation or prevention, require a form of new equipment, methods, systems or processes.

In the Netherlands an amount of at least 45 million guilders is spent annually on BMT research at the universities both traditional and technological. The total BMT research capacity of these institutions is in the order of 300 manyear per year. Recently a summary picture of the main characteristics of the BMT elements in the research programmes of these universities has been issued [1].

Current BMT research can lead to new techniques for medical application. Medical technology assessment (MTA) aspects can be investigated before such a new application is introduced. MTA-praxis developed mainly to a selective influencing of the diffusion of already existing medical technology.
However it will be much more economical to find ways to MTA-considerations already in the course of development of new BMT research projects. For every research group active in this field the question "What is significant BMT research?" should be a constant subject of study. What criteria can be important in such a problem area? With what method should the various matters be expressed more clearly? How do we find the most worth-while research aims?

How do we fit these questions into the terms of future reconnaissance indicated under the title of Medical Technology Assessment? What methods and tools for the economic appraisal of health technology could play a role in the processes of developing new BMT research projects?

These questions are of course easier to put than to answer. In developing BMT research projects one can not avoid these questions. However in general they do not have a strong influence in the course of development at the moment. The question of economical appraisal e.g. is not neglected but mostly does not play a major role in these processes.

To the economists, especially to those attending this workshop of economical appraisal of health technology, we put the challenge to show the ways to improve this situation.

In the following sections 2-6 some characteristics of BMT-research are discussed. Most characteristics given will not be un-known to BMT-researcher. However many aspects mentioned here in brief form are not so well known to others and they do play an important role in the development of new researchprojects or industrial products. In this field we experienced that there always is a tendency to neglect some aspects, while others are open to over estimation or to the opposite. If we want to make this problem area accessible for economical appraisal first of all we have to grow a realistic total picture.

An important element in this picture is the reality of researchers being active only on parts of medical problems or only on certain aspect systems of problem areas in health care. To a great extend research processes take place in closed systems. This too has to be an important point to consider. From an economic point of view it will be worth while to try to break this open and to grow to a wider framework of expertise for the selection processes of aims for research or for the development of new industrial products.

For this purpose communication processes are required in multidisciplinary setups. However we experienced this to be a difficult task. We developed a special working procedure for such multidisciplinary reconnaissances. This is discussed in section 7. At
the Eindhoven University of Technology this procedure is applied annually to one or two complex medical subjects.

This working procedure has also been applied to a MTA-reconnaissance regarding research policy for BMT in general. The main results of this process of opinion forming are discussed in sections 8-10. Finally in section 11 some concluding remarks are given.

2. The researchers

A researcher in a given branch of science is oriented to a specific field of data. He is concerned with searching out, identifying and verifying these data. He seeks to systematise and classify them and to obtain scientific insight into the target field in so doing.

The acquisition of scientific insight is the aim and justification on the part of the researcher. The standards for his activities he obtains from science itself. So to speak, these standards are autonomously laid down for him.

Professor John Ziman (ref. 2) recently described the scientist as an extremely individualist and introverted person who works intensely on an extremely difficult and highly specialised subject, seeking to achieve a reputation for excellence in that subject. The academic manner in the pursuit of science, as John Ziman says, will even cause people who do not have a natural aptitude for the job, to persist and, in many cases, to succeed.

The development of science is moreover characterised by a rapid increase in the number of specialisms and an increasing dynamism in all those fields of research. Excellence in a given branch of science requires long-term training, intensively keeping abreast of numerous developments in the field of interest, and makes a great deal of concentration, creativity and hard work essential.
A scientific career thus needs a great deal of time and dedication, so that there is practically none left for anything outside. The great restlessness caused in recent years by cut-backs, changes in scientific education and the restructuration of research has negatively affected this situation in the Netherlands still further.

From the picture given above one may conclude that at an university generally speaking, a researcher is concentrated on a limited area of the total reality. To a great extend a researchprocess is enacted as a closed system. A researcher applies the specific tools of his own discipline mostly on problems self chosen. He has limited aims. In most cases such a BMT-researcher does not have a great interest in industrial products, which may become a spin-off of his work.

3. Forms of science

One approach to an economic appraisal of the development of BMT-research is to consider the possible new products on the market which may result from a new project.

Between a new product on the market and the scientific research on which it is based there is a certain interval. This interval or distance can be described as time required, manpower, provisions available. One can distinguish between various forms of science. The distance between these forms of science and such a new product is variable. A common distinction is shown in figure 2 [3].

Fig. 2:
Forms of scientific research with various "distances" to a new industrial product
It is practical empirical science which stands closest to a new product. Here we find the realisation of new products, methods, systems or processes. It is also described as applied research. Theoretical empirical science stands further away from a new product. Here research is oriented to the acquisition of more fundamental insight in the form of a theory or a given model of reality. The distance to a new product is still greater in the case of non-empirical science. Here analytical tools are developed. For instance, mathematics is considered as belonging to this branch of science.

BMT research occurs in all these forms of science. A BMT research project often has elements from all these manifestations of science. As a rule the accent in that case lies, however, in one particular manifestation or other. BMT research is either strongly application-oriented or dominantly structured in the direction of basic insight.

In interpreting suggestions for new BMT-research projects or industrial products, it is important to consider the scientific starting point from which they have to come into realisation. From the standpoint of application-oriented research a new product can be developed in a shorter period of time than would be possible by way of suggestions from more basic research. From successful basic research new insight can lead to more thoroughly considered specifications for a new product, with greater promise for successful development, but as a rule a great deal more has to be done before that is the case.

The position of prototypes and testproduction runs in figure 2 is discussed in section 5.

4. Multidisciplinary research

BMT research is multidisciplinary in nature. Figure 3 provides an impression of this. Such a research development commences with the statement of the medical problem and its translation in terms of a technological problem. The formulation of such a problem in both branches of science mostly takes place in an interactive process between experts in these various disciplines.

Then follows the selection of theories and the formulation of working hypotheses. They are tested in calculations and experiments, which again leads to adjustments to theory and working hypotheses. As a rule these empirical cycles are gone through several times.

In the development of the experiments, different technological disciplines are often applied. In animal experiments and in clinical evaluation, various medical disciplines have their role to play. A BMT
project will in most cases require the attention of a complete multidisciplinary team of researchers.

Fig. 3:
Process followed in research and product development in the field of biomedical and healthcare technology (Brouwers 1983)

Should such a BMT project give rise to a new product which is promising for industry, then the same amount of dedicated attention is required for the design cycle. From the environment of research and often, too, from the standpoint of an industry, such a product development is estimated in fact as a bit too simple.

Of course, all the partial processes shown in figure 3 will not always be of significance for a new research project or industrial product. Experience has shown that careful estimation of all aspects concerned in the development of a product is anything but simple and certainly very necessary. It has also taught that there can be cases in which the initial "push" by research must give way to a "pull" from industry. There is moreover a great deal of management concern required for such a process of innovation, and it is known, from experience, that industry can provide for this better. However in the next section we make a plea for a further improvement in this situation.
5. A total picture

In figure 4 we sketch a rough picture of the interconnection between university institutions, industry and the health-care system [3].

In BMT research the relationship with health-care experts is good as a rule. In medical faculties at the universities this interlink is of course very strong. But for BMT projects at technological universities also involves cooperation in research, mostly in an inter-university framework, and sometimes with peripheral hospitals.

Fig. 4: A picture of the interconnection centring on an industrial innovation in the field of biomedical and health-care technology

The Netherlands health-care system is a far from negligible market for industry. The National Hospital Council (Nationale Ziekenhuisraad) has recently estimated this market at a value of three thousand million
gilders per year, 0.8 thousand million gilders per year being spent on capital goods. [5]

The health-care system shows a number of specific market characteristics. These market aspects have of course to be thoroughly investigated. Too little insight increases the chance of suffering shipwreck with a product. Knowledge of this is even considered to be important for the decision processes as to operating on this market or not.

Considerations of this kind are of course also important in the course of developing new research projects. It must be stated that cooperation between BMT research at university institutions and industry occurs relatively seldom, although it is not completely unknown.

Figure 4 therefore leaves something suspended in the air, as it were, that is the production of prototypes, the production of test series and their evaluation in market situations. Of course these aspects attract the attention of industry when they give rise to new products on the market. But the picture here sketched is based on the ambience of BMT research. Where BMT research is rounded off with a product, possibly suitable for industrial innovation, it is no simple matter to find an industry willing to take it up directly.

The majority of small and medium-sized industries do not pursue so aggressive a policy. The financing system, however, allows a university institution no room for adding the above-mentioned steps to such an investigation. The present-day structure and usage at our university institutions are moreover considered by us to be hardly suited to this sort of activity. But structural solutions can certainly be found for the problem sketched out here. We restrict ourselves at the moment to drawing attention to it.

Finally, two important aspects concerning every innovation in this field: Attention to the integration of all elements essential and a forceful management.

The universities here again do not seem to be the right institutions to take care of these aspects. But often many small and middle-sized industries are not so capable as well in meeting such management requirements. We make a plea for a structural solution to this problem, that is setting up a network of organisational consultationbureau, manned by experts in the BMT-field, who can provide the temporary specific needs in project management.
6. Research development

The existing culture in our institutions for research and education is continually giving rise to new significant research. This is to a great extent determined by local history, availability of facilities, equipment, of persons who together form a specific disciplinary framework, as a general rule one single field rather than a multidisciplinary field, often also with a specific vision on man and society and as regards what is considered significant as new research.

A scientific forum (pure-science research groups, scientific committees of Teaching and Research Institutions, congresses etc.) functions for a given field of research and contributes to the training, adjustments and changes in the cultures of local research groups from a wider framework. Such a forum plays an important part in keeping the quality of research up to the required level and directing such research to the most significant targets. However, such a forum also has a specific momentum of its own, is subject to limitations with respect to the disciplinary spectrum, has a limited view of the total reality.

Society expects from researchers that they direct their efforts to things which society stands in need of. Therefore relevant standards and values must be made explicit, alternatives developed for research, choices must be consciously made in the case of new research. This is all a difficult process, however and in itself is a field of investigation for research.

In order to start out with wider vistas than those based on BMT alone and in fact, from a level ulterior to that of the BMT activities, it was felt to be worth while giving consideration to the most important general characteristics and trends in recent developments in BMT research, to general social developments in particular as regards health care, to characteristics and changes in medical science.

Such meditation on the basis of a wide insight into our society can lead to the formulation of criteria for significant new BMT research or to methods for obtaining such criteria. A dialogue on this matter, structured as widely as possible will be significant if it enables new aspects to be added to the existing system of standards within the current activities in the field of BMT. Such a dialogue can have a function in making implicitly present standards visible in the development of BMT research.

It must be stated emphatically at this point that such reconnaissance will have to be followed also by concrete steps. Criteria, made explicit in this manner, have a determinant function with regard to active
research policy. The process of such a reconnaissance must remain oriented towards this goal.

From these ideas a MTA reconnaissance was structured as regards research policy for biomedical technology in general [4]. This will be discussed in the following sections.

7. The communication process

There are many complex problem areas which do not fit comfortably within the domain of a single skill. They are called multidisciplinary. Characteristic of this situation is thus that one single person is cognitively just too limited for an adequately wide overview and detailed knowledge at a given level compared to the aspects of the problem on the one hand and scientific knowledge and methods which can be used to solve problems in the field on the other.

In a growing number of disciplines, parts of the total reality are studied. Every discipline develops its own characteristics, methodology, linguistic practice and set of standards of its own. As a result, problems of communication between disciplines arise. Communication difficulties even occur within the various streams in a single discipline.

It is therefore also a necessity in a multidisciplinary reconnaissance of a complex set of problems to give a great deal of attention to the processes of communication between a great variety of experts. Something like that is usually also needed because the persons whose participation is greatly desired are often very busy people.

In developing research projects on complex biomedical subjects at the Eindhoven University of Technology a special working procedure is followed. In this procedure named SAM, elements are used of the "Delphi method" for forecasting the future, and working principles are applied which have been derived from the theory of organisation development (Brouwers 1979).

In this procedure the accent is laid on personal interchanges of ideas between the various experts by one or two coordinators (katalysts, integrators). In this way suggestions are put forward, worked out, tested, submitted in a form comprehensible to all participants and, moreover, in very succinct formulations. Every participant can thus contribute his own expertise from his own background at his own rate. It is only then that results are combined and made available in a written communication to all participants. Only after one or two such
communication rounds do the participants concerned meet one another at a workshop.

Such communication cycles are worked through once or twice annually on complex subjects, considered to be important from a medical point of view and with sufficient elements embodied to promise a good fit to the characteristics of the Eindhoven capacity for BMT-research.

These reconnaissances have taught that in such multidisciplinary set-ups indeed a great deal of communication is necessary to acquire more comprehension of each other's worlds of thinking; much effort is needed to direct such a communication process to a convergence of a joint vision and to a determination as to how it can be brought to an advance as concrete as possible.

**THE SAM-PROCESS FOR MULTIDISCIPLINARY COMMUNICATION ON A COMPLEX SUBJECT**

- First picture forming of the whole
- Decision forming
- Choice of disciplines
- First series of orientating thoughts
- Approach to potential participants
- Structure of the workshop
- Written communication with all participants on the whole
- Compilation of all orientating thoughts
- Bilateral communication with all participants
- Total vision
- Structuration of all the information
- Last version of the discussion cadre
- Workshop
- Report

Fig. 5: Shows what activities take place in succession and which run parallel, starting from the initiative up to and including the submission of the report. The parts of the lines indicate actions. At the nodal points actions for this point have to be adequately worked out before the next one can be started.

As introduced already in section 6 this working procedure has also been applied to a MTA-reconnaissance regarding research policy for BMT in general with a large number of different experts in various fields of science and areas of policy in the Netherlands [4]. The main results of this process of opinion forming are given in the sections 8-10.
8. **Starting points for BMT-research developments**

One set of results from the multidisciplinary dialogue, mentioned in the previous section gives main criteria or starting points for developments of BMT-research projects or BMT-industrial products in general.

One starting point, as already stated before is the expectation that such multidisciplinary reconnaissances can throw new light on the question as to what BMT research projects should be developed, from the standpoint of a wide societal perspective.

A second starting point is to be found in ethics. This point was formulated as the general urge to humanisation of man and the world he lives in, as discussed by philosophy and ethics (be it in a pluriform manner): The welfare of man and promotion of a humane world for living in are standards in reflection on and making operational the different aspects of biomedical and public-health technology.

As a third point the attempt has been made to find a good description of the concept health. After the necessary discussion a choice was made of the description which holds the middle course between a purely biological and a widely anthropological concept of health. The health of the human being can be described against that background as enjoyment of undisturbed bodily functionality and psycho-social opportunities in order to achieve self-realisation in solidarity with fellow human beings (Sporken 1984). For the derivation of standards from this concept the starting point can be that health manifests itself in such a course of physiological, psychical and social processes in itself, in relation to one another and to the environment in such a way that disorders in and by these processes are corrected with an acceptable time without intervention from outside (Verzellenberg 1982).

Care of health, derived from the two preceding points can be seen as the warding off of the burdens of sickness. This can be expressed in terms of decreasing mortality and morbidity but also in the promotion of the quality of life. The last-named can be concretised by means of standards, for instance such as repelling of pain and discomfort.

From this reconnaissance we arrive at the opinion that at present, owing to lowering of mortality and morbidity, the quality of living must weigh more heavily as a criterion than has been the case so far.

Also derived from the second point mentioned is the necessity of paying more attention to ergonomic aspects in BMT developments. New techniques must be effective, the efficiency of health care must be increased, made safe and easily managed. Account must be taken of the specific situations for patients, doctors, paramedical and nursing staff.
In a greater number of situations than is often thought, it applies that organisational aspects also have an important role to play in the environment of BMT. We are then dealing with things such as procedures, division of tasks, adjustment of tasks and coordination between various persons and parts of the system of health care. In many cases the necessary attention will have to be paid to such aspects as well.

Naturally, economic aspects also form an important point which must be borne in mind. A concrete measure can in many cases be the relationship of expected costs/benefits in judging a BMT development. Aspects which can make health care cheaper are interesting. In the cases concerned the extent to which employment can be influenced should also be taken into consideration. Here it is conceivable too that the promotion of a new industrial activity, with a worldwide orientation, can also justify extra expenditure.

Finally, every research development must seek a proper interconnection with the strong elements in the research capacity. Likewise, account must be taken of the international research interest in a given theme.

9. Reduction

The total field of health care is difficult to survey. A great distinction in thinking on this subject must be drawn between the organisation of this health care on the one hand and the practice of medicine on the other.

The organisation of the health care is in itself already a complex datum. Here, too, further subdivision of aspect systems into partial systems is necessary in order to make the field accessible to research development. This can now be done in a number of ways and, pragmatically, what is done is to seek connection to the already stated most important targets (priorities) in policy documents in the Netherlands.
- Quality control, coherence and costs of the system of health care.
- Promotion of extramural (among other things out patient) care as opposed to intramural clinical care.
- Promotion of basic and non institutional health care.
- Promotion of preventive compared to curative care.

The Dutch Advisory Council for Scientific Policy (RAWB) states in the report on priorities in health research an approach by means of which it is hoped to achieve contraction of the field of medicine and the establishment of priorities in the process. It is suggested to do so in the total field according to groups of ailments. [6]
The classification put forward by the World Health Organisation (WHO) has been adopted. In this way indicators can be used that have already brought together a great deal of information.

<table>
<thead>
<tr>
<th>Groups of ailments according to WHO classification</th>
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<tr>
<td>1 Infectious and parasitic</td>
</tr>
<tr>
<td>2 Neoplasms</td>
</tr>
<tr>
<td>3 Endocrine, nutritional and metabolic</td>
</tr>
<tr>
<td>4 Blood and immunity</td>
</tr>
<tr>
<td>5 Mental disorders</td>
</tr>
<tr>
<td>6 Nervous system and sense organs</td>
</tr>
<tr>
<td>7 Circulatory system</td>
</tr>
<tr>
<td>8 Respiratory system</td>
</tr>
<tr>
<td>9 Digestive system</td>
</tr>
<tr>
<td>10 Genitourinary system</td>
</tr>
<tr>
<td>11 Pregnancy, childbirth, the puerperium, reproduction</td>
</tr>
<tr>
<td>12 Skin</td>
</tr>
<tr>
<td>13 Musculoskeletal system, connective tissue</td>
</tr>
<tr>
<td>14 Congenital anomalies</td>
</tr>
<tr>
<td>15 Conditions originating in the perinatal period</td>
</tr>
<tr>
<td>16 Injury and poisoning</td>
</tr>
</tbody>
</table>

The RAWB (Dutch Advisory Council on Scientific Policy) then suggests after the above-mentioned visual impression, setting up a process of personal weighting to achieve priorities between these groups of ailments. In this way one would have to make political decisions with regard to priorities in public health care policy. As a second step attention can be oriented to the question of how research should be able to contribute to the realisation of these priorities. In this way priorities are reached in health-care research.

In and after that second stage we are brought face to face with the question as to how the contributions of BMT in this research can be efficiently fitted in.

The participants at the MTA reconnaissance reported here [4] were able to agree with the above RAWB approach. They were able to sympathise with the first reconnoitring attempts on the part of RAWB to apply this priority-finding method. The point of departure of RAWB was from the three dimensions: possible priorities in public health policy, quality considerations and the volume of the present-day research effort in Holland.

However, it was clearly established that the results of this pilot study on the part of RAWB must not immediately result in weighty implications.
Before this is the case the RAWB process must first be carried out on a greater scale and with a great deal more care.

In the way sketched in the foregoing the total health care can be divided up into part areas. Certain processes will lead to priorities in the desired research effort per partial area. If there is subsequent concentration on such a part area with a high priority then there are still many interrelated elements which make a research development into a complex process. The further schematisation of these elements is discussed in the following section.

![Multidisciplinary dialogue on technology assessment for BMT-research](image)

Fig. 6: The convening of a number of experts on various fields for a reconnaissance of general aspects of research on Biomedical Technology

10. **Reconnaissance of a part area**

In reconnoitring a BMT theme, the identification of the relevant elements, their examination from the various standpoints concerned and from those of the parent disciplines have been combined to form the basic of the present reconnaissance. The thinking and discussion outcome on this subject are summarised briefly in the accompanying general work scheme for the systematic reconnaissance of a part area in health care. In such a reconnaissance of a part area of the health care system all the points for consideration discussed in section 8 (page 13, 14) must be included.

Every model and every schematisation is inherently limited compared to the complex reality. This scheme is neither more nor less than a procedure which is considered useful for a multidisciplinary framework with which to start out on such a reconnaissance.
Not all elements will have the same content value for all themes. For some research developments one or two will occupy a dominant place and others will be found to be of less interest. It is however considered to be a good thing to pay attention to all the elements stated here in every research development.

In this scheme it is also made abundantly clear that many partial activities are given simultaneous attention by different branches of science and organisations within the health-care system. In addition we see elements in which the integration process of the various partial activities are assigned an important function in this working procedure.

Orientating ideas for realisation were brought together on various elements in this scheme. We shall not go into this detailed information here. We shall restrict ourselves to a brief characterisation of the various elements in this scheme so that a clearer picture can be formed of the total process. The opinion forming on such a total process of multidisciplinary reconnaissance is considered to be more important than greater completeness in part aspects.

Fig. 7: General working scheme for reconnoitring a part area in health care.

The nodal points are numbered for the purposes of reference.
Action 1-5 is directed to the problem of what is to be considered as belonging to the area under consideration and what does not. The drawing of such limits is in many cases a problem in itself. The characterisation of a part area must be of such a nature that no misunderstanding is possible between the various disciplines, experts and institutions involved in such a reconnaissance.

In action 5-10 as much relevant information as possible is gathered as regards the reality of that part of health care. In addition to the nature of the medical routines it is of importance to make quantitative, qualitative and economic information accessible as well.

Between 10 and 20 the reconnaissances proceed from the basis of a number of disciplinary points of attack. The research alternatives which can arise from this are considered in process 20-25 for their mutual consistency and, where possible, placed in a priority order.

By means of 1-15-25 it must be possible to form some idea as to the available research capacity which can be used for this purpose. In many cases the various matters will have to be considered in an international framework.

The usual actions in the case of research development are placed between 25 and 35. Special attention is considered necessary for a good, cooperative, steering framework for research on such an area. Something of this nature is all the more important according as a number of related projects are brought into being.

From this MTA reconnaissance it follows that the reconnaissance of such a part area does not fit well into one single existing institution for teaching and/or research. Something like that requires cooperation and "top down" policy consideration if the necessary organisation, actual peripheral conditions, accessibility of information and cooperation from a diversity of angles of incidence is to be brought about. With a vigorous "push" from the ministries concerned, such a reconnaissance should be able to be carried out within the space of one or two years. The structure of our teaching and research institution is of such a nature that this kind of "all in" approach from the basic position of researchers alone cannot be brought into being.

There is obvious need for a supra-university body capable of coordinating and stimulating such a development.
11. **Concluding remarks**

In the evolution of societies one development is very pregnant: the growth in complexity. Every modern society is above all characterized by an increasing amount of very complex problems. The Health care systems form one of those complex problem area's in modern societies.

Sciences are making astonishing progress. One experiences a rapid increase in the number of specialisms and an increasing dynamism in all those fields of research. Our universities are producing excellent specialists in a variety of disciplines. However our modern societies are lagging behind in dealing with the integration of knowledge of many experts needed for complex multidisciplinary problem areas. Too often important decisions do not lead to expected results because of lacking good enough overall pictures of complex realities. The health care systems are marked too with experiences of this kind. Above all we have to focus our attention to these phenomena.

Health care systems are strongly influenced by a technology push from industry and research institutions. In the praxis of medical technology assessment (MTA) one tries to make the best choices between already developed new technologies. In this process new products disappear again, being too expensive and not so effective as expected. From an economic point of view it is of course worth while exploring MTA-considerations more intensively already in the course of development of BMT-research and industrial products.

For this purpose one has to grow realistic total pictures, characterized by variables and relations based on a wide insight into the object area, and practical enough to lead us to effective criteria or aims for significant BMT-developments. Economic aspects of course have to be included in these pictures.

Forming a complex field, difficult to survey, one has also to decide upon a method for the reduction of the total area. Well chosen part areas should be made subject of MTA-studies in wide multidisciplinary setups. One should not restrict this to one country. The European Community might provide a suitable framework for structuring such MTA-studies. For the most important part areas the pushing power behind these MTA-studies could be spread out over suitable research centres in various countries of the European Community.

Such complex subjects require a multidisciplinary approach. However the reality shows that most of the processes in this field take place in almost closed systems, with a limited disciplinary spectrum, and directed towards limited aims.
In our vision one should not try to change the researchers nor their immediate scientific environment. Something like that would hardly be possible. Research projects do belong where the needed specific knowledge and skills are available at the highest levels, which one normally finds in the monodisciplinary groups of experts at the universities. We have to accept the limitations going with these situations. The objects of research however we should learn to select from a wider vistas than those present in specific BMT-research groups alone.

For this purpose effective organisations have to be structured. Functional working procedures have to be adopted. A great deal of attention has to be given to the processes of communication between a great variety of experts in this field. We have to grow a network of generalists being active in this difficult problem area. We must create functional boundary conditions for these processes considered to be necessary for this purpose.

As a philosopher one has to be an idealistic monist to believe that we can grow the needed bird eyes views enabling to make all the right decisions in this field. Of course it will be very unrealistic to expect this really. Moreover one has to keep an open eye for the fact that creative researchers always will come up with new findings not planned at all.

However we strongly believe that still much can be improved to make a more effective use of our BMT-research capacities to things which society stands in need of. This paper is ment to throw some light upon a few aspects of this problem area and to report on some activities bringing such improvements within range.

Such MTA-reconnaissances have to be followed by concrete steps. Criteria and aims made explicit in these processes have a determinant function with regard to active research policy. The activities illustrated in this paper in general lines normally are directed to the development of concrete new projects for well defined researchgroups.

On this workshop attention is directed especially to the questions of economic appraisal. Developing new BMT-activities economic aspects usually are not neglected but in general do not have a very strong influence yet. Ways have to be found to improve this situation.

In health care economical elements do form a specific aspect system, though a very important one. In many cases an economist active in this field turns out to be a suitable generalist or integrator in a complex medical problem area. In other decision processes the economical aspects form a minor part only.
One of the objectives of this workshop is to increase the dialogue between economist researchers and key "target groups" for specific medical problem areas. This can be considered as very worth while. However, as a final remark, we are pleading for structuring also multidisciplinary key "target groups" where economists are included, in continuous processes of interactions directed to mutual decisions for new BMT-activities.

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