Problem Identification for Design

Robin Jacques and Reg Talbot
University of Manchester Institute of Science and Technology

Abstract

Differing motivations for design activity are discussed as a basis for examining the relationship between problem identification and problem solving. Active rejection of solution concepts in the early stages of problem identification is advocated, and any exhaustive formulation of complex problems is considered impossible. The case for a formal problem identification activity is presented, supported by observations on the human tendencies towards unjustified assumptions, inappropriate transfer of experience, and diverse perceptions of the world. It is concluded that since no single universally correct definition of a complex situation can exist, the task of policy makers is to find an enabling basis for action.

In part 2 the nature of design problems is discussed and it is suggested that the resolution of discrepancy between 'what is' and 'what ought-to-be' is a predominantly technical task following the more fundamental processes of problem identification and policy making, which define 'what is' and 'what ought-to-be'. The basis of an approach to problem identification is described which encompasses the purposes of intervention in situations perceived as unsatisfactory. It appears that arbitrary constraints help to maintain the humanity of the man-made world.

Introduction: Problem Push or Solution Pull?

There are two main, and often complementary, motivating forces underlying the majority of design activity. One is the drive for the satisfaction of identified needs — from basic needs such as shelter, to emergent needs such as the reduction of motor accidents or pollution. The other seems to lie in man's continual striving for the fulfilment of human potential — the achievement of visions. It is rare that one would find either entirely absent from design activity but often it can be said that one or the other dominates — consider the difference in motivation between projects such as mass housing and moon shots, or between motorway crash barriers and Concorde.

Whatever the motivation, it is interesting to note that from the attempts to achieve visions will emerge new needs; and the satisfaction of existing needs will permit new visions.

Perhaps not inappropriately the achievement of visions can often call upon far greater resources than can the satisfaction of needs. This is perhaps a manifestation of man as a spiritual being, but is often attacked. Perhaps such attacks overlook the cumulative de-humanising effects of a needs-oriented engineering approach to design. Yet in the end there need not be any great division, for the satisfaction of needs may take place as part of a visionary process — and indeed must if it is not merely to be a reinforcement of the status quo.

We are, in this paper, going to be concerned with needs and with visions because when they become immediately relevant to the designer they can both be dealt with as particular kinds of problem. In short, we are taking a pragmatic rather than a philosophical view, in which the relative merits of needs satisfaction or achievement of visions as motives are not argued, but their implications for problem identification and design activity are assessed. These two different motivations have been referred to as PROBLEM PUSH and SOLUTION PULL, and for brevity we will use these terms hereafter.[1]

The Sources of Design Objectives

The objectives of any design activity must be achieved within a context of resources, organizations, laws and so on. These effectively constrain the ability to meet given objectives, but at the same time provide the raw material and resources for change.

So, in addition to any internal coherence which a designed artefact must have, it must be compatible with its environment of production and use. One could say that any design must satisfy both internal and external criteria in order to be successful.

In 'problem push' situations it is therefore necessary to understand the context of operation of any artefact the motivation for which is to improve the conditions in that operational context. Thus if one was asked to design a safer motor car it would be necessary to understand the dangers which it is supposed to ameliorate or eliminate – which means understanding the conditions of its use, the physiological and psychological capabilities of its users, the cost limits of producer and purchaser, etc.

In 'solution pull' situations one would not necessarily expect great account to be taken, by the visionary, of the constraints pertaining in the existing situation. It is nevertheless true that in such circumstances the solution will, either through merit or manipulation, have to create for itself a supportive environment. For example, in addition to the immense development costs involved in Concorde, there will need to be an operational environment created in order for it to be a success. Thus governments must make huge subsidies for its purchase by airlines, laws must be altered and created, crew must be specially trained, airfields re-located and re-planned perhaps, and so on.

Here we see one of the differences in consequence for the designer of differences in the motivation for design. In 'problem push' situations he has to seek close fit between the artefact and the conditions which generated the need for it. In 'solution pull' situations he may have to seek realisation of the project in conditions unsuitable or even conflicting with it, a circumstance which will in itself be demanding on all sorts of resources. There are far more uncertainties, far more risks of failure, and probably far more surprises of all kinds in store. On the whole it might be said that one of a designer's objectives should be to make the introduction of his artefact surprise free for its users, and of course this is much more difficult with 'solution pull' problems.

In both cases a designer's ability to correctly interpret the present state of the world is critical, as is his ability to predict how his actions might change that state. If he fails in either then the success of his design will be compromised.[2]

First, Catch your Problem

Rittel[3] has termed planning problems 'wicked' and design problems 'ill behaved' because they have no unique solution, cannot easily be defined or limited, depend on value judgements and belief for their resolution, and so on. Rittel's terminology seems to imply an active and even mischievous resistance to man's intervention. The case is, however, that although such problems are very complicated, they are only 'wicked' when seen from the viewpoint of a wish to exercise total control over their resolution.

However, this is not to quarrel with Rittel's observation that to treat such problems as clear in cause and predictable in outcome is a dangerous and misguided practice. Most modern socio-technical problems demand an approach very far removed from the traditional deterministic, fragmented and often simplistic approaches of the past.

If we accept for the moment that the kind of design problems in which we are interested have no unique 'correct' answer, we can logically conclude that they must therefore have many potential answers. One of the problems is therefore that of choosing between alternative possibilities. One criterion of choice is commonly provided by the objectives for intervention in a situation. At the same time it is apparent that

much design work is carried out with little or no formal identification of objectives other than in terms of solution concepts. Rittel maintains that all problems are seen in terms of solution concepts. We do not entirely agree as we will explain, but practically speaking he is probably correct for the traditional design disciplines. If a client goes to an architect with a problem he is likely to end up with a building solution. The reason he went to an architect in the first place was because he saw his problem in terms of an architectural solution — otherwise he might have gone to his bank manager. Having been approached, the architect will reinforce the likelihood that the problem will be seen in architectural images because

a) of his conditioning through education and experience;

b) his skills and strategies relate to architecture;

c) his fees are based on the costs of construction.

Similarly, if a client goes to a mechanical engineer for a clock he will get a mechanical clock — draw your own conclusions on what he will get from an electronic engineer and a water engineer.

The flaw in all this is that there may be a given type of clock which is ideal for the client's purpose and another which is totally unsuitable. Similarly a change in factory working methods and some new equipment may achieve more than will the expansion of premises for an industrial client. The mechanical engineer and the architect represent resources from whom solutions may be commissioned, but somewhere back along the line some decisions have to be made about just what the problem is. There are assessments and policy decisions to be made, and there is evidence to show that to an important degree these assessments can and should be made more or less independently of reliance upon solution concepts. Now for a factory or a clock these policy decisions may well be made adequately by the client body, but for cities, health services, transport systems, housing policy, and so on the task is not a personal but a public one. As such it is subject to national goals and inerests. This makes it more complex, more varied, more critical, and more political.

This is not to say that solution concepts can be successfuly excluded, especially by those unskilled in any other way of looking at problems. However, we would go as far as to say that active rejection of solution concepts at the early stages of problem identification is desirable in complex socio-technical situations.[4] Rittel says 'in order to *describe* a wicked problem in sufficient detail, one has to develop an exhaustive inventory of all conceivable solutions ahead of time'.[5]

This statement leads Rittel and Webber down a path of impotency which results in their unwillingness to make even tentative proposals for dealing with those problems which they see as wicked. They have, however, in some ways led themselves into a trap. Because they conclude that 'tame' problems can be fully and exhaustively formulated, they 'logically' become concerned with the problems of exhaustively formulating 'wicked' problems. It is readily apparent however that this is not possible. This does not preclude us either from formulating such problems, nor from acting upon them. After all, politicians, economists and taxi-drivers all take action in the face of uncertainty, often with considerable success. It is Rittel and Webber's apparent desire for omnipotence which makes their position as planners untenable.

It Must be Good, it Won a Medal

Design problems commonly have no clear cut objectives, not because they could not be devised, but because they often could not be agreed upon. Furthermore it has not been all that *necessary* to clarify objectives. There

has been a general belief that 'design', 'progress', 'improvement', 'redevelopment', 'slum clearance', etc., are all GOOD THINGS in themselves. It has proved extremely difficult for researchers to assess the success of say, local authority housing schemes because other than the general objective of providing housing at a given cost per unit there have been no objectives set up. Imagine then the difficulties inherent in more complex situations such as urban renewal or national transport co-ordination of trying to decide not only when you have reached a satisfactory solution at the design stage, but of evaluating the success of your proposals after they have been implemented.

To see even better how important for the designer is the setting up of clear and realistic objectives in designing for complex situations, we can refer back to our earlier discussion on motivations for design.

In many cases, the designer is called upon to change some, presumably unsatisfactory, situation. Part of his effectiveness will be perceivable by *the extent to which the unsatisfactory situation becomes more satisfactory*, and the nett value of the improvement will in part be a function of *the relationship between that improvement and the resources used to achieve it.* Dissatisfaction with the outcomes of design often lies in the feeling that the extent of the improvement has not been worth the cost of achieving it and since so much of design practice is concerned with marginal improvement, the critical relationship exists between costs at the margin and the margin of improvement.[6] This means that in many cases one can begin to make objectives firm at some point of diminishing returns in the investment of resources. Such a criterion is of great importance in, for example, local authority fund allocation where there are far more demands upon resources than can possibly be met. In large complex situations this provides one of the determinants for deciding upon the right scale or level of satisfactoriness of a solution.

Thus the objectives for a project must be clarified if such judgements of worth and value are to be made in any way explicit. In this way one is helped to decide upon the appropriate design resources needed to meet the levels of performance and predictability selected, and can subsequently test the success of the implemented solution by reference to the objectives set. (Of course it may have been that the objectives were wrong or inadequate and again it is important that they were explicitly identified in order to contribute better ones next time).

This ability to evaluate the success of measures taken is becoming increasingly important at a time of world shortages, stress and conflicting demands. Sponsors of design activity expect that given methods, approaches or techniques can actually deliver the goods. How can this be proved? The answer is that on the whole it cannot be proved in the past practices and results of design. Only the most subjective of responses can be given – such as that the client is satisfied, or that the design won a medal. In the vast majority of cases one is unable to say that a design has met or exceeded its objectives, because none were ever formally identified. This applies to architecture, town planning, industrial design, transportation etc. There is something to be learned from the newer areas of system design, operations research and so on (but with caution of course).

To move on, we will see that the designer has both a different basis and need for the identification of objectives in situations related to a vision, or a conviction, or a desire, held by some body with the power to at least begin to initiate its realisation in the real world. Any objectives posed must be far more tentative because they relate to a non-existent state, possibly with few reference points in the present. (In problem push situations objectives will usually be firmly rooted in present state referents).

Demolish all Schools!

The great difficulty is that there is no single logical relationship between the goals of a situation and its achievable objectives. To illustrate this we can point out that the goal of 'equal educational opportunity for all' can be achieved in part by setting as an objective the demolition of all schools. It is a value judgement to try to achieve the goal with the objective of building many schools.

In 'problem push' situations one's goals and values are usually accepted reference points to which any objective agreed upon implicitly relate. In 'solution pull' situations one's vision probably challenges current goals and values to some degree, but the difficulty lies in choosing objectives which, if achieved, will result in the valued goal states. In the former case the objectives can be established empirically, in the latter only hypothetically.

Thus an important difference between the objectives defined in the two conditions is that one set is firm and the other tentative. This is important because in the first situation the designer fails if he fails to meet the objectives; and in the second situation part of his skill will lie in modifying the objectives as he goes deeper into the conceptual and technical problems of realization. It is fairly well known in design that the structural concepts (solution images) which one develops to handle a problem, generate qualities and properties hitherto unperceived in the situation for which one is designing. Here we are introduced to the inter-active process between problem identification and solution generation mentioned at the beginning of this paper.

Earlier we pointed out that we considered it possible and desirable to resist solution images in problem identification. The identification of objectives is not a PROBLEM IDENTIFICATION task, but lies at the bridge between this process and that of SOLUTION GENERATION. In fact it is probably more *critical to avoid premature identification of objectives* in incremental change situations than in visionary situations. It doesn't really matter how people have visions as long as they have them. In situations which are unsatisfactory in some critical way, however, an inadequate identification of the problem may have disastrous results. (Take for example the vast Pruett-Igoe housing complex in St Louis, U.S.A. The first tenants moved into the planners' pride in 1954. 20 years later the blocks were dynamited to rid the city of a concentration of violence and vandalism).[7]

Emergent Properties, Rally Winners and Death Traps

We have already mentioned that the process of design results in unexpected emergent properties, which in some cases are not just a bonus, but lift the concept from a worthwhile one to a major influence. Thus one finds that the British Leyland Mini becomes a world leader in automotive design and has qualities quite unplanned, such as its racing and rallying performance. It is often impossible for an observer to distinguish whether or not a property or a design is an emergent one or not – only the designer, and perhaps his client knows – and often they do not tell.

This phenomenon has been known as 'serendipity' – or the art of making beneficial discoveries by happy accident. It is an important characteristic in all sorts of fields of human activity besides design. Whatever else we do to the design process we must not reduce the chance of such occurrences.

But the situation has its reverse. Just as we can find that something which we have designed has unexpected beneficial properties, so we can find that it has undesirable or dangerous ones. We have a very 'good' national traffic system within which about 30 people each day are killed and many in-

jured. The Lockheed Starfighter has claimed the lives in peacetime of over 200 West German pilots during its operational service with their air force. The most modern of British zinc refining plants at Avonmouth had to be closed down for weeks because it had so poisoned the air and the Severn Estuary. You can no doubt think of many other examples.

Thus we can observe that emergent properties may be either beneficial or detrimental, and part of the task of those involved in design must be to control the effects of these secondary properties so that they do not so compromise the primary functions of a design that it is rendered unacceptable. One could find many supporters for the argument that this control has failed for the motor car, urban centres, and mass housing, to name but a few.

Analysis with Blinkers On

Many of the difficulties in making such changes of approach to the early stages of design as those we have been advocating are rooted in the personal and inter-personal capabilities of human beings in their role as designers. We have pointed out that clients and designers will tend to think in solution concepts, partly because of their experience, training and so on. We have said in effect that the mental conditioning imposed by such things acts as *a constraint on the way they see the problem*.

Much of the work of Edward de Bono[8] is concerned with this limitation on perception and understanding. He puts forward the concept of lateral thinking as a way of stepping outside the mental constraints of experience, custom, tradition and ideology. There are many examples capable of demonstrating how our minds all too readily prevent us from seeing other than a few facets or possibilities in most situations. Some of you may know the story of how Brunelleschi landed the job of designing the duomo for Florence Cathedral by exploiting his capacity to look at problems in a more divergent or exploratory manner. At best here one can merely show a few party tricks to help prove the point.

Ex. 1

* * *
* * *
* * *

Connect all the dots with 4; straight lines without removing the pen from the paper.

Ex. 2.

Take four matchsticks and lay them on the table. Use them to make 5 squares (without snapping them).

Some of you will 'see' the answer quickly, and some will never get it without looking at the answers at the end of the paper. Some of you will be constrained by assumptions, and others will use solution images from other puzzles inappropriately.

It is possible, however, to adopt procedures and train one's mind to step over the mental blocks which inhibit new perception. If such blocks are operational on such simple situations as those given above imagine the implications for really complex and humanly significant problems.

If we commonly think in solution concepts consider the differences occurring between people from different backgrounds and different cultures. When used well these differences can be a rich source of ideas and cross-fertilisation but they can also lead to confusing and conflict-generating misunderstandings within design and project teams. It is now increasingly common for teams to include members from many cultures. A major civil engineering project may have a West African government representative, a West German technical consultant, a Scandinavian designer and a financier from the USA. Imagine the mess that could result from all their implicit assumptions about what each meant.

Of course, many such projects are realised

satisfactorily (we assume, with little evidence) but on the other hand many far more modestly diverse project groups find themselves with considerable problems resulting from misunderstandings. Without some recourse to formal problem identification processes, the likelihood of missed potential through unjustified assumptions, of partial understanding through mental blocks and of misinterpretation through diverse experience and concepts, is so great as to be unacceptable in critical and complex problems. It is not unfair to say that a great deal of design begins by *Analysis with Blinkers on.*

Whilst in past times of much slower change such procedures may have been less risky, they are today quite unacceptable. We are now in a situation where experience quickly becomes out of date – which is not to say that experience has no value but that active steps must be taken to overcome the tendency to treat this year's problem the way you successfully treated last year's.

However, perhaps the most important single influence upon the definition of problems is the way the members of any design team see their own role. We have suggested that it may be an implicit desire for omnipotence which leads Rittel and Webber to see dynamic, complex planning problems as 'wicked'. An alternative attitude, which has the effect of producing a different view of problems in general and in particular, is to accept the natural justice of man's lack of omnipotence. This means accepting that the motivation for action – the source of someone's interest in wishing to define a problem – must constitute one reference point by which the 'correctness' of the problem definition itself may be judged. It means accepting that no single universally correct definition of a complex problem can exist. Thus the major task facing design policy makers is to find an enabling basis for action.

In conclusion therefore we can say that problem identification for design is important for the following reasons:

1. Differing motivations for design action change the nature of the design task and the objectives which design seeks to meet.
2. Design problems in socio-technical systems are continually changing and each one is unique and ramified.
3. There is no single correct definition of or answer to a design problem.
4. Traditionally, dependence on solution concepts in defining problems has the effect of restricting the scope for action on the problem.
5. Objectives should be set up, not to justify preconceived solutions, but in response to the motives for change.
6. Man's experience causes him to impose familiar patterns on unfamiliar phenomena. This characteristic causes perceptual myopia and subsequent misjudgements of the appropriateness of solution ideas.
7. A designer's ability to interpret the present state of the world is critical, as is his ability to predict how his actions might change that state. If he fails in either then the success of his design will be compromised.

Part 2
The Nature of Design Problems

The Problem 'as given' is Primitive

We've looked at the need for Problem Identification in design, and we can now develop our understanding of what this might actually mean in practice, with the aim of proposing what the characteristics of a well formulated problem statement might be.

First, we shall examine a typical approach to a traditional single-disciplinary designer. The first step is to express the need or desire in terms of a solution concept. Thus typically

a client may say: 'I want a new factory'.

We may term this a PRIMITIVE PROBLEM STATEMENT. The normal response of, in this case, the architect is to take the PROBLEM AS GIVEN and begin to carry out an analysis of it (with blinkers on!). He immediately places himself and his client in a tightly bounded situation.

Of course the client will elaborate on the basic statement but basically he will be saying 'I want a factory'. Similarly clients want rapid transit systems; monorails; automatic coffee dispensers; new international airports; industrialised housing systems and so on.

All of these are solution concepts, all of them are PRIMITIVE, and all of them comprise the perfectly acceptable starting point for a long tradition of design practice. Today, however, we can and do question whether mass housing is the right answer to the housing needs of people; whether another international airport is actually necessary; whether a tea lady might be preferable to a coffee dispenser; whether monorails aren't just as inflexible as other tracked systems; and so on.

Now when we ask the question 'What do you want?' we don't mean 'How do you see the answer to what you want?'. We mean 'What are the things which are happening which suggest to you that some action for change is necessary and why have you come to me?'. It's much more of a mouthful, and indeed it is much more serious. It is more serious because it is more difficult to answer such a question. Furthermore the employment structure of designers makes them reluctant to help a client realise that he may not need them after all.

To conclude this point we can say that, particularly in complex systems and stressed design environments the *Problem as Given* must be treated as a PRIMITIVE PROBLEM STATEMENT. It is not an adequate starting point for design, only for the clarifying process of PROBLEM IDENTIFICATION.

Some of the things which make problem statements primitive [10] are easy to define, others not so easy. Some easy ones are:

A problem statement is primitive if YOU DON'T UNDERSTAND IT. A good problem statement should be clarifying and self-explanatory.

A problem statement is primitive if IT CONTAINS INBUILT ASSUMPTIONS ABOUT VERIFIABLE MATTERS. A good problem statement should at least *indicate* what could be found out and how important it might be to find it out.

A problem statement is primitive if IT IS DESCRIBED IN SOLUTION CONCEPTS. A good problem statement doesn't give the answer before it has been devised.

But not so easy are some other concepts which help us to know the difference between a primitive problem statement and what we might term a WELL FORMULATED PROBLEM STATEMENT. (WFPS). If we don't know these differences then we are not in a very good position to devise a WFPS.

What is a Problem?

It was not long ago, at a meeting of the Society for General Systems Research that an eminent speaker gave the usual response to that question. His reply was 'Everything is a problem' accompanied by a look of surprise that he should have been asked to define the situation for which he had, for the previous half hour, been describing his solution and how he went about devising it.

Indeed 'everything' is not a problem; many things are puzzles and some things are children. The response is, however, symptomatic of the readiness of designers in all fields take the PROBLEM AS GIVEN as an acceptable starting point.

Rittel [9] says 'A problem originates from a recognised discrepancy between *what is* and *what-ought-to-be*. Any attempt to solve it consists in the search for removing this

discrepancy'.

This view seems to be reasonable as far as it goes, and it is consistent with Rittel's view that designers and others can only identify problems in terms of solution concepts. We have already questioned this view (whilst agreeing that he is probably right for most practising designers). However, just as this reality does not necessarily define what is *possible* for problem identification, Rittel's definition of a problem does not define all design and planning problems. It is perhaps just because he accepts the false inevitability of solution concepts that he defines a problem in terms of them.

The limitations of Rittel's description, particularly for the complex 'wicked' socio-technical planning problems to which he refers, can probably best be illustrated by two further definitions which we have formulated.

A problem originates from a discrepancy between one view of *what is* and another.

A problem originates from a discrepancy between one view of *what ought to be* and another.

Both of these latter statements seem far more fundamental to the conditions prevailing today than does Rittel's definition. He defines what is in effect a *technical problem* — of HOW to get from point A to point B where point A is the present and point B is some preferred future state.

Let us first look at an example of the problems that confront us in deciding and agreeing upon what our preferred future state ought to be. There has for some years been a policy at national level of increasing the mobility of the population, in order that a freer, more dynamic relationship would exist between employment prospects and work force. The ability to move house, to commute, to work away from home and be easily able to visit, etc., has been fostered in our national transport policies and systems. People have become encouraged to be more cosmopolitan. At the local level this has often meant that the free flow of commuter traffic has been given precedence over say, local needs for parking outside corner shops and street-fronting houses.

Recently, however, we have heard much more of the call for 'community spirit'; for citizenship and local pride, possibly as a reaction to increasing crime and vandalism. Yet not so long ago thousand upon thousand of the populations of our cities were compulsorily uprooted and put down in overspill areas far from where they preferred to live.

The question here is 'ought people to be cosmopolitan and free travelling, or ought they to be community based with local commitments and roots?'. Until one has made some attempt to choose; or to establish whether they are or are not mutually exclusive or to decide on the balance of needs or preferences, etc., one is in a poor position for choosing an appropriate technical solution. For all the recent talk on 'participation'[11] there is little evidence that anyone in authority is prepared to allow the non property-owning public to choose its own location and life style.

So let us observe, for example, that the present situation is unsatisfactory in some way (Definition of 'what is') and that we wish to do something about it. We may observe that commuters are getting into traffic jams and that children in a local residential street have been knocked down. If we take the view that mobility is more important than community in this case, then we have a basis for resolving the discrepancy mentioned by Rittel between what is and what ought to be. However, if we decide that community is more important than mobility in that particular case, we have a completely different basis for resolving the discrepancy. In terms of solution concepts one might result in banning parking and putting up pavement barriers whilst the other may result in closing the street except for access by residents.

Now neither of these means of resolving

the discrepancy is really a *problem* unless it is a technical problem akin to a puzzle. If we can decide where we are and where we should be, then we can enjoy working out how to get there, and we will know when we arrive.

In many cases, policy disputes seem to be concerned with wrangling over means, that is with dispute over the best way of removing a discrepancy. This is not because those in dispute have agreed upon what they are trying to achieve but, on the contrary, because they have ASSUMED that each has more or less the same implicit views. One could find, therefore, in such cases that the dispute could be traced to a more fundamental disagreement about what ought to be. There are, of course, many situations in which different views of what ought to be can be satisfied by a common objective. Management and Unions may have fundamentally differing views about who should own the means of production, but they may both agree that each of their goals is best served at present by getting the men back to work after a strike. Good design carried out following good problem definition would be better able to seek such classes of solution in the case of conflicts between interested parties.

So from this brief description we can conclude that there are problems inherent in defining preferred future states. But that even in the case of apparently irreconcilable conflicts of view and belief the designer may well find solutions which bridge the disagreement. There is little chance of him so doing unless he has identified the nature of the conflict however. We have also said that when the desired future state has been defined, there is likely to be less dispute over how best to get there. Any remaining dispute is basically over problems associated with our limited ability to predict the effectiveness, efficiency and effects of using particular technologies and designs to achieve results within acceptable limits of risk.

We still live in the Stone Age

But we haven't yet finished. It is easy to see that people may disagree about what the future ought to be. It is perhaps less easy to see that people disagree about *what the present is.* This is another deficiency in the structure of Rittel's definition because one man's reality is different than another's. What does a planner see when he visits a slum? He sees poverty; unhygenic conditions; damp walls; leaking roofs: and probably rather pathetic children and perhaps slightly frightening adults. What does a slum dweller see when he comes home to a slum? You tell us, we've never lived in one. How then could a designer adequately resolve the discrepancy on behalf of the slum dweller? Not only does he not know what is important to the slum dweller, what the situation means or *is*, he doesn't know how the slum dweller sees what *ought to be*. What usually happens is that the designer resolves a discrepancy on behalf of others between how the designer sees what is and how the designer sees what ought to be.

In the example discussed this usually has meant that the designer gives dryness and hygiene priority because that's what most offends him about slums. When the people get into the dry hygenic mass housing he has devised they sometimes smash it up and burn the door jambs as firewood. Many of you may doubt this; it is not widely publicised by designers or the local authorities who commission them.

We cannot doubt that mankind has a greater stock of knowledge, techniques, technologies and material resources at his disposal than anyone would have dreamed even 100 years ago. Man has the *power* to build paradise or wipe himself out and even greater power, over the creation of life, seems imminent. There seems little doubt that man can overcome most technical problems, and provide solutions to certain classes of problem almost on demand, whilst aborigines and South American pygmies still live in the

Stone Age. President Kennedy instructed his designers to land someone for a walk on the Moon, and they did it within a very short space of time. We have all sorts of technological solutions to the transport problem in cities – moving pavements, bicycles, electric runabouts, hover monorails, underground railways, computer controlled taxi-tracks, horses and carriages, and so on. But in reality none of them are solutions; they are technological resources. They are not solutions because no-one can really define the problems which they could be drawn upon to resolve. Man in this, as in so many other aspects of life, is unable to decide on what the city ought to be. He doesn't have to decide it all for cities, but he is unable even at a local level to decide what a given city ought to be.

Partly he cannot decide on this because *what a city is* is different for the different people in it. For a petrol station owner the present transport system is ideal – he doesn't want it changed because he has a vested interest in it the way it is. And why not? Such interests can be identified without recourse initially to solution concepts. As discussed earlier, there is considerable value in avoiding ideas for solution during the early stages of identifying the problem.

An example of what this means for transport in the city can be given. One can decide that the present situation is unsatisfactory for many reasons: e.g. too many people get killed; many people don't own cars and the buses don't run often enough for the rest; there isn't enough parking space and so on. All of these are PRIMITIVE PROBLEM STATEMENTS. One can begin to make them less primitive by identifying for whom these things are *unsatisfactory.* Then, by identifying whether there are some people for whom they are very *satisfactory*. Immediately one can begin to see some of the dynamics of the situation and what might happen if you try to change it. Some people would support change and others would oppose it. Not because of any given solution concept, but because they are inherently satisfied or dissatisfied with the present state because the city *is* different places for each of them. Then you can say that certain organisations and institutions would lend power to one side or the other, not in response to a proposal for a solution but because they are constituted to protect certain interests, e.g. the AA would support motorists.

Birth Control: A Religious or a Medical Problem?

One would also be able to identify aspects of the situation which might be differently easy or difficult to change. For example, it might be easy to change the direction of traffic flows, but not the alignment of streets. But you could not get very far with some of these things unless you clarified the basis for your PROPOSED INTERVENTION in the situation. That is to say, 'What is the vested interest of the people who are proposing change, and upon which aspects do they have the power and resources to act? The answer to such a question may be given from the wide base of a government to the narrower one of a town council. In either case, however, it is open for the interested party to ally himself with others to increase his scope for action.

The recognition of something wrong or unsatisfactory may take place for all sorts of reasons, but that recognition does not necessarily generate a design problem. For a design problem to exist, some person or organisation has to decide that they wish to take action to change the situation which is unsatisfactory. *In order to change it purposefully, intervention into the situation has to take place*. Here we refer back to the earlier discussion on objectives and goals. Purposeful action is goal seeking action, and goals are sought by people. We have established that not all people hold the same goals so some process of

advocacy, of gaining concensus, of the exercise of power, or bargaining has to take place. The choice of these depends on circumstance, culture and so on, but in complex socio-technical situations, which involve many people by definition, some way of securing the scope for action is required.

It is usual that any group will have primary interests in definable areas, and will have only certain kinds of power or influence. Even a national government is so limited. In these circumstances the potential for intervention into a situation is also limited. Firstly, those primary interests or responsibilities will have the effect of assigning relative priorities to various aspects of the situation. Secondly, limitations on influence and power will make certain aspects of the situation more or less susceptible to change by the interested party. Thus for example, the medical profession is less likely to be able to change birth control behaviour by appealing to people's religious convictions than by offering medical evidence. We can conclude therefore that *for any given interested party the identification of a design problem must take account of the potential for intervention held by the specific interests and circumstances of that party.*

This view is essentially practical, not loaded by any particular theories of design or philosophies of elitism. The question remains the same: 'What can *I* do to change this situation for, what I believe to be, the better' whether one is asking it is a privileged design professional, or as a member of a community self-help group. It is the answer that changes. In the example given above, the primitive version of the problem might make reference to the goal of halting the population explosion. A well formulated definition of the problem would be modified to reflect the interests and influence of those who wished to act upon the current situation. Thus the medical profession's formulation would include observations on the extent of unwanted pregnancies, various health risks, rising malnutrition, and so on. Religious leaders, however, would probably make reference to the state of morality in modern youth, the sanctity of marriage, the soul of the unborn child, etc. These different interests refer to the same 'problem', and each may draw upon the other's ground, but their scope for intervention lies in very different areas, and the objectives which they finally set up would also vary greatly when each defined *where* and *how* their influence could be applied.

The important thing is that both can be right in their definition of the problem, and both directions of intervention equally valid. Problems can only be defined from the viewpoints of people affected by them and/or wishing to affect them. Change in complex systems comes about through the action of multiple agencies, and any desire for comprehensive system-wide control has great philosophical and political implications which we won't go into here. Suffice it to say that the undesirable secondary characteristics of such a control system would be likely to far outweigh any increases in efficiency, productivity, or other quantifiable criteria.

What is a Well Formulated Problem Statement?

We can conclude now therefore that every design problem has two roots:

a. *The resolution of conflict* — the problems of belief; truth; choice; power; values, etc.

b. *The removal of discrepancy* — the problems of fit; of matching means with ends; of making up deficiency; of righting imbalance; etc.

In the same class as the 'discrepancy' view of the problem is Christopher Alexander's concept of 'Misfits' between form and

context. He takes the view that design problems originate from such misfits which become problems when the extent of the misfit becomes large enough to have undesirable effects on people's comfort, convenience, etc. As we have said before, this seems to be true of traditionally defined design problems and the norms of design practice, but increasingly our modern problems are of CHOICE rather than fit. It has become critical that we learn how to handle the problems of variety, values and beliefs, and preference – in short to find ways of establishing direction. Once we have done that then the means and the skills are available to achieve the removal of virtually any discrepancy between *what is* and *what ought* to be.

If the definition does not seem to cover the problem of say, road accidents or pollution, consider that though they seem to exist not everyone is interested in doing anything about them. If certain groups persuade the government that pollution and road accidents are undesirable, then any moves to reduce them have to find a balance between all sorts of factors from economics to personal freedom.

At this point we can fill in some of the other ways in which a PRIMITIVE PROBLEM STATEMENT can be seen to be primitive.

Previously we established three criteria of primitiveness.

1. Lack of clarity.
2. Unjustified assumptions.
3. Expression in solution concepts.

Now we can add that a problem statement is primitive if it omits to say:–

4. What the evidence is of the existence of a problem.
5. For whom it is a problem.
6. Who might support change.
7. Who might oppose change.
8. What are the purposes of intervention.
9. Where might intervention occur.

It can be seen in the list above that it starts from the observation of those manifestations which are proving unsatisfactory, and goes as far as it can – up to Item 7 – to identify the current problem state. Items 8 and 9 reflect the intent of some party to take action in the situation and generate an appraisal of possibilities for change. Thus one encompasses the realities of the purpose of those wishing to initiate change; using this both as a means of limiting the boundaries of the problem, and as a means of defining central intent, or the focus of action. It is only after this has been done that one can begin to analyse the situation and model it effectively.

What this does it to postpone the use of solution concepts for as long as possible in order to increase the likelihood that the many facets of the problem may be allowed to influence the final attempts at solution. The view of the problem is kept fluid and broad and insights sought which will give the best chance of providing the essentially varied base for problem solving in complex socio-technical situations.

In the end it has to be realised that in such problems it is the preferences, intentions and desires of man which have to draw the boundaries. What more natural than that you go as far as you can with the resources available; that the core of the problem reflects your interest in it and that the degree to which your intentions prove disadvantageous to others will determine the resistance you expereince. We should not find ourselves dismayed by such arbitrary constraints, but rather feel that it is they which ensure the humanity of the man-made world for mankind.

In past ages, and perhaps in some places now, where change was so slow as to be almost imperceptible, the context was closely woven into habit, tradition, custom and belief. In times of rapid change, however,

when everyone is disorientated, when values are turned about and conflicts and stress abound, the context of design activity is uncertain and the parameters of form are unknown. It is these circumstances which generate the need for an explicit process of PROBLEM IDENTIFICATION – a process whose purpose can be defined as THE DEFINITION OF SOLUTION CONTEXT.

References

1. The terms 'Problem Push' and 'Solution Pull' are not original to the present authors. However, we cannot at present trace their origin, and apologies to whoever we are failing to acknowledge.
2. Some elaboration of this point may be found in Jones, J.C. 1970. *Design Methods*. (John Wiley & Sons),

   and in

   Archer, L. Bruce. 1971. *Technological Innovation*. (Science Policy Foundation).
3. (a) Rittel, Horst, W.B. & Webber, Melvin M. 1971. *Dilemmas in a General Theory of Planning*. DMG – DRS Journal. Vol.8, No.1. Jan. – Mar. 1974. (Reprinted from Policy Sciences, Vol.4, No.2. Elsevier Scientific Publishing Co., Amsterdam).

   (b) Rittel, Horst. 1970. *Some Principles for the Design of an Educational System for Design*. DMG – DRS Journal, Vol.7, No.2. Apr. – June 1973. (Reprinted from past DMG Newsletters – Dec. 1970 & Jan. 1971).
4. Another version of this viewpoint can be found in Singleton, W.I. 1974. *Man-Machine Systems*, Penguin Education (Penguin Books), particularly on page 30 'In particular it is necessary to separate the functional concept of a system from its physical realisation; that is, to contemplate what it does as an issue quite separate from how it does it physically'.
5. As reference 3(a).
6. Further reading on the subject of the use of explicit objectives in the allocation of resources and decision making in complex situations can be found in Williams, Alan *Cost-benefit Analysis: Bastard Science? And/or Insidious Poison in the Body Politick?* in Wolfe, J.N. 1973. Cost Benefit and Cost Effectiveness. (George Allen & Unwin).
7. Winchester, Simon *They've come a long way in St Louis*. Guardian Extra Wednesday May 15th, 1974.
8. de Bono, Edward, 1967. *The five-day course in lateral thinking*. (Pelican Books 1969) and other books by de Bono.
9. As reference 3(b) but further elaborated in 3(a).
10. Asimov, M. 1962 *Introduction to Design* (Prentice-Hall, N.J.) says 'We assume that we have been given a primitive statement of needs. By primitive we mean that the statement represents opinions based mainly on casual observations but unsupported by organised evidence'.
11. For example in Cross, M.G. (Ed.), 1972 *Design Participation*. Proceedings of the DRS Conference, Manchester 1971. (Academy Edition, London).

ANSWERS TO EXAMPLES IN PART 1.

1. 
   Most people make the assumption that they are unable to go outisde an imaginary line joining the outer dots.
2. Gather the matchsticks tightly together and look at them end-on. Most people lay them down and try to use the matchsticks as sides of squares, then give up.