

The various sources of uncertainties in acoustic consultancy work

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The acoustical consultant has to face various kinds of parameters : technical but also human and economical. Each of these 3 factors introduces uncertainties. The quality of his work is when he succeeds in managing all of them and offering the best acoustical solution taking into account all the parameters. To do so he has different tools at his disposal. Some of them are presented hereunder in the classical 4 phases of the consultancy work.

Le consultant en acoustique doit faire face à plusieurs paramètres qu'ils soient techniques, humains ou encore économiques. Chacun de ces trois facteurs entraîne des incertitudes. La qualité de son travail est reconnue lorsqu'il arrive à gérer tous ces facteurs et à offrir la meilleure solution acoustique en prenant en compte tous les paramètres. Pour cela il a à sa disposition différents outils. Certains d'entre eux sont présentés ici au travers des quatre phases habituelles du travail de consultant.

The French acoustical consulting market

The French market of acoustical consultancy is rather new. Until about 1990, he was dominated by a small numbers of acoustical "gourous". In the early nineties the actors have tried to organize themselves around the GIAC (Groupement de l'Ingénierie Acoustique) which represents now the profession in "official" French organizations like government or official instances dealing with acoustics, AFNOR working groups, The GIAC represented 80 independent consulting companies in 2004 of about 400 persons and about 30 M€ turnover. Six companies had more than 10 persons. The estimation is that the GIAC represents about 2/3 of the independent acoustical consulting independent engineers or companies.

Apart from representing the profession, the GIAC has also internal working groups such as:

- Professional insurance: a special insurance contract has been established in cooperation with an insurance company taking into account the characteristics of the activity of the members like transversal activities, immaterial damages, ...
- Acoustical economy survey: 4 times a year the members give (anonymously) economic data and tendencies and a synthesis is given to the members.
- Technical meetings ("Rencontres de l'Ingénierie Acoustique") on acoustical subjects.
- etc.

The consulting acoustic market remains in France a very small economic market with the characteristics of all of "fragmented" market :

- Multiple sources of differentiation and changes (unstable market),
- No durable competitive advantage possible,
- Low barriers at the entrance,
- Few "scale economies" possible,
- Flexibility,
- Uncertainty in terms of evolution.

That means that the acoustical consultant has to deal with uncertain and unclear economical situations that he has to overcome. He need to develop many capabilities such as commercial, psychological, technical competence and creativity.

The factors acting on acoustical consulting work

To help him in taking the right decision, the acoustical consultant has to take into account the TEA factors : the *Technical* factors influencing his work (the acoustical consultant remains first a technician), the *Economical* factors and the human *Actors* influencing his work.

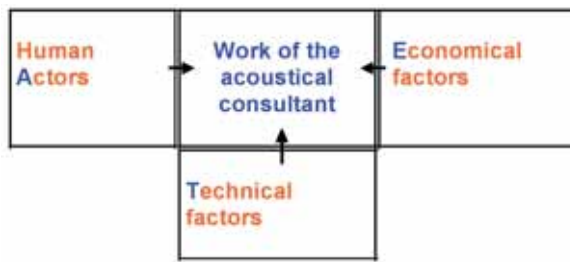


Fig. 1 : The "cup of TEA" of the acoustical consultant

At each phase of his work, the acoustical consultant has to face these 3 variables.

The four phases of acoustical consulting work

The 4 phases of any acoustical consulting project are :

- Initial contact with the client, identifying the acoustic need
- Formulating an offer and contracting
- Realizing the work (measurements, simulations, recommendations, solutions, follow-up and receipt of the solutions, ...)
- Conclusion and synthesis of the work

Phase 1 : Initial contact and entry, identifying the acoustic need

In the beginning of the work, the human factor is the key factor to focus on. First of all, the acoustical consultant has to identify the actors and has to evaluate their position related to his work. Sometimes the actor can be unique (but it is very rare), sometimes many actors can influence his work. The consultant has interest in making a list of all the actors and ranging them in a two dimensional diagram (from [7]).

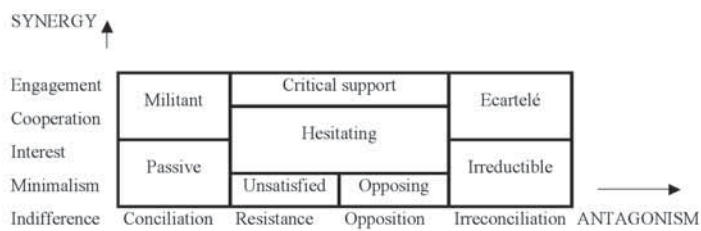


Fig. 2 : the sociodynamic map of the actors (FAUVET)

The synergy : the cooperation to promote his project.
The antagonism : the opposition against his project.

The position of the actors along these two axes help to identify :
The actors who have no special position related to the project :
they can be passive, hesitating (they are waiting for benefits

but they doubt) or "ecartelé" (favorable to the project but not for the consultant for instance)

The adversaries : the irreducibles (revolutionary against the project), opposants (against the project but ready to listen) or unsatisfied (passive resistance)

The allies : the militants (favorable to your project) or critical supports (positive but critical allies)

The sociodynamic advise to avoid the fight against the adversaries and to invest in the "strategy of allies" that is to adapt the project to transform the hesitating and neutral actors into allies.

For each actor, the consultant has to identify their risks and objectives and their resources (see [5] and [6]).

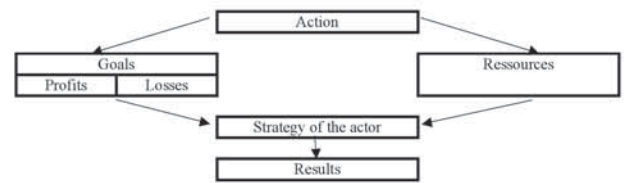


Fig. 3 : behaviors and strategies of the actors (CROZIER and MORIN)

In each situation the behavior of an actor is strategic : he try to solve the problem that he has himself in his own interest. He try to maximize his advantages or profits and to minimize his disadvantages or losses.

Each decision or situation is source of profit or loss for each actor.

The actor uses his own resources increase them.

Each actor uses a coherent strategy in his own logic.

The knowledge of the different logics and strategies of the actors helps the acoustical consultant in reducing uncertainties in the human aspects of his work.

The personality of an actor can also influence his behavior and strategy and the consultant has interest in identifying the personality of each actor and take into account it in his work. According to [2], we can classify the actors as follows in their relations to other people.

The *narcissic actor* : all his behaviour is related to himself. It is very difficult to influence him. The acoustical consultant has interest in proposing him work that will improve his image.

The *possessive actor* : his relations with others are oriented to dominate the others. If you want to have him as ally, you must accept to be dominated. They are very often oriented to immediate results which will improve their power.

Relations from himself to himself	... other to dominate him	... other to seduce him	... other to respect him as another himself
	Narcissic actor	Possessive actor	Seducer	Humanist

Fig. 4 : personalities of the actors

The *seductor* : his relations to others are oriented to seduction. He wants to be loved. This actor is very often charismatic and fascinating. He wants to be an idol and you must be his fan.

The *humanist* : his relations to others are oriented to respect. He considers other persons as equal to himself.

Phase 2 : formulating an offer and contracting

When the consultant has identified the problem, the needs and the various actors, it is time to formulate an offer.

The content of the offer needs to be the best answer to the needs of the client taking into account the personality and the objectives of the different actors.

- For instance, if a client is obliged to "conformity to regulation" measurements, the content must assure the client that all legal aspects are included in the offer. The price will probably be a key factor.
- As another example, if a client needs an study that will increase his ego, nice acoustical mapping and imaging must be included in the offer.
- etc.

The price of the acoustical work plays of course an important role. From that point of view, the offer can be done in two ways :

- The price based on the "offer" : the consultant establishes first a content (or the need is very precise in terms of contents like for some quotations). He calculates his costs (time spent

x hourly rate + specific costs) to realize the work and adds a margin to it.

- The price based on the "demand" : the consultant fixes the sell price independently of the content of his offer. When he fixes the price, the consultant tries to determine the maximum above which the client will not buy it. He will also determine the minimum price under which the client will not consider his offer as credible to respond to the need.

Both ways of evaluating the price of an offer have their own advantages and depend on the context and the personality of the actors and especially the decider. In practice both methods are very often interdependent and used together.

Phase 3 : Realizing the work (measurements, simulations, recommendations, solutions, follow-up and receipt of the solutions, ...)

The quality of the result will be a conjunction of the quality of the tools used and the competence of the specialist.

It is impossible to determine *a priori* an uncertainty for all acoustical problems. Each problem is specific and even inside one project there will be no unique value for the uncertainty.

Based on his experience, the acoustical consultant can develop some simplified schemes which will help him in globally evaluating the uncertainties and looking which particular point need to be investigated further.

Example of global approach of uncertainties in building acoustics

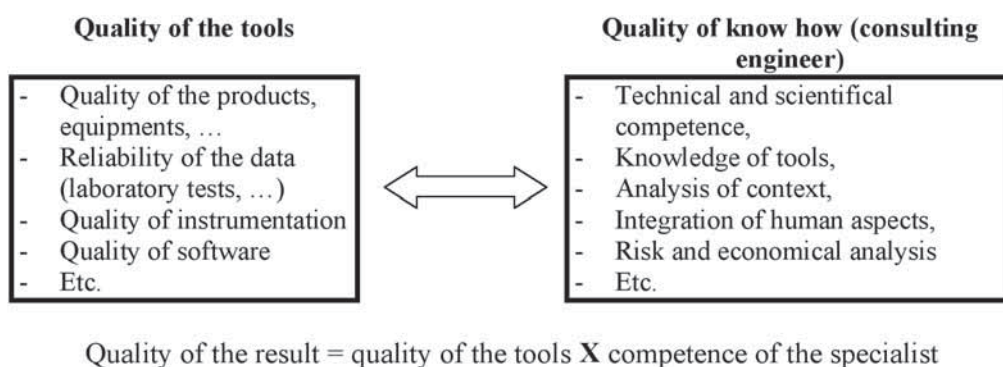


Fig. 5 : quality: a combination of tools and competence

Number of transmission paths	Uncertainty of global insulation	Precision
One dominating transmission path	Uncertainty $\sigma_1 \approx$ uncertainty of this transmission path	Bad or medium precision, further investigations are eventually needed concerning the dominating transmission path
N equivalent transmissions paths with similar uncertainties	Uncertainty $\sigma_n = \sigma_1 / \sqrt{N}$	Better precision

Fig. 6 : global approach of the uncertainties in prediction of acoustic insulation in buildings

Example of global approach of uncertainties in environmental acoustics




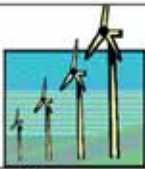

Type of problem		Source	Distance to receiver	Precision Uncertainty
Urban environment	1 technical equipment on the roof of a building		Short (example 30m)	Medium or good precision
		Uncertainty $\sigma_1 \approx$ uncertainty of PWL_{source}		
Urban environment	N similar technical equipment on the roof of a building	 ...	Short (example 30m)	Good to very good precision
		Uncertainty $\sigma_n = \sigma_1 / \sqrt{N}$		
Urban environment	1 technical equipment on the roof of a building with screen protection		Short (example 30m)	Bad precision
		Uncertainty $\sigma_1 \approx$ low frequency uncertainty of PWL_{source}		
Rural environment	Wind turbines project		Long (example 2 or 3 km)	Bad precision
		PWL_{source} and background noise variable with wind conditions High meteo and ground effects due to long distances High "human sensible" problem		
Suburban environment	Road traffic project		Variable	Good precision for close receivers, bad precision for long distance receivers
		High meteo and ground effects at long distances High "economically sensible" problem : one dB difference can cost millions of extra protections		

Fig. 7 : global approach of the uncertainties in prediction of environmental noise

Phase 4 : conclusion and synthesis of the work

At the end of his work, the acoustical consultant has to manage the communication that is done around his work and the perception that the client has of it.

The global quality of the work is when the given service as the client perceives it corresponds to the waited service [8].

The global deviation is determined by 4 elementary deviations (see figure) :

- The *knowledge deviation* : deviation between the demand of the client and the perception of it by the consultant.
- The *offer deviation* : deviation between the perception of the demand of the client and the content of the offer and contract.
- The *working deviation* : deviation between the contract and the delivered work.
- The *communication deviation* : deviation between the delivered service and the perception of it by the client.

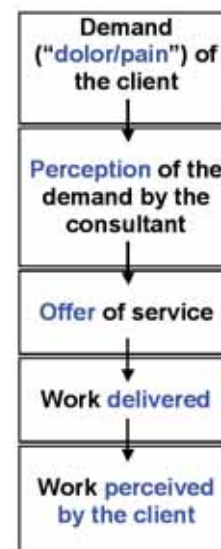


Fig. 8 : chain of deviations in service quality (ZEITHALM and BITNER)

The acoustical consultant has to face technical as well as economical and human uncertainties in his daily work and he has at his disposal specific tools to manage these parameters.

The heavy tendencies of the acoustical consulting market are :

- Growing of the demand,
- Internationalization (European Directives, ...),
- Diversification of the competences needed,
- Flexibility,
- Availability "7/24" : the client would like you available 7 days a week and 24 hours a day (internet, mobile telephones, ...),
- Urgency : everything must be finished before beginning,
- Development of exigencies regarding the results : more and more legal actions.

Conclusion

The acoustical consultant has to manage a lot of technical, human and economical aspects who introduce their own

uncertainties in his work. More and more, the acoustical consultant is dealing with the contradiction between exigencies of more and more precision in an always more uncertain environment.

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