Report on mechanism of social engineering

An invitation to actively meet recent challenges

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1. Introductory remarks

1.1 The global need

The development of the society has been an extremely quick one within the past few decades. The urgent need for "social engineering" can be seen as a result of this development.

The traditional meaning of the word "engineering" includes the entire sector of technical efforts in developing projects and technical solutions. For a very long period the technical feasibility has been the crucial criteria for realisation. Due to the continuously advancing technical excellence increasing the costs the economical feasibility of a project superposed any decision process, serving as a second, significant criterion.

Both the awareness of people towards any alteration of their individual environment but also the dimension of projects has been increasing rapidly. A completely new field of engineering has to be developed – the social engineering, focussing exclusively on non-technical aspects within the project implementation.

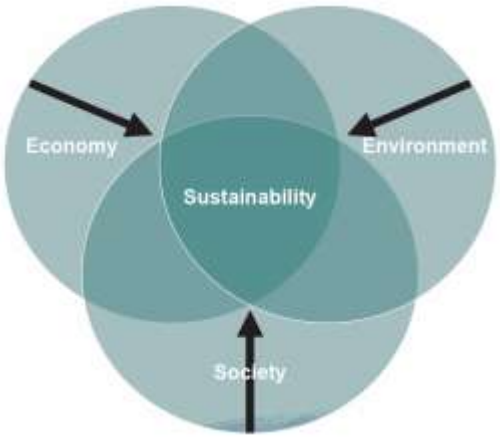
Obviously social engineering will be of high importance whenever technical or economic arguments are not sufficient to persuade people involved. Apart from the individual need, social engineering should become an obligatory part of any engineering process in a wider scope.

There are a few classical fields of application: waste disposal sites, airports, freeways, high voltage lines, nuclear power plants but also hydropower plants. Social engineering is a general task and there is global need for it.

This report is focussed on aspects of social engineering in the context of hydropower plants. Some criteria and mechanism are still general, but some are very specific meeting the peculiar features of hydropower.

1.2 Social engineering – a key element of sustainable engineering

Looking at the traditional definition of sustainability it becomes clear that social engineering is an essential and unavoidable part of it. Everybody dealing with sustainability knows best the problems of criteria and indicators. It is ambitious in terms of economy, it is difficult in terms of environment and it is a challenge in terms of society.



Sustainability is not a static condition but a process, reacting on variables. Social engineering has to react on human variability which is the most unpredictable task.

1.3 Fear as the driving force

Social engineering can be seen as methodical approach to overcome opposition against a project. To find solutions it may be helpful to find out the reason of opposition which may be manifold. Still remaining on general level any opposition is based on fears which are based either on facts or on emotion. Of course in many cases we are facing a mixture of both. Nevertheless the reason for the fear makes the big difference. Factual fears can be met by rational arguments – emotional facts have to be dealt with on emotional level.

What kind of fears do people have?

Fear of losing money

Fear of personal safety and health

Fear of having any kind of disadvantage

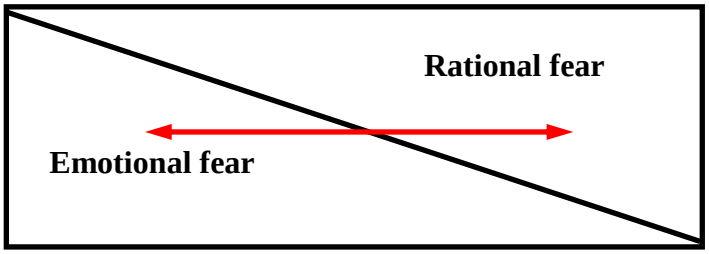
Fear of decrease of living condition

Fear of any unexpected alteration in their life

Fear to be tricked

The intensity of the fear is direct proportional to the alteration itself.

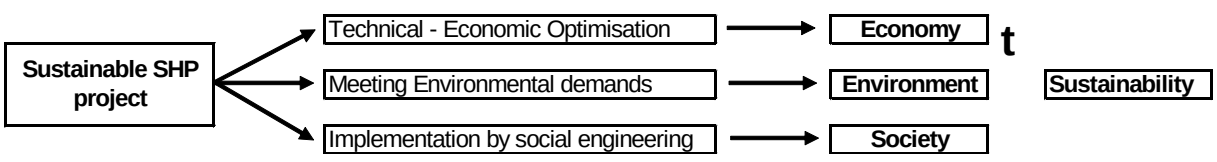
In simplification it can be said that "total fear" is combined of both types of fear which can be exchanged up to a certain degree.



Anyway – to deal with fears needs communication and consequently the willingness to communicate of all parties involved. Without this precondition the majority of "social engineering tools" cannot be applied.

1.4 The target of social engineering

Social engineering means accompanying technical and economic aspects with the great variety of social aspects. Social engineering will never stand alone. Necessarily it needs a project to deal with. The final target is the factual implementation of an idea.



1.5 Applying the general idea on hydropower exploitation

Electricity production from hydropower is undoubtedly a task of public interest. Nevertheless a certain part of the population will not recognise the close relation between individual electricity consumption and electricity production although electricity has become an unavoidable part of our life.

Hydropower exploitation is a very special task concerning public interest because there is a conflict with the environment being also a matter of public interest. In both cases there are historical emotions involved. The lack of knowledge but also the lack of information seems to be the main problem.

There are many approaches to achieve the target of public awareness and acceptance of small hydro and as many of them as possible should be applied together. The following aspects to be discussed should not be seen as obligatory, or to be applied at any project. The idea behind the examples discussed may encourage open-minded engineers to implement hydropower projects even in conditions which may seem hopeless.

2. The tools

There are four groups of tools that can be applied:

- Conceptual strategies
- Operational approaches
- Involvement
- Ownership and identity

2.1 Conceptual approaches

Usually, at the very beginning of a project, the engineer faces a complete one-dimensional job, defined by the principle: design and implementation of a small hydro plant. It remains for the competence, the experience and the art of the design engineer to embed the one-dimensional idea into a wider, comprehensive concept, receiving positive public interest. Conceptual approaches belong to engineering, but need also to be multidisciplinary and it is necessary to recognize sometimes complex links between them. These are the means of transporting the core-idea.

2.1.1 Changing priorities: environmental concepts and additional small hydro development

Many of the rivers which are attractive for small hydro development have had hydraulic works installed in the past, aimed at lowering the risk of flood or increasing the river stability. The ecological quality is sometimes quite poor but little happens because of a lack of funds.

The implementation of a small hydro plant may in fact be able to increase some ecological parameters, provided the design becomes environmentally sound. Nevertheless, if the official

target of the engineering project is the construction of a small hydro plant, people will tend to interpret some environmental measures as an ineffectual attempt to compensate for severe ecological destruction. The better way is to change the priorities. The main target of the project should be environmental sustainability, including the production of renewable energy by small hydro. This is just a question of highlighting certain aspects which may not otherwise be regarded as the main topic.

2.1.2 Synergies and multipurpose plants

Hydropower, in fact, does not consume the water that drives the turbines and so the water is available for various other uses essential for human subsistence such as: prevent or mitigate flood, prevent or mitigate droughts, provide irrigation, provide supply water for domestic, municipal and industrial use, improve conditions of navigations, improve conditions of fishing and improve tourism and leisure activities. Even if the power plant in some cases pays for the facilities required for developing other water uses, this aspect is very important.

The traditional way of designing and engineering aims at the main target of the project, while minimizing any negative impacts or compensating them if they cannot be avoided. This is the conservative way to proceed in the fundamental sense of the word. Thinking the other way round means to aim at the main target but also to alter conditions which are not primarily necessary, but likely to be in the interests of other people.

For example: the traditional way aims to maintain the current (recent) degree of flood protection. Any open-minded engineer may, however, decide between either an improvement in protection, or the creation of a wetland area. Both of these options are much better than the conservative solution, because other people and other interests are addressed and they may become partners in the enlarged project.

A wide range of potential synergies and multipurpose ideas exist, such as:

- Installation of small hydro plants within drinking water supply systems;
- Installation within irrigation systems;
- Installation within wastewater treatment plants;
- Installation within cooling water systems;
- implementing recreational infrastructure;
- Improvement in ecological performance;
- Improvement of flood protection;
- Inclusion of traffic demands;
- providing measures to stabilize groundwater level.

In many cases, the construction of multipurpose plants will result in a sharing of costs, of risk and of responsibilities.

2.1.3 Combined energy production and consumption concepts (PCC)

The energy produced by small plants is generally fed back into the grid, with guaranteed and quite acceptable tariffs being obtained. This will not provide any additional partners. It sounds better to complement production by direct consumption. The latter can be a manufacturing plant, public buildings, a whole village or district, or at least a block of flats. Depending on the respective tariff structure, such systems must be optimized to gather advantages for both the producer and the consumer. In the case of industrial units, sometimes the low price to get public energy avoids such PCCs. If it works, the effect on the public is very high, in relation to employment, identification, the 'green power image', and so on.

2.1.4 Multi-resource concepts

Multi-resource concepts mean, in the present context, renewable energy (RE), although even other combined concepts may be supported. The reason for this restriction is a strategic one. Combining RE with coal or gas may reduce the value of RE and increase those of non-renewal energy sources.

The 'green image' (a very powerful public feature) of different sources of RE is quite different. In such a ranking, the position of small hydro is not that high. A partnership will thus become an advantage.

On the other hand, small hydro is reliable, predictable and highly available. Wind and PV, which are among the leaders as far as the green image is concerned, are slightly lacking in these features.

Biomass or geothermal energy, however, have high availability. Any multi-resource concept will either strengthen the green image per se, or do so by improving the overall availability. Such a concept does not necessarily have to achieve excellent technical values. Even some attempt counts in terms of public image.

2.1.5 Green image, environmental audits

Another technical solution is to gain an environmental audit, a green certification to prove that the plant operations are managed in such a way that the safeguard basic features of the ecological integrity of the river system are preserved.

The criteria to state the green image of a hydropower plant are chosen in order to insure this integrity.

2.2 Operational approaches

Engineering is a challenging job. The end of the initial design usually represents the start of an even more exiting and unpredictable phase. In relatively few cases there is no need for redesign, alteration or adjustment. The only requirements are: social competence, flexibility,

persuasive power and authenticity, besides technical excellence. All these aspects can belong to a more general open-mind planning attitude. Some examples may illustrate the approach:

2.2.1 Flexibility in design

A complex engineering process has to be variable on a time axis. The variability may be based on alteration of any of the following:

- Ecological knowledge;
- Economic conditions;
- Various other interests;
- Political will;
- Availability of technical solutions.

In general, flexibility in design means the ability to face and cope with new demands. To meet that challenge, the engineer has to understand the project completely and precisely in all its details so as to be able to react exactly to any alteration, without changing the whole contents of the project where changes are not necessary.

2.2.2 Design in the construction phase

Although a plan and a technical report should be the basis of the project implementation, that principle has a certain limit. With respect to the theory presented in Section 1.2.1, the design during the construction phase can be understood as a continuation of the design during the plan phase.

Technical measures and precise engineering fit together quite well. But environmental measures may often escape the usual degree of precision. The result, expressed by the ecological function, is based much more on individual adjustment than on a precise design. Consequently, a reasonable part of the environmental design can only be done during the construction phase.

The design provides only the framework, the target, the principles and the tools. In reality, this procedure requires very close cooperation between the engineer and the executing staff.

2.2.3 Mental preparation

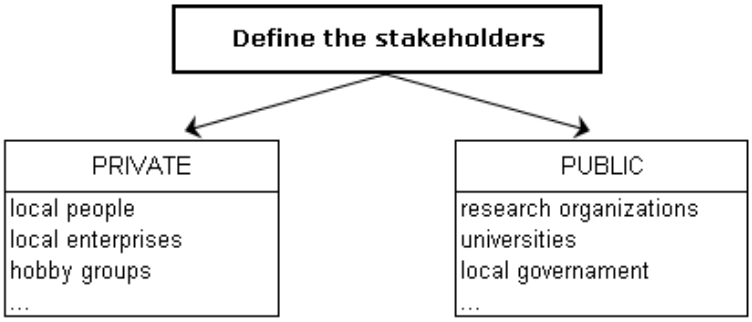
Within the engineering procedure a good and successful project is based on two main pillars:

- Excellence in content and design;
- The conviction that the project is the best possible.

Both facts are decisive in defending a project in any approval procedure or participatory process. There must not be any doubt in the heart of the engineer that the implementation of the project is an important step in achieving a sustainable development. In this case, other people will not only understand, but also appreciate the quality of the project.

2.3 Involvement

From a general point of view the first step is to identify who is really involved by the project and which is his interest. Generally it is possible to distinguish between local inhabitants, who want to protect their own interest, the local enterprises, who are interested in working opportunities, the research organisations and/or universities, who can be involved from a scientific point of view, the whole government but also non-governmental organizations existing on the territory. Every one of these entities is animated by different kind of interest, which should be determinated and exploited.



Every entity tries to defend is own interest. According to this, every entity will fear something different.

private	local people	fear of flood destruction	popular-social aspects
		fear of losing money	
		fear of losing natural environment	
	local enterprise	fear of losing job	
		fear of not earning money	
	hobbies groups	fear of losing fishing possibilities	
		fear of losing sport possibilities	
		...	
public	research groups universities	fear of environmental impacts	technical-economical aspects
	local government	fear of social and economical impacts	
	government agencies	fear of social and economical impacts	
		fear of pollution	

As mentioned before, at the basis of every solution there must be a technical and engineering correct project. That is: it's not possible to convince people that they won't be interested by floods if before this has not been proved. And this, for sure, is necessary for every aspect.

The levels where one is acting are different and of course the solutions will be different. For example, to preserve the private rights and interests of a sportive association a real cooperation and a deep dialogue is necessary to find the compromises which can satisfy every part. This, obviously, provides a preliminary spread of information, planning meetings and the flexibility of the engineering, mentioned before.

Any positive public opinion assumes at least a certain amount of public knowledge. Managing a project involves providing that information in the quality and form required.

The second reason for public involvement, generally, is the tendency for human aversion to any new idea. Offering ideas progressively in small portions will reduce resistance, because

people identify certain aspects as already known. To involve people will put a new value on an individual project, and make it more of a public one. Of course, this involves some risks, but the positive effect usually dominates.

POSSIBLE REFUSAL REASON		POSSIBLE SOLUTIONS			
		Conceptual Approches	Operational Approches	Involvement	Ownership and Identy
Fear/Opposition against something new which can damage...		↓	↓	↓	↓
	example				
→ *Private Safety*	fear of floods			*give information*	
→ *Private Interest*	fishing, sport, leisure		*social competence*	*give information*	*planning cooperation*
→ *Private Economy*	economic fears			*give information*	*privat ownership*
→ *Public Safety*	water quality, environmental aspetcs	*environmental sustanibilty*	*technical excellence*	*give information*	
→ *Public Economy*		*multipurpouse plants*		*give information*	

2.3.1 Involvement of governmental representatives

Within the regular approval procedure, a group of governmental representatives will review and evaluate the project. Traditionally, this group is given details of the project in its final state. Respecting social concerns, it is recommended to contact these representatives at certain stages of the project as follows:

- 15 % feasibility study;
- 35 % general design;
- 70 % detailed design; and,
- 90 % before completion.

The level of interaction should be high because of the expertise of the governmental representatives. These are more or less forced to participate in the engineering process by having their opinion or their expertise sought for certain solutions. The more familiar they are with the project, the greater the mental identification with it.

Nobody will argue against his own ideas.

2.3.2 Participation in the engineering procedure

In the past, several projects have failed as a result of local public resistance. When analysing this resistance, it seems that the main reason was the holding back of any information about the project. If people feel ignored, they may also be suspicious that they are being tricked. The content of the project, once transmitted to them, is usually not the major barrier.

In the context of development plants programs, participation can be defined as " the process through which stakeholders influence and take part in decision making, in the planning, implementation, monitoring and evaluation of programs and projects".(Kaosa et al, 1998)

Participation is difficult to evaluate as there are no commonly accepted quantitative indicators. It is thus important to distinguish between different levels of participation. In their study about participation in the Mekong River Basin, Kaosa- et al. (1998) describe four stages of participation: information gathering, information dissemination, consultation, and participation.

Other scholars like Pretty (1995) make a more detailed differentiation: passive participation, participation in information giving, participation by consultation, participation for material benefits, functional participation, interactive participation, and self-mobilization (Pretty 1995).

Table 1--Forms of participation

Passive participation	People are being told what is happening. It is a unilateral announcement by an administration or project management without any listening to people's responses.
Participation in information giving	The information being shared belongs only to external professionals. People participate by answering questions posed by researchers using questionnaires or surveys. People do not have the opportunity to influence procedures or outcomes, as the findings are neither shared nor checked for accuracy.
Participation by consultation	People participate by being consulted, and external agents listen to views. These external agents define both problems and solutions and may modify these in the light of people's responses.
Participation for material benefits	People participate by providing resources such as labor, in return for food, cash or other material incentives. It is very common to call this 'participation' yet people often have no stake in deciding about the processes and in extending activities when incentives end.
Functional participation	People participate by forming groups to meet predetermined objectives related to the project. These institutions tend to be dependent on external initiators and facilitators but may become self-dependent.
Interactive participation	People participate in joint analysis, which leads to action plans and the formation of new local institutions or the strengthening of existing ones. It tends to involve interdisciplinary methodologies that seek multiple objectives and make use of systematic and structured learning processes. These groups take control/ownership over local decisions, and so people have a stake in maintaining structures or practices.
Institutionalized participation	Participation in theory and practice are included in the political and legal national framework and the population has actual decisionmaking power. Consultation and joint decisionmaking is a must for project implementations.

Source: Adapted from Pretty 1995

A general aspect which is necessary from everyone entities, even if aimed above all at local people, is the information giving. How is possible to divulge the technical character information to the common people? For sure, we need document papers and reviews explaining, even in a simple way, some of the fundamental aspects of the design. This direct involvement of people is a process which can be carried out also through a series of informational meetings and public hearings. During these meetings is possible to urge the population in the decision making process.

Table 2.2: Instruments of Public Participation	
Document Review	Community members and other stakeholders increase their capacity to participate by reviewing background materials presented in a language and at a technical level they can understand. Having access to documents and reports also increases the accountability of decision-makers and the perceived legitimacy of the decision-making process.
Informational Meetings	Informational meetings provide basic information to the public about proposed projects, such as where or when a road or power plant will be build and its potential benefits and impacts. Informal meetings when conducted, early on in the process can help minimize initial public fears, identify local concerns to be addressed in the design of the project, and develop trust and communication with local communities.
Public Hearings	Public hearings are meant to provide a formal opportunity for the public to voice their opinions and concerns on a proposed project, law, or environmental policy. Public hearings are often viewed as ineffective and lacking meaningful public participation. In some countries, government agencies have trained facilitators to preside over public hearings to improve the dialogue between the regulator, project proponent, and the public.
Advisory Committees	Advisory committees allow for greater participation of key stakeholders that is more in depth, continuous, and policy oriented. There is a distinction between citizen advisory committees, which consist of a diverse representation from civil society and expert advisory committees which usually bring together scientific or technical experts. Citizen advisory committees are intended to serve more as the voice of the larger public.
Public Involvement Volunteers	Public involvement volunteers are people from the community who are enlisted to assist an agency in developing and implementing a public involvement program. They can be specially trained to speak about the public participation process or proposed project. The volunteers help the agency to better understand the community concerns and improve the public hearing process.
Community Based Environment Management	Through community based environmental management, multiple stakeholders come together to develop and share solutions to local environmental problems via consensus-based approaches that integrate environmental, economic and social objectives. This approach encourages voluntarily and collaborative actions by all stakeholders — the government, citizens, and industry — for solutions that ensure both environmental protection and economic growth.

(Source: Information collected during the study)

Participation is, as described, much more than giving information and may have significant influence on the engineering contents of the scheme. The engineer should not principally resist other ideas but it is his job to evaluate new ideas and to check whether they can be implemented, modified or rejected.

2.3.3 Mediation in the implementation phase

If the great variety of other tools have either not been applied or could not lead to a final compromise and there is still resistance to a project, mediation is a well known and well proven tool to gain a good result.

Although ‘environmental mediation’ is a well known term, mediation is not limited to overcoming environmental barriers.

It is a procedure to overcome any disagreement which has reached a stage where resolution would otherwise not be possible. It is carried out by a professional mediator, who must be neutral. The solution has to be found by the clients, and the participation is voluntary. The mediator simply conducts the process and gives it the necessary structure.

2.3.4 Public monitoring in the operation phase

For scientific purposes, monitoring is a well known process, carried out by the design team or some scientific bodies, and relating directly to the aspect to be monitored.

Another kind is public monitoring, which aims to prove that the results predicted for the project have been achieved in reality.

Such public monitoring is based on very simple features, but also on the results of professional monitoring.

A very successful approach is the participation of educational bodies such as schools.

One may ask why any efforts are considered useful after the implementation of a project. The simple answer is that the success of a project does not end after its construction. There remain a lot of open questions within the operation phase, indicating an urgent need for public identification with the power plant.

2.4 Ownership and identity

Identification is a kind of ‘magic word’ and can be achieved either by measures described in Section 1.3 or by real ownership. The share, of course, has some influence on the intensity of identification. In principle, even a very small percentage guarantees a positive effect. It is the actual commitment which counts, and not the amount, depending on the individual economic situation.

Identification needs a ‘real’ object with which to identify. In former times, small hydro installations tended to be hidden away, to avoid resistance.

Resistance as well as identification are emotions, to a certain degree, and both require objects and symbols, simply a focus to emerge and to grow.

2.4.1 Public ownership

Wind energy has demonstrated this concept from the very beginning, and the mechanism works perfectly. To share ownership has at least three advantages:

- Excellent public interest;
- Shared risk;
- Shared investment.

It is not clear why there is almost no experience in ownership-sharing models in the field of small hydro. There is in fact no reason.

There are many economic models, and they can be applied in the case of small hydropower. However, the public ownership model needs an operational body, like a limited liability company. The everyday business is carried out by the company, production reports for the owners may be given monthly, and a general assembly can be convened annually. The number of participants will be limited by the funds needed and by the portion.

2.4.2 Public–private partnerships

A little bit different to the model above is that of public-private ownership. The portions are then not offered like a loan or a stock, but the partnership is the result of negotiations. That concept sometimes occurs when two or even more potential investors are interested in exploiting the same situation. The inclusion of a public body like a community will serve as a neutral partner, and will be able to unite the former competitors.

Those models are also applied when the total investment exceeds the potential of one single investor. A public partner will limit the risk and in most cases the operational responsibility remains in the hands of the primary investor.

Besides all the economic reasons, any inclusion of public bodies is likely to encourage public interest and identification with the plants.

2.4.3 Public identity

Ownership is usually an economic fact. But in addition, it may also become a mental concept which is far from the financial aspects. To become a subject of public identity can be regarded as the highest level of acceptance.

Some examples can be given to illustrate this. Some small hydro plant operators have installed a kind of museum within the powerhouse, showing old-fashioned equipment. Others show their collections of historic agricultural tools, or collections of local art.

One excellent idea is the painting of the powerhouse by local children. Another is the installation of an energy filling station for electrically driven cars.

Along a bike-track, a small hydro operator may consider offering drinks and snacks. For visitors interested in technical aspects, a screen could show the recent performance of the small hydro plant.

An educational exhibit for the public could offer a list of certain energy consumers in everyday life, with a calculation of the hours of operation with a typical day’s production of the small hydro plant.

There are many occasions in our society to celebrate the opening and the start up. The production of the first kWh renewable energy should be an excellent reason to invite all the people showing some interest. Such a ceremony offers also the opportunity to invite politicians and mass media. A positive reaction is most likely to be seen as a result.

3. Conclusion

The overview given in this brochure is certainly not complete. The aim of the author was not to produce a list rules strictly to comply with but to describe the basic mechanisms and causalities. Reading this brochure should encourage to criticising conservative and old-fashioned standard on how to run a project and to react on upcoming challenges. Of course this principle must never imply the neglect of technical and economic criteria. They remain valid.

The way to find some new approaches is in principle quite simple and can be characterised by a few recommendations as follows:

- Discover advantages in disadvantages;
- Try to be able to say: this has never been done before;
- Believe in the incompleteness of well-known solutions
- Share all your expertise – the feedback will be exciting and creative;
- Ask laymen what they are thinking about your project
- Discuss your project with colleagues of completely different expertise
- Think and act in a multi-dimensional way in interdisciplinary groups.
- Adopt achievements in other disciplines

The life of engineers has become difficult in the last decades, but it has also become creative and exciting.