

Societal rationality; towards an understanding of decision making processes in society

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1 Introduction

Researchers in risk perception are often struck with the large diversity in opinions, which are connected to new and hazardous technologies. Some people view the technologies as the savior of mankind and others see their use as the ultimate proof of human greed. How such images develop is not well understood, but the processes seem to be anchored deeply in basic beliefs of how the world is built.

A resolution of controversies connected to hazardous technologies seems to need new approaches. One approach could be to make issues and arguments easier to understand and thereby establish a common ground for further discussions. An analysis of debates for instance on nuclear power suggests however, that the issue is not connected to an understanding of the technology in itself. A more likely explanation is that traditional societal decision making processes break down when a stand towards new and hazardous technologies should be taken. If this is the case a remedy has to be sought in how societal decision making processes should be structured, explained and implemented.

In a search for new ways to structure decision making on complex and controversial issues it is necessary to build an understanding of why traditional decision making processes break down. One reason is connected to the issues themselves. They represent steps into the unknown and decisions should therefore be made with prudence. A second reason is connected to a track record according to which new technologies are seen as generating more problems than solutions. A third and more fundamental reason is connected to the decision making processes themselves and a need to find better ways to approach difficult questions in the society.

One way to approach societal decision making processes is to investigate their hidden rationality in an attempt to understand causes of observed difficulties. The paper is based mainly on observations from the nuclear industry, but it builds also on controversies experienced in attempts to agree on global efforts towards sustainable approaches to development. It builds on an earlier paper [1], which discussed the

basis of rationality both on an individual and a societal level.

2 In search of rationality

Decision making relies on a concept of rationality. Rationality in itself is not a straightforward concept, because attempts to provide descriptive, normative and prescriptive definitions fail in being practically non-verifiable [2]. This notwithstanding there is still a benefit of a search for a kind of theoretical platform for investigating rationality in societal decision making processes.

2.1 Rationality *ex ante* and *ex post*

The concept of rationality is connected to reasonability and sound judgement. Rationality in decision making is often associated to the ability to select the best alternative in a situation of multiple choice. Models of decision making situations have been constructed to explain what is meant with the best choice. These models typically identify a set of concepts such as a set of decision *alternatives*, a world *model* which connect the decision alternatives to possible outcomes and a *utility function* which defines the utility of the outcomes for the decision maker. Many of the models suggest that the decision, which gives the highest expected utility, should be seen as the best in a normative sense.

One difficulty in applying the expected utility theory for practical problems is that large uncertainties in the world model and complex utility functions make simplifications necessary. The validity of such simplifications, i.e. the *decision model*, are however often possible to assess only in hindsight. In a consideration of decisions *ex ante*, i.e. before the decision, it is therefore necessary to include another decision problem, which is concerned with various alternatives to build a decision model of the actual situation. According to the concept of bounded rationality, the effort of building a decision model has a cost, which has to be compared with potential gains of a better decision. Decision making *ex ante* therefore breaks down into a chain of decision making problems, which are solvable, only by using inaccurate and highly simplified models.

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Considering decisions *ex post*, i.e. after the decision when the outcome is known, there are always lessons to be learned. Already a conclusion that the actual outcome was unexpected or brought unexpected costs, contains the suggestion for a search of improvements in later decision making processes. Such improvements may be directed to the decision model itself or to its components. Improvements may also be necessary in the processes by which a selected decision is implemented.

2.2 Co-operation and competition

A decision making problem where several independent actors are involved is much more complicated as compared with the case that one actor plays against nature. The complication arises from the fact that the utility functions of the actors may be completely or partly conflicting, so that gains of one actor are paid with losses of another. There are situations where two or more actors have a common benefit of co-operation. Research in non-zero sum games has only recently shed some light on the complexity of co-operation and competition [3].

Co-operation between two or more actors for some common goal brings in the problem how they should share the benefit of the co-operation. If they cannot agree on a suitable formula to solve that problem, mutual trust and co-operation is likely to dissolve. Co-operation therefore always includes a component of competition.

The building of common resources to be used in a group of co-operating actors is a way to further extend a concept of co-operation. Such commons may be intended to help actors in coping with external resources varying over time or they may be intended to allow a functional specialisation. The problem in the management of commons is to establish the rules for building and utilising them.

2.3 Intangible utilities

Man has been characterised as a social animal. That means that relationships and interactions between a decision maker and his social environment have a utility in themselves and therefore should be included in a consideration of decisions. Social relations can be seen as a set of intangible utilities, which are balancing other more tangible utilities. Such intangible utilities may involve honour, prestige, appreciation, esteem, respect, etc. Psychology also points to the utility of self-respect, which is related to maintaining a valid image of oneself.

In a consideration of societies there are reasons to believe that group norms are facilitators of co-operation between group members and that they therefore are important for the efficiency of the society. Consequently there are many explicit and implicit mechanisms by which societies enforce group norms.

Interactions between actors in a society suggest a utility of social trust, which reflect a history of earlier transactions. Emergence of trust between people seems possible only in an atmosphere of reasonable open and efficient communication. Trust also seems to create a mutual dependability of giving and taking, which may break down if the motivation behind actions is placed in doubt.

Finally a consideration of right and wrong is anchored in basic beliefs to make some decision alternatives uncomfortable or even unthinkable. There is also cultural biases towards certain actions which may be difficult to understand without explicitly bringing them into the decision making process. If the full spectrum of such intangible utilities are not brought into the models, the decision making process will easily appear irrational.

3 Decision making in society

Decision making in a society depends on a general view of its members and their rights. Autocratic societies typically view their citizens as dependent and uninformed, whereby democratic societies are stressing the sovereignty of their members. Decision making in autocratic societies is straightforward, but has several other drawbacks. Decision making in democratic societies can be slow and complex, but has the benefit of being more robust with respect to several delicate balances.

3.1 Division of labour

Division of labour is one of the bearing principles by which societies have become efficient. Division of labour enables individuals to invest efforts in education and training for specialised skills with a corresponding gain in efficiency for the benefit of the society. The extent to which division of labour is utilised in a society is a matter of resources, available technologies and convenience.

Division of labour involves delegation of authority and power. Certain decisions in the society are for the common good authorised to persons or groups of persons. The delegation of authority has an important function, but involves some problems. The first is to decide when a delegation of authority is possible and desirable. Secondly there has to be agreed principles of selecting the person or group of persons to whom the delegation will be made. Finally there has also to be principles for deciding when this authorisation has to be revoked.

Authority and power carries the balance between individual and societal utility. As long the balance is in favour of the society there is no need for a change, but already a promise of something better may initiate a change of leaders. Authority is in democratic societies typically awarded through elections, which

sometimes can cause frequent shifts in major policies.

3.2 Handling of conflicts

Co-operation and competition have an inherent potential of conflicts. Conflicts can be expensive for the society in large and therefore there are established institutions for their resolution. A simple formula for resolving conflicts is to avoid them. For this purpose rules of conduct are laid down in laws and regulation and they are enforced by various penalties. In addition there are many unwritten rules buried in societal norms and practices. Also these rules are enforced by various mechanisms.

Societal norms call for the resolution of conflicts by negotiation. The process of negotiation from conflict to agreement may however, be long and difficult. A straightforward way to resolve conflicts *ex post*, is to agree on compensations when wrongdoings have occurred. Finally practice has shown that when no other means are found, then power often is used as the last resort.

Voting is one mechanism for resolving conflicts. If votes cast all support or reject a decision alternative no problem arises, but this is seldom the case. A simple majority vote is often used to select the most popular alternative, but ensuring support from a loosing minority may warrant special considerations. Voting procedures also have their own inherent problems.

3.3 Economic systems

Societies have created economic systems to facilitate exchange of goods and services. These systems often reflect a societal view on human rights and take stand on ownership, land use and heritage. In their simplest form the systems regulate transactions of a barter economy. More refined systems define how tax in the form of goods or labour is collected for the creation and management of common resources. The systems often also include some form of wealth collection and redistribution.

The most important part of the economic systems is the establishment of an exchangeable object of value i.e. money, because they facilitate the exchange of goods and services. Money provides a basis for comparing different utilities. Money also simplifies discussions of compensation for some negative utility. Money provides the basis of assessing the value of investments in terms of costs to be spent for some later benefit to be reached.

Recent discussions of the relative merits of various economic systems have been targeted to comparisons between planned and market economies. Simplifying the question one could say that philosophy behind the planned economies is some kind of rational planning and decision making, whereby market economies rely on the "invisible hand" for the optimisation.

Planned economies can be seen as providing a top down approach for decision making, where the market provides a bottom up explanation for how market forces are constituted by micro decisions. The recent break up of many planned economies in the world has put a large faith in the market as a warrantor of efficiency, but also a free market will need enforcement's and compensations to ensure a fulfilment of societal goals.

4 Decisions in a modern society

A comparison of decisions in societies only a few hundred years ago with decisions in a modern society point to many differences. Firstly decisions in a modern society are delegated to an extent far beyond earlier imagination. Secondly decisions by those in power today can have a far larger impact both on people and the environment than decisions by the powerful of yesterday. Finally there are far better methods and tools today for implementing rational decision making processes.

4.1 Characteristics of difficult decisions

Difficult decisions typically involve many stakeholders with completely or partly conflicting objectives. The decisions are often concerned with the establishment or use of common resources in the society. They affect power structures and thereby processes by which other decisions are resolved. These characteristics make the decisions difficult to consider in isolation.

The technical development has brought many new dilemmas to the modern society. Firstly decisions even in the small have through various amplification mechanisms the potential to have a global influence. Secondly there are many new products taken into use which may introduce new dangers that have to be understood and evaluated. Thirdly recent development in biotechnology have the potential to introduce unprecedented changes in the genetic material of all species.

Difficult decisions in the modern society are irreversible at least in practice. They have the potential to cause a very large damage, although the probability for doing so is small. There are also large uncertainties involved, both predicting the outcomes and estimating their probabilities. Difficult decisions in addition involve a multitude of different utilities, which have to be combined in some way to provide a sound basis for a selection between alternatives.

4.2 Principles for approaching difficult decisions

Difficult decisions often have the characteristic of requiring an active solution with the meaning that the solution of postponing them cannot be considered

acceptable. That means that the society should have procedures to avoid expensive decision deadlocks in situations where no agreeable solution seems to be at hand.

A difficult decision is always including a multitude of considerations. A simple approach is to consider different phases of a decision making process as separate decisions, which again can be further subdivided. One subdivision of a decision process separates between five phases; an identification of the need to make a decision, an identification of decision alternatives, an evaluation of the expected utilities of the identified alternatives, a selection of the best alternative based on the evaluation and the implementation of the selected decision. The implementation will in addition assume follow up activities where the selected route of actions is fine tuned.

Processes for approaching difficult decisions have to combine both an overview and details. The benefit of dividing the decision process into phases is that it makes it possible to handle details, but a final consideration of decision alternatives have to rely on a view in which all aspects have been weighted together. Formal methods have been used for that purpose, but they do not compromise for the need of understanding the issue itself.

Mathematical modelling is to a large extent used to support decision making in predicting outcomes and probabilities. That places issues on a scientific platform, but available models do seldom have a predicting power to account for all possible chains of events. Models also rely on expert knowledge, which may be difficult to transfer to decision makers. Experts developing the models also have their own connections to stakeholders in the decision making process.

4.3 Politics

Politics is a connective concept for many aspects of societal decision making. Basically it is emerging from the need to set societal goals and finding ways to implement them. In a democratic society politics usually is associated to political parties, but any system carries the need of forming pressure groups for bringing important issues forward in a decision making process.

Politics in itself is relying on a division of labour. People specialising in public administration are authorised to represent a group of voters. Politicians themselves as well as political parties seek public support of ideas and visions to get a future term in office. Because practical decision making in society always requires compromises to avoid deadlocks, politics has developed its own practices to resolve difficult issues in a process of give and take.

When politics becomes a profession for some people, the dilemma of individual and societal utility emerges. It is all too easy to give rosy promises be-

fore an election, which are impossible to fulfil in later actions. Similarly it is tempting to tune a political programme to assumed beliefs of a group of voters as opposed to give a clear expression of own preferences on controversial issues.

5 Societal control of hazardous technologies

There is a large agreement in the present society that hazardous technologies cannot be allowed to be developed and operated only according to conditions of the market. Therefore societal institutions and regulation have to be introduced as the means in responding to the ends of protecting individuals and the environment. Regulation tries in a top down approach to set borders within which a technology can be considered acceptable.

5.1 Introduction of new technologies

Technological development has changed our society profoundly. Productivity gains, which rely on the use of external energy sources, has made it possible to free labour for an accelerating process. Increasing wealth brought to people has made it possible to devote even more time on inventing and refining new methods and tools with further gains in productivity. Systematic R&D combined with an efficient exploitation of the results for putting new products on the market has placed an unprecedented wealth within the reach of a growing middle class all over the globe.

The introduction of new technologies seems to follow a common path in which seeds of later controversies are planted. New inventions are typically marketed with a lot of promises. In a sobering from unfounded expectations, drawbacks and other side effects, an opposition towards the technologies is created. In that stage a polarisation between opponents and proponents of a technology often emerges and then the end of either suppressing or advancing the new technology seem to sacrifice any arguments used in a debate.

New technologies influence the society in several ways. They have an influence on economics, division of labour and even on norms in the society. The path towards the utilisation of new technologies seems to be irreversible in a way that a denouncement of their benefits seems difficult to achieve. The supporting capacity of the globe builds on an efficient utilisation of many inter-linked technologies and therefore a voluntary step back for some uncertain benefit seems very unlikely.

5.2 A track record of new technologies

There is almost no new technology, which have not later shown to produce any adverse effects. A con-

centrating only on the drawbacks may suggest that it would have better not to introduce the technology at all, but in larger context most people agree on the blessings of the every-day technologies and do not want to step back. Some may also argue that the competitive edge of new technologies has been based on a ruthless exploitation of natural resources. This argument may be partly true, but it is not fair in a consideration of several older technologies, which have made orders of magnitude more benign by new technological development.

Another track record is connected to reactions by proponents of a new technology when the first signals of emerging problems are showing. It has often been a blank denial of any problem paired with a ridicule of the opponents. When the proponents in the following debate have been forced to withdraw from their positions they have generated ill-will for themselves and goodwill for various movements specialising in technology opposition.

A belief in technological development as beneficial or harmful cannot be proved, but both views have to be accepted in a debate. A disagreement in this respect should however not restrain from a search for emerging problems with new technologies. At the same time the absence of an absolute proof of the harmlessness of a technology should not be an obstacle for its use.

5.3 The role of regulation

The need for regulation can be motivated from the need for a societal insight in the solutions selected by operators of hazardous technologies. This also implies that a societal agreement on the borders of acceptability is created. If the selected solutions are not within these borders, the society can revoke the authorisation for the operation of the technology.

Regulation is typically built as a system of requirements, which have to be fulfilled before an operational permit can be issued. By requiring and monitoring a transparency in the regulative process it can be assumed that controversies are less likely to develop. Evidently a regulator has to be independent from the regulated industry.

The opening of markets more globally has pointed to a need for a global harmonisation of regulation, because otherwise the technologies just can move to regions on the globe with the most limp regulation. There seems however, to be difficult to introduce competition between agents who have a regulatory status, as some recent accidents in the shipping business has shown.

5.4 Lessons from the nuclear industry

The case of nuclear power provides several lessons for researchers interested in how societies handle hazardous technologies. These lessons can be further elaborated by comparing different countries and how

they have responded to nuclear power. From its early introduction nuclear power was connected to many promises and fears, which have moulded public images of the technology. The rapid expansion of the nuclear industry in the sixties and seventies was followed by an almost complete stand still during the eighties and nineties. The present situation has brought difficulties for the nuclear industry to maintain competency for the remaining lifetime of present plants.

The perhaps most important lesson from the nuclear industry is that there always are improvements before a technology can be considered mature. The experience available today would make it possible to build safer and more economic plants than those presently operated. This suggests a prudence principle were new technologies are introduced gradually from a small scale, to allow for experience to accumulate. This may be difficult to achieve if new technologies are allowed to develop purely on market conditions.

Another lesson from the nuclear industry is connected to the management of safety in the operation of hazardous technologies. This is an endeavour with many facets. It includes an extensive quality control in all steps of design, manufacturing, operation and maintenance. It also includes a consideration of what people do and how all errors can be caught before they impact the safety of the plants. Opponents to nuclear power point to accidents and claim that the plants are too complicated to be operated by people. However people who have an insight in the safety precautions have a firm belief in the safety of the nuclear power plants.

6 Deciding on hazardous technologies

Decisions on hazardous technologies are by definition complex. A common observation is that major risks are due to events with a very low probability, but with very high consequences. This fact also carries the difficulty of proving that a certain chain of events by any practical conclusions can be considered impossible. Views on pros and cons of a certain technology tend to be coloured more by images, beliefs and familiarity than objective assessments [4].

6.1 Stakeholders and roles

It is necessary to divide between different roles people have in a decision process. Firstly there are stakeholders in the decision process, who have something to gain or lose. Decisions may also have an indirect influence on third parties. Assuming that the decision involves some kind of conflict, it is desirable that the decision maker can be considered neutral. A decision process could also involve an

arbitrator taking a role of proposing compromises in a process of negotiation.

Difficult decisions will involve experts in different functions in the decision process. Experts are supposed to calculate likely outcomes of decision alternatives and their probability estimates. Just simply calculating outcomes are in this connection not enough, but the experts are also supposed to account for secondary, tertiary, etc. effects of the decision. Experts participating in the decision making process are often in one way or another associated to the stakeholders. They have their own beliefs and values, which may be reflected the advice they give.

Finally the general public may for different reasons be interested in the decisions and therefore also media. It is important to note that also media have their own interest in bringing bad news to the public. Similarly one-issue movements have found their own utility in opposing actions which can be seen as compromising their goals. One may even claim that there in many situations between to competing views enters a third, which is more interested to initiate and maintain a dispute than to resolve the disagreement.

6.2 Framing the decision process

There is a benefit of framing the decision process in a formal way [5]. That implies an identification of applicable societal norms and stakeholders in the broadest sense. It also implies the construction of various world models by which decision alternatives and their outcomes are sought. This frame can be seen as the model of the decision making process itself. In this connection there is a benefit of stating the expected time duration, costs and milestones of the decision making process.

To make the decisions making process manageable, its scope should be restricted as far as possible. That means for example that there should be agreed cut off criteria in the search along possible cause consequence chains. Similarly there should also be some agreed cut off level beyond which trace elements are not followed any more in a life cycle analysis. Probabilistic methods also require some agreed cut off probability beyond which events are considered unlikely enough.

An important part in the framing of the decision making process is a consideration of costs. It is not rational to build up a complex and expensive decision making process to solve some simple conflict. Complex issue cannot on the other hand be expected to be resolved without proper investments in time and resources. It is also important to try to quantify costs and benefits of various decision alternatives as accurately as possible. Finally also the utilities of the stakeholder should be measured in terms of costs and benefits. It may sometimes feel difficult to convert utilities into costs and benefits, but orders of magnitudes can sometimes help in setting priorities.

6.3 Better models and communication

The frame of a decision process suggests three separate models. Firstly a model of the society itself and its functions, norms and practices has to be created. A second model is concerned with stakeholders; their conceptions of the decision to be made their values and beliefs. Finally the third model describes the decision itself, what the alternatives are and how the system is expected to respond.

It is important that these models are understood by the decision maker and the stakeholders and that there is a reasonable agreement on them. This is not to say that all have to have the same level of expertise, but the models should be transparent enough to provide a broad understanding on their assumptions and limitations. The system model is generally the problem in this connection, because the whole reasoning process involving causal chains and probabilities are not familiar to people.

It is always beneficial to get better models, which give more truthful descriptions of the situation. This is however not enough, because the goodness of a model will also be judged by the ease of its communication. This generally means that models have to be described at several levels of abstraction, starting from general principles and going all way to a detailed documentation of how the results for specific cases have been obtained. The models should also be possible to audit.

6.4 Searching borders of uncertainty

One common observation in difficult decisions is that uncertainties in predictions are very large. When uncertainties are very large a simple decision is often to start additional investigations to decrease the uncertainties and these will often shed additional light on the decision itself. A sensitivity analysis can give a good insight to allow priorities to be set for decreasing uncertainties.

In the process of evaluating uncertainties involved also implicit assumptions in the models should be scrutinised. For that purpose a questioning process where laymen ask the experts questions about their models have shown to be efficient. Such a process also has the benefit of making the experts aware of their own values and beliefs.

Finally the utilities of the stakeholders should also be scrutinised. Very often players in a game do not disclose their true intentions and utilities. Sometimes trade offs between utilities are not considered in enough detail to avoid inconsistencies. One approach is to rely on an outside arbitrator in trying to build up trust between stakeholders to make it easier to exchange information on true utility functions.

6.5 Towards the future

With the emergence of new technologies, new dilemmas will arise. The alternative to suppress new inventions does not however seem to be a sensible solution. One solution is certainly to require that hazardous technologies are regulated and that the regulation is applied globally. Some of the new dilemmas may need new ethic principles to be constructed on the basis of suitable precedents.

In the ever-growing complexity of the world and the emergence of astounding new technologies there is a danger that pseudo-science gets media attention and public support. One may even speculate that a growing confusion among people would wake a desire for them to get a point of social reference through the faith in and commitment to a movement of some kind. The only possible remedy is to educate people in scientific thinking and methods.

A vision for the future is that the complexity of the issues will grow further. More subcultures seem to be forming and therefore more disagreement even on basic issues can be expected. On the other hand means for communication are better and also information on difficult issues is easier to access. It seems evident that there is a need for research in societal decision making processes to make them smoother and more efficient in finding agreeable solutions to difficult issues. The solution to the dilemmas does not seem to be less reliance on technology, but an introduction of more responsible and enlightened technologies.

7 Conclusions

Research in societal decision making has to rely on a true multi-disciplinary approach. It is not enough to understand the technical and scientific models by which outcomes are predicted, but it is also necessary to understand how people make sense of their environment and how they co-operate. Rationality is in this connection one of the key concepts, with an understanding that people always are rational in their own frame of action. The challenge in this connection is to understand how this subjective rationality is formed.

Societal rationality has to do with the allocation of resources. There are decisions in which several conflicting views have to be considered. Spending time and resources *ex ante* may support a consensus *ex post*, but unfortunately there is no panacea for approaching difficult decisions. Decisions with an uncertain future have to be more robust than decisions with a more predictable future. At the same time investments *ex ante* in the decision making process are more likely to become wasted if all preconditions change. The rapid development of our time suggests an evolutionary approach to urgent problems.

Decision making processes on hazardous technologies sometimes seem expensive and time consuming. Final outcomes are also unpredictable and they may not be socially acceptable after all. It may be so, but the expenses of selecting a route, which later has to be reversed due to societal disagreements, can also be expensive. Investments in the decision making process should therefore be seen as an insurance against bad decisions. This is however not to say that that important decisions should be voice voted, because there has to be a stability in basic principles applied.

Decision making processes have to rely on an honesty of decision makers, stakeholders and experts. It seems possible that making general principles explicit could facilitate consensus building in decision making processes. Basically this would mean lifting up generic dilemmas to make the reasoning transparent and traceable.

Decision making processes have very much to do with how people understand and make sense of the world they live in. That means that stakeholders have to be open in explaining their motives, values and beliefs. Unverifiable beliefs have in this process to be taken with their face value as a standing point for further argumentation in a search for a common platform to agree on. This is not likely to be easy, but the alternative is an increasing disagreement on difficult issues.

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