APPORTS DE LA RECHERCHE

Risk, uncertainty and decision-making

Field observation of group decision-making

Juliane Marold, Ruth Lassalle, Markus Schöbel and Dietrich Manzey

n° 2013-11

THEME

Human and organizational factors of safety

Les Cahiers de la sécurité industrielle

FONCSI
Fondation pour une culture de sécurité industrielle

The *Foundation for an Industrial Safety Culture* (FonCSI) is a french public-interest research foundation created in 2005. It aims to:

- undertake and fund research activities that contribute to improving safety in hazardous organizations (industrial firms of all sizes, in all industrial sectors);
- work towards better mutual understanding between high-risk industries and civil society, aiming for a durable compromise and an open debate that covers all the dimensions of risk;
- foster the acculturation of all stakeholders to the questions, tradeoffs and problems related to risk and safety.

In order to attain these objectives, the FonCSI works to bring together researchers from different scientific disciplines with other stakeholders concerned by industrial safety and the management of technological risk: companies, local government, trade unions, NGOs. We also attempt to build bridges between disciplines and to promote interaction and cross-pollination between engineering, sciences and the humanities.

The work presented in this document is the result of research funded by the FonCSI. The opinions presented are those of the authors.

FONCSI
Fondation pour une culture de sécurité industrielle

Foundation for an Industrial Safety Culture
A public-interest research foundation

http://www.FonCSI.org/

6 allée Émile Monso — BP 34038
31029 Toulouse cedex 4
France

Telephone: +33 534 32 32 00
Twitter: @LaFonCSI
Email: contact@FonCSI.org

Résumé

Titre	Une étude de terrain de la décision en groupe en présence d'incertitude dans le secteur hospitalier
Mots-clefs	décision, groupes, incertitude, psychologie, questionnaire
Auteurs	Juliane Marold, Ruth Lassalle et Dietrich Manzey (TU Berlin) Markus Schöbel (Universität Basel, Suisse)
Date de publication	novembre 2013

Les auteurs ont étudié les processus quotidiens de prise de décision en présence d'incertitude, à l'aide d'une étude de terrain (*field study*) dans le secteur médical. Le travail s'inscrit dans la tradition de recherche en *naturalistic decision-making* (NDM), qui vise à comprendre comment des personnes travaillant dans un environnement critique conceptualisent et internalisent les incertitudes, comment ils les gèrent pour parvenir à prendre de bonnes décisions dans leur activité quotidienne.

Le travail s'appuie sur l'**observation de réunions** de professionnels de la santé au cours desquelles sont décidées des options de traitement pour personnes atteintes d'un cancer, ainsi que sur des **questionnaires** remplis par les médecins participant à ces réunions. Les chercheurs ont analysé les stratégies employées par les personnes pour faire face à l'incertitude, ainsi que l'ordre dans lequel ces stratégies sont utilisées. Les caractéristiques des décisions dont les processus de prise de décision ont été jugées par les experts impliqués comme étant «bonnes» ou «acceptables» ont été analysées.

Cette recherche identifie une nouvelle source d'incertitude qui n'avait pas été trouvée lors d'études NDM précédentes: l'existence d'opinions divergentes parmi les membres du groupe de décideurs. La présence d'un fort gradient hiérarchique lors des réunions est perçue comme contribuant à une mauvaise performance du processus de décision.

Les auteurs suggèrent un certain nombre de techniques qui pourraient être employés pour **améliorer la performance du processus de prise de décision**, comme l'utilisation de procédures formalisées d'aide à la décision pour mieux distinguer la phase de présentation de l'information de celle de son évaluation, et pour encourager l'échange entre décideurs. Les personnes dirigeant le groupe pourraient être formés à des techniques de *coaching* pour améliorer la sécurité psychologique, et les autres membres du groupe pourraient être formés à une attitude sûre et la défense de leur point de vue ("speak-up behaviour", "assertiveness").

About the authors

Juliane Marold est chercheur, et Ruth Lassalle doctorante, à l'Institut de Psychologie et d'Ergonomie du département Travail, ingénierie et psychologie organisationnelle de la Technische Universität Berlin. Dietrich Manzey est Professeur de psychologie du travail et de l'organisation à la Technische Universität Berlin. Markus Schöbel est chercheur en psychologie organisationnelle à l'Universität Basel.

Courriel: juliane.marold@tu-berlin.de

To cite this document

Marold et al. (2013). *Une étude de terrain de la décision en groupe en présence d'incertitude dans le secteur hospitalier*. Numéro 2013-11 des *Cahiers de la Sécurité Industrielle*, Fondation pour une Culture de Sécurité Industrielle, Toulouse, France (ISSN 2100-3874). Disponible à http://www.FonCSI.org/fr/.

Abstract

Title	A field study of group decision-making in health care
Keywords	decision-making, groups, uncertainty, psychology, questionnaire
Authors	Juliane Marold, Ruth Lassalle and Dietrich Manzey (TU Berlin, Germany) Markus Schöbel (Universität Basel, Switzerland)
Publication date	May 2013

The authors have undertaken a field study of daily decision-making processes in groups under uncertainty, in the health care domain. The work follows the tradition of *naturalistic decision-making* (NDM) research. It aims to understand how groups in this high reliability context conceptualize and internalize uncertainties, and how they handle them in order to achieve effective decision-making in their everyday activities.

The work is based on observations of a specific kind of health care meeting where treatment options for cancer patients are discussed, as well as on questionnaires completed by the participating physicians. The researchers have analyzed the strategies used by people to cope with uncertainty, including the order in which these strategies are used. The have analyzed characteristics of decisions where the decision-making process was judged by the experts involved to be "good" or "acceptable".

The work identifies a new source of uncertainty not found in previous NDM studies: divergent opinions held by decision-makers in the group. A strong hierarchy gradient in play during the meetings is perceived by group members as contributing to poor decision-making performance.

The authors suggest a number of techniques which could be used to improve decision-making performance, including the use of formalized decision-support procedures to more clearly distinguish phases of presenting information and evaluating it, and to encourage information exchange between group members. Group leaders could be trained in coaching behaviour in order to improve psychological safety, and other members could be trained to encourage speak-up behaviour (assertiveness).

About the authors

Juliane Marold is a researcher, and Ruth Lassalle a PhD candidate, at the Work, Engineering & Organizational Psychology department of the Institute of Psychology and Ergonomics, Technische Universität Berlin. Dietrich Manzey is Professor of Work and Organizational Psychology at the Technische Universität Berlin. Markus Schöbel is a senior researcher in organizational psychology at Universität Basel.

Contact author: juliane.marold@tu-berlin.de

To cite this document

Marold et al. (2013). *A field study of group decision-making in health care.* Number 2013-11 of the *Cahiers de la Sécurité Industrielle*, Foundation for an Industrial Safety Culture, Toulouse, France (ISSN 2100-3874). Available at http://www.FonCSI.org/en/.

Foreword

In 2008, the FonCSI published a Call for Proposals titled *Risk, uncertainty and decision-making practice* aiming better to understand how people concerned by hazardous activities relate to and cope with uncertainty. How do people handle uncertainty? How do they manage to act despite ambiguity while studying problems, making decisions, taking stands on issues? How people create the conditions which make it possible to move forward in uncertain contexts?

Six research teams were selected for funding. They concern a range of scientific disciplines — psychology, sociology, management, industrial engineering, nuclear engineering — and a variety of case studies: risk management practices around French Seveso facilities, the preparation and management of an avian flu pandemic, group decision-making in hospitals, and the development of medicines in the pharmaceutical domain. For more information on this research programme, please consult FonCSI's web site.

The work presented in this document, concerning **decision-making in groups under uncertainty**, is that of one of the teams selected for funding, based at the department of psychology and ergonomics of the TU Berlin.

There is a long tradition of research into decision-making under risk and uncertainty which aims to identify the "optimal decision", given a model of decision-makers' preferences. This work in decision theory, which can be traced back to French mathematicians Blaise Pascal and Pierre de Fermat, assumes that possible decisions and outcomes are well delimited, that decision-makers are perfectly informed, are able to reason probabilistically without making mistakes, and are perfectly rational. This *normative*, or *prescriptive*, approach to decision-making has led to the development of decision-support tools which are used in areas such as project planning and finance.

The recommendations made to decision-makers revolve around what psychologists **[Lipshitz and Strauss 1997]** call the "RQP heuristic":

1. **R**educe uncertainty, by attempting to obtain more information;
2. **Q**uantify irreducible uncertainty, by providing a probability estimate;
3. **P**lug the result into a formula, which suggests which decision alternative is optimal given the estimated probability.

Researchers in psychology, analyzing how people perceive and react to risk and uncertainty, have shown that this theory has poor explanatory power concerning most practical, day to day decisions:

- people's perception of an event's probability is affected by their perception of its severity: we cannot interpret the two dimensions of risk in an objective manner;
- we often make mistakes when making probability calculations;
- people are affected by a number of *cognitive biases* **[Tversky and Kahneman 1974]** (or *heuristics* which we use to make decisions), such as anchoring effects, framing effects, availability heuristics, base rate fallacy, loss aversion and illusion of control, which lead to choices which are incompatible with the prescriptive models ("irrational behaviour");
- people seem to make decisions based on **hunches** or intuitions that they derive from their experience, or follow group/**cultural norms** rather than making probability calculations;
- decision makers are sometimes unable to act not because they *lack* information, but because they are overwhelmed by the **abundance of conflicting meanings** that it conveys.

Over the last 20 years, researchers in psychology have investigated more **descriptive**, or **behavioural**, approaches to decision-making under uncertainty, based on observing **what people actually do** when faced with uncertainty and the **strategies they use to cope** in such situations. The *Naturalistic Decision-Making* (NDM) school has focused on observing and

attempting to understand decision-making and sensemaking by experts in complex real-life situations, such as fire-fighting and military engagement. These field observations have allowed researchers to identify characteristics of situations where very **experienced individuals** deal with high stakes, strong time pressure, incomplete information and poorly defined procedures, in a **real-world context** (very different from traditional laboratory experiments). These researchers have found that decision-makers in these situations seem to use their experience to identify a *reasonable*, "good enough" course of action, and do not spend time weighing other alternatives, thus deviating strongly from normative decision-making procedures. The amount of information available and the level of expertise of the person making the decision were found to be critical to the quality of the decision.

Previous work using the NDM approach has focused on individual decision-making processes. The authors of the present document have applied these techniques to analyze **group decision-making**, which introduces additional forms of uncertainty ("what do my colleagues think?" and "how will my team-member react to a given event?") and possibilities for biases or heuristics (deviations from normative decision-theoretic models), such as group-think and false consensus effects. The research is based on the medical domain.

This document presents results from the **field-work** phase of the project. A previous document, published in the same collection (number 2012-05), presents earlier work in the project based on a survey of how people conceptualize and internalize uncertainty.

Eric Marsden, FonCSI
November 23rd 2013

We welcome in your feedback! Please send any comments or suggestions for improving this document via email to `cahiers@FonCSI.org`.

Contents

Introduction

Context

In the field of health care, decision-making is a crucial element. Healthcare professionals have to take many critical decisions in relatively short time during their everyday work. In addition, lots of the decisions have substantial consequences and involve important trade-offs, for example between the chances of recovery and the adverse side effects of a treatment. This is also recognized by the World Health Organization, which ranks decision-making among the most important human factors aspects with an influence on patient safety **[Flin et al. 2009]**. Many decisions are made by more than one person. If a decision is made by a group, it is the group that has to go through the medical decision-making process and deal with all occurring uncertainties. These groups are often multidisciplinary and established as a means to improve decision-making by pooling expert knowledge and ironing out individual differences **[Ho et al. 2007; Kee et al. 2004]**. An important type of decision-making groups in health care is the cancer multidisciplinary meeting. The following study on decision-making in groups under uncertainty is focused on this type of group decision-making process.

Cancer multidisciplinary meetings (MDMs)

Cancer multidisciplinary meetings (MDMs) are the central forum for clinical decision-making **[Lutterbach et al. 2005]**.

Cancer multidisciplinary team meetings, also known as multidisciplinary cancer conferences, multidisciplinary tumor boards or case conferences **[Wright et al. 2007]**, are defined by the UK Department of Health as a:

> *group of people of different health-care disciplines, which meets together at a given time (whether physically in one place, or by video or tele-conferencing) to discuss a given patient and who are each able to contribute independently to the diagnostic and treatment decisions about the patient.*

MDMs were established in the 1960s; since the 1990s, there has been a transition of the primary goal from education to the delivery and improvement of care **[Patkar et al. 2011]**. MDMs play a critical role in multidisciplinary cancer care. Cases of individual cancer patients are thoroughly reviewed by a team of physicians and other health professionals from different areas of expertise and with unique perspectives. Cases of various types of diseases are selected for presentation based on complexity, unusual manifestation of the disease, or special interest. In most of the cases the diagnosis and/or course of treatment are not clear cut. Tumor characteristics, pre-treatment evaluation, staging, treatment plans, and enrollment in a clinical trial are issues commonly discussed. Case presentation can include the patient's medical history, clinical findings, diagnostic studies, therapy modalities, and research data.

MDMs are approved to ensure that care delivery is consistent with the best available evidence. These forums aim to ensure that all patients receive timely diagnosis and treatment, that patient management is evidence-based, and that there is continuity of care. The MDM benefits patients by offering a comprehensive, coordinated approach to cancer care for even the most difficult of cases. **[Forrest et al. 2005]** matched up outcomes of patients who were diagnosed four years apart before (n=117) and after (n=126) the introduction of an MDM. Chemotherapy use and median survival improved in the MDM cohort (3.2 months *vs.* 6.6 months).

Although MDMs are well accepted in the health care community, such evidence supporting their effectiveness is rare **[Patkar et al. 2011; Tattersall 2006; Wright et al. 2007]**. One reason might be that it is difficult to show proof, because multiple changes in cancer care have occurred in the past decades (*e.g.* improved diagnosis opportunities or the introduction of evidence-based guidelines and protocols of care) **[Fleissig et al. 2006]**.

Although scientific analysis regarding MDM activities is lacking **[Lutterbach et al. 2005]**, some aspects of the effectiveness of MDMs have recently become a subject of attention: Differences in teamwork, communication, hierarchical boundaries, time pressure, degree of discussion

structure, leadership, and information basis and exchange have been acknowledged as reasons for variable decision-making performance at MDMs [Fleissig et al. 2006; Lamb et al. 2011a,b, 2012, 2011b].

All these factors can make the difference between successful group decision-making and decision-making processes that are at best just a waste of time and resources, and in the worst case clinically inappropriate, unacceptable or even harmful to patients (*e.g.* [Blazeby et al. 2006; Lamb et al. 2012; Tattersall 2006]). [Patkar et al. 2011, p. 2] conclude: "It naturally follows that if the team functioning, communication and decision-making are improved, then ultimately both patient care quality and patient outcomes will improve".

MDMs are the ideal setting for the study of decision-making in groups composed of medical experts, assembling health care professionals with relevant and specialized knowledge for the diagnosis and treatment of one kind or a group of tumors [Fleissig et al. 2006]. During meetings, medical experts share their knowledge and make collective evidence-based recommendations for patient care [Patkar et al. 2011].

In principle, handling uncertainty during clinical decision-making in a multidisciplinary team has at least one big benefit compared to decision-making by individual experts: it may be **safer**, because team members assemble to **share their expertise** and create additional **defenses against error**. However, in practice this obvious benefit can be offset by several inhibiting factors related to, *e.g.*, the hierarchical gradient within a group or a suboptimal discussion culture. This was suggested by the results of our first study addressing decision-making under uncertainty in groups [Marold et al. 2012].

Objectives of this document

To develop effective MDMs, it is necessary to understand how experts work together and how they handle uncertainties. This document presents results of the field observation stage of a research project in *Decision-making in groups under uncertainty*. The aim of the field observations is to allow a **detailed description of strategies used in the field** by individuals involved in decision-making under uncertainty.

More specifically, the current work focuses on decision-making processes in groups consisting of members with different areas of expertise. Special attention is paid to processes where members of the decision-making group 1) postpone the final decision or 2) judge their final decision as appropriate or inappropriate. The latter allows for the analysis of characteristics of *good* or *acceptable* decisions. Earlier studies (*cf.* [Marold et al. 2012]) offer a first understanding of decision-making in groups under uncertainty and highlight possible positive influences as well as obstacles to efficient and appropriate decision-making processes.

As in earlier studies conducted in this project, the focus of our research is on the health care sector. The authors have undertaken observations and worked with doctors in a hospital located in Germany, focusing in particular on MDMs related to head and neck cancers.

Document structure

Chapter 1 starts with a description of MDMs and the types of decisions involved. The different **methods used in the research** are then described: non-participatory observation of MDMs, a questionnaire used to obtain participating physicians' subjective viewpoint on the analyzed MDMs, and an evaluation questionnaire in which MDM participants recorded their case-specific rating of the quality of case discussion in an MDM.

Results of the work are presented in chapter 2. Results are structured with regard to various aspects of handling uncertainty (*e.g.* strategies, influencing factors, characteristics of postponed decisions).

In chapter 3, the **key findings** as well as their implications are discussed.

1

Methods used

The goal of the present study is to explore how medical decisions in cancer multidisciplinary team meetings (hereafter referred to as "MDMs") are made, in order to gain a deeper understanding of:

- the strategies used to handle uncertainty;
- the factors influencing decision-making;
- the characteristics of an acceptable or unacceptable decision;
- the characteristics of postponed decisions.

We have videotaped weekly cancer MDMs over a period of three months. Video data were analyzed by two independent observers using an observation checklist. Observations were complemented by a questionnaire gathering subjective evaluations of MDM members.

1.1 Cancer MDM under study

A German academic medical center cooperated in the present study. All data were gathered with regard to the head and neck cancer MDM at this hospital. Medical disciplines represented in this MDM are otolaryngology, oral and maxillofacial surgery, oncology, pathology, radiology, radiotherapy, ophthalmology, and nuclear medicine.

The head and neck cancer MDM is the central meeting where all head and neck tumors are presented and diagnoses as well as therapies are discussed. As seen in figure 1.1, every case is ideally presented twice (before and after surgery).

Figure 1.1 – *MDM case presentation during medical process*

The head of the cancer MDM is the head of department for otolaryngology or his deputy. The role of moderator is not assigned to a particular person or function. The MDM is held weekly and scheduled for duration of 30 minutes.

The admission of patients is organized centrally. Three hours before the meeting, the agenda is emailed to the participants of the MDM. In addition, 'spontaneous' presentations are allowed.

Tumor cases are presented by a member of the treating department according to a common structure including patient information, diagnoses and already undertaken treatments. Residents produce a protocol documenting the decisions and recommendations. All protocols are saved electronically and distributed to all head and neck cancer MDM members afterwards.

The room where the cancer MDM takes place is equipped with facilities to project radiological information (*e.g.* X-ray, MRT/MRI-images).

The following transcript of a video-recorded sequence illustrates a typical case discussion. The discussion lasted two minutes. Out of eleven attending physicians, four contributed to this case.

Example transcript

Senior physician radiology: Next is A.

Resident otolaryngology: A. is a 64 years old patient who has been suffering from dysphagia and hot potato speech for a few weeks. We performed a panendoscopy which clinically revealed a hypo pharyngeal carcinoma and histological a poorly differentiated squamous-cell carcinoma. Operation is scheduled next Monday in form of laser surgical tumor resection, selective neck dissection on both sides and if necessary tracheostomy.

Senior physician radiology: Looking at the images…

Head of department otolaryngology: Is a partial resection possible? Really? This seems to be quite huge.

Resident otolaryngology: During panendoscopy doctor XY has already removed the tumor to the greatest possible extent. The tumor had a relatively thin stalk directing at hypo pharyngeal posterior wall and …

Head of department otolaryngology: I see, OK.

Resident otolaryngology: … but was relatively big, cauliflower-like structured.

Head of department otolaryngology: This means, the basis was relatively sparse.

Resident otolaryngology: Exactly. Thin.

Head of department otolaryngology: I understand.

Resident otolaryngology: The image does not correspond to the current status.

Head of department otolaryngology: OK.

Senior physician radiology: Moreover, the patient has a few borderline lymph nodes on the left side. Not clearly suspect. This one is conspicuous. I wondered about small lymph nodes, which are round and normally not found at this position. Here and here. They caught my attention. But I can't definitely assess them as abnormal. As I said before, their localization is conspicuous. Apart from that, the patient has a distinct fatty liver and two pulmonary round lesions. One in the middle lobe, XX mm, and one in the posterior lobe, XX mm. The colleagues, who diagnosed them, were confident that they are sub pleural lymph nodes. I think, we cannot be sure, no. It might be something like this, but it could just as well be metastases. With regard to the images we can't commit to one way or the other.

Head of department otolaryngology: But in principle they can be quite easily resected, can't they?

Senior physician radiology: It depends.

Head of department otolaryngology: This is functional perfectly feasible. So, in no way we want to mutilate him. Would it make sense to clean him up and later have a follow up?

Senior physician radiology: The colleagues who diagnosed the images recommended a follow up. That is the minimum.

Head of department otolaryngology: We check again after two months? And if something can be found we recommend resection.

Senior physician radiology: Three months would be better. Two months are a little bit short to give them time to become larger.

Head of department otolaryngology: Three months?

Senior physician radiology: Three months at least.

Head of department otolaryngology: Fine.

Pause

Head of department otolaryngology: Fine.

Head of department otolaryngology (*Turning around to all physicians*): Do we have consensus in that we do it this way? We operate him in any case; we push it and then monitor it?

Senior physician oncology: Yes, they are now too small. They need to be a few millimeters larger.

Head of department otolaryngology: Yes.

Pause

Head of department otolaryngology: OK, next.

1.2 Research methods

Nonparticipant observation of group decision-making processes and a **questionnaire survey** provided the material for this field study. Using these two data collection methods enabled triangulation of the findings and ensured a richer, more detailed understanding of the decision-making process.

A third source of data was an **evaluation questionnaire survey** provided by the cooperating medical academic center. The evaluation questionnaire was set up for other purposes originally (pretest for validation of a new MDM procedure, which is still waiting to be established), but offers useful information with regards to the purpose of the study at hand.

1.2.1 Observation

The goal of the observations was to record the decision-making process that took place within the team, noting particularly what kind of strategies were used, and what kind of influence factors might have inhibited or promoted the decision-making process. Therefore, the MDM cancer conferences were videotaped. The assessment of decision-making processes and the corresponding handling of uncertainty required systematic observation. Thus, an *Observation check list* was developed, incorporating different categories. The *Observation check list* was piloted with two observers to ensure questions and categories were understood in the same way. In the following, the structure of the *Observation check list* is described.

First section: General case information

In the first part, different kinds of general information regarding the MDM and patient case were collected (table 1.1).

Categories for general information
Number of board members
Head of department attending
Discipline and status of member presenting the case
Duration
Case reassessment/first consultation
Initial question for board meeting

Table 1.1 – *Observation check list (Part 1: general information)*

Second section: Strategies used to handle uncertainties

After the general information, the questionnaire assessed what kind of strategies were used during the patient case consultation and also at what particular time the different strategies were used by the board members. Strategies of handling uncertainty listed in the observation sheet (figure 1.2) stem mostly from the work of **[Lipshitz and Strauss 1997]**. The strategy *delegation of the decision to the patient* was added to the list, given the specific characteristics of the clinical work situation. A strategy was rated to be in use when board members showed the corresponding behavior or communication (*e.g.* "Let's check the histological results to understand what we are facing" indicated the strategy: *collection of additional information*). The duration of strategies could differ.

The end of a single strategy was marked by the use of another strategy or the start of behavior and communication non-relevant for dealing with uncertainty in a given case (*e.g.* planning time schedules for treatment or private conversations).

Two observers independently rated the occurrence of strategies (in their chronological sequence). For example, if the first strategy observed was the *collection of additional information* this would be marked by ticking the box in the row "a" and in the first column labeled by "1" (see figure 1.2). The next observed strategy would be documented by ticking the corresponding box in the second column (labeled "2").

In addition to documenting the chronological sequence of strategy use, observers were asked to rate the **perceived intensity** of each strategy during the decision-making process, on a three point scale from *1=low, 2=medium* to *3=high*. For example, if board members had a long discussion on each others' opinion the strategy *soliciting advice* as a reduction strategy was rated on the intensity scale as *high*.

Strategies in handling uncertainty					
What kinds of strategies are being observed (in chronological order)?					
	1	2	3	4	5
Reduction					
a. Collect additional information					
b. Delay action					
c. Solicit advice					
d. Follow guidelines					
Acknowledgement					
e. Preempting					
f. Weighing pros and cons					
g. Avoid irreversible actions					
Ignoring					
h. no discussion regarding uncertainty					
Delegating					
i. Delegate decision making to patient					
Others					

Figure 1.2 – *Observation check list (Part 2: strategy observation)*

Third section: Influencing factors

In the third part of the *Observation check list*, factors influencing the decision-making process were assessed:

- ▷ hierarchy (dominant behavior, disagreement: speak up)
- ▷ discussion culture (interruptions, coaching behavior)
- ▷ need for consensus
- ▷ structure (leading behavior, differentiation between information search and evaluation)

To assess aspects in relation to **hierarchy gradient**, observers were first asked to rate the perceived intensity of dominant behavior of the highest status member on a scale from *1=not observed, 2=observed*, to *3=strongly observed*. Furthermore, disagreement with respect to *e.g.* decision options suggested by other group members was rated on the same scale.

To gain insight into aspects of the board's **discussion culture**, first of all interruptions were counted (*frequency measure*). Every time a communication strand could not be finished by a board member (*e.g.* because of the contribution of a colleague), this was counted in the category *interruption*. A second characteristic of the discussion culture was rated on a scale from *1=not observed, 2=observed*, to *3=strongly observed* as coaching behavior. It was counted as observed when the highest status member explicitly signaled guidance for speaking-up or bringing in relevant information. The **need for consensus** was also rated on a scale from *1=not observed, 2=observed*, to *3=strongly observed*. If at any time during the decision-making process at least one of the board members explicitly asked for consensus, it was counted as observed.

At the end of the *Observation check list*, observers documented whether there was any differentiation found between information search and evaluation (yes/no question) and whether any leading behavior had been observed during the decision-making process (on a scale from *1=not observed, 2=observed* to *3=strongly observed*).

In addition to these questions, observers were asked to rate the frequencies of communication of uncertainties (explicitly and implicitly), and whether communicating the final decision to all board members had been observed (binary yes/no question).

Part	Interest	Response format
1	Personal data	Multiple choice
2	Uncertainty sources at cancer MDMs	5-point rating scale (1=never, 5=very often)
3	Strategies of handling uncertainties	5-point rating scale (1=never, 5=very often)
4	Influences on group decision-making	5-point rating scale (1=disagree at all, 5=totally agree)
5	Decision criteria	5-point rating scale (1=never, 5=very often)
6	Characteristics of good and poor decisions	Open questions

Table 1.2 – *Questionnaire sections*

Fourth section: Final decision

In the last section, the final decision made was recorded with regard to categories of treatment decisions established by **[Lutterbach et al. 2005]**. One of the categories had to be marked.

1.2.2 Questionnaire

The *questionnaire* was developed to complement observational data with the subjective views of physicians participating in the cancer MDM under study. Thus, the *questionnaire* was answered by the same physicians who participated in the cancer MDM. The *questionnaire* included six sections that addressed topics similar to the information assessed in the *Observation check list*. Table 1.2 summarizes the sections and response formats of the *questionnaire* in use.

First section: Personal data

The first part of the *questionnaire* asked for the medical discipline and hierarchical position of the participants.

Second section: Uncertainty sources at cancer MDMs

The second section of the *questionnaire* focused on different sources of uncertainty at the cancer MDM under study. Participants were requested to rate how often they perceived different sources of uncertainty.

Items included sources described for individual decision-making **[Lipshitz and Strauss 1997]** as well as sources of uncertainty in a group context and sources that seemed to be specific to the medical context **[Hansson 1996; Marold et al. 2012]** (*cf.* table 1.3).

Sources of uncertainty	
Completely or partly lacking information	Lack of knowledge, skills, or expertise
Inadequate understanding owing to equivocal information	Divergent opinions
Seemingly equivalent alternatives	Ambiguous purposes of others

Table 1.3 – *Questionnaire assessment of uncertainty sources*

Third section: Strategies of handling uncertainties

In the third section of the *questionnaire*, different strategies of handling uncertainty were presented, and participants were asked how often each strategy had been implemented in the head and neck cancer MDM. Tactics stemmed mostly from the work of **[Lipshitz and Strauss 1997]**. Delegation of the decision to the patient was added to the list of strategies, to cover the clinical work situation. For an overview, see table 1.4.

Tactics of reduction	Tactics of acknowledgement	Tactics of suppression	Tactics of delegation
Collect additional information	Preempting	Ignore uncertainty	Delegate to patient
Delay action	Improve readiness	Rely on "intuition"	
Solicit advice	Weighing pros and cons		
Follow norms, SOPs, *etc.*			
Assumption based reasoning			

Table 1.4 – *Questionnaire assessment of strategies to handle uncertainties*

Fourth section: Influences on group decision-making

To assess the existence of promoting and inhibiting influences on group decision-making, participants were requested to indicate their agreement concerning 13 statements. These statements covered three promoting and three inhibiting factors. To avoid biased response tendencies, some items were phrased negatively (*e.g.* agreement indicates the non-existence of an influencing factor). Answers to these statements had to be recoded. See table 1.5 for an overview of the items including recoding information. For convenience, items are here presented with regard to the influencing factor. In the actual printed version of the *questionnaire* they are presented in a randomized order.

Fifth section: Decision criteria

Decision criteria found in a previous study by the authors **[Marold et al. 2012]** constituted the items in the fourth section (see table 1.6). Participants were asked to rate how often group decisions in the MDM under study were based on these criteria.

Sixth section: Characteristics of good and poor decisions

In the last part, characteristics of good and bad decisions were addressed via two open questions.

1.2.3 The evaluation questionnaire

The *evaluation questionnaire* assessed the subjective rating concerning the quality of a case discussion at the MDM. It was case-specific and filled out by all participants attending the MDM under study. This questionnaire contained the following statements:

Nr.	Question
1	The details of the patient case were presented in a satisfactory manner (sufficient information source)
2	All disciplines participated in the discussion intensively
3	The decision-making process was well structured
4	The sources for decision-making were clearly communicated
5	The decision is documented sufficiently

Table 1.7 – *Questionnaire to evaluate the decision-making process*

All questions had to be answered on a scale from 1 (*totally disagree)* to 5 *(totally agree*).

	Aspect	Original item	Recoding
Promoting influences			
Psychological safety	No blame	If someone has made a mistake, it is held against him during discussion	yes
	Skills valued	The skills and talents of every single member are always valued and utilized during discussion	
Structured decision-making	Clear structure	The decision-making process at the tumor board is absolutely clearly structured	
	Communicated criteria	Often criteria leading to a decision are not clearly communicated	yes
	Separated analysis and solution	Problem analysis and search of solutions are strictly separated processes	
Discussion culture	Raised doubt	If someone is in doubt about a decision, he voices this anytime in an open manner	
	Conveyed ideas and concerns	Everyone communicates own ideas and concerns clearly and directly	
	Respectful atmosphere	A positive and respectful atmosphere pervades the tumor board	
Inhibiting influences			
Hierarchy gradient	Hierarchical differences	Along members of the tumor board, strong noticeable hierarchical differences exist	
	Lack of encouragement	People with lower hierarchical status are encouraged by higher status members to share their opinion	yes
Need for consensus	Denial of divergent opinions	Diverging opinions are only listened to reluctantly	
	Suppression to state uncertainty	If you're uncertain it's better to keep it to yourself	
Time pressure	Time pressure	Decisions in the tumor board are often made under time pressure	

Table 1.5 – *Questionnaire assessment of influences on group decision-making*

Decision criteria
▷ Hierarchy
▷ Patients interest
▷ Professional competence
▷ Medical facts
▷ Consensus
▷ Guidelines

Table 1.6 – *Questionnaire assessment of decision criteria*

1.3 Procedure

1.3.1 Video recordings of MDMs

Observation data stemmed from video recordings of cancer MDMs at the cooperating hospital. The contact person at the cooperating German academic medical center selected among all cases signed up for a meeting two cases with the highest expected uncertainty to be discussed first. Although the whole MDM was video and audio recorded, only these two cases were analyzed, to ensure the existence of uncertainty.

Before the beginning of each MDM, the eleven attending physicians were informed that the meeting would be videotaped and asked for their permission. They were informed of the general research interest in decision-making in teams under uncertainty, but more specific research questions were not communicated.

For the recording, two video cameras and one boundary microphone were installed in the meeting room. Cameras were arranged to obtain the best view while minimizing the intrusiveness to the meeting. One camera recorded the screen displaying body imaging and the radiologist from the back of the room, the second one recorded the other participating physicians from the front of the room (figure 1.3). The recording equipment was set up and tested before the meetings.

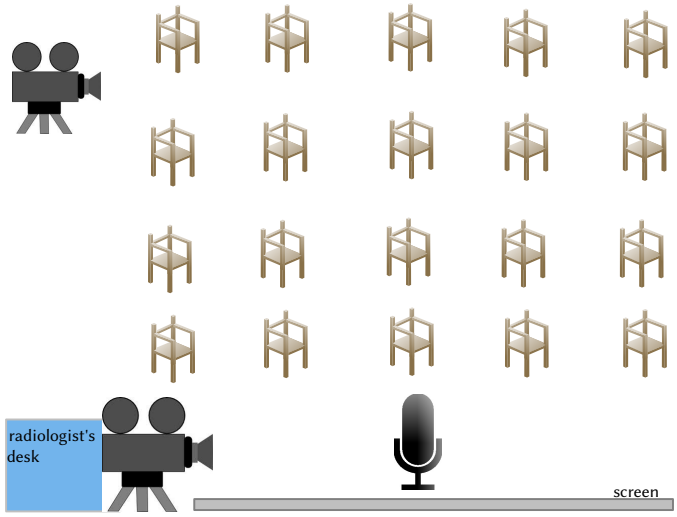

Figure 1.3 – *Position of camera and microphone during the video analysis*

The recordings of the meetings were synchronized and annotated using the AVsP and Virtual Dub freeware. In the end, every video showed exactly one case discussion with the full screen video track from the front camera, the video track of the back camera displayed in the upper right corner and the audio track stemming from the boundary microphone. More than ten hours of video material was collected and prepared this way.

1.3.2 Rating the videotaped MDMs

Nonparticipant observation of meetings was performed by the first two authors of the study. The case information data was completed in the corresponding *Observation check list* by one of the observers. These check lists were then used to rate the behavior seen in the videos. This was done by two observers independently. First, observers rated the strategies used in their chronological sequence as well as their intensity. Second, observers rated the behavior on the scales regarding hierarchy, discussion culture, need for consensus, and structure of the process. Implicit and explicit communication of uncertainty was counted as well as objections. Finally, both observers marked the final decision.

After the independent observation, the two observers compared their results. If differences occurred, the observers discussed the underlying data and agreed on the rating of one of the two observers.

	Kappa	n
Strategies		
Collect additional information	0.70	20
Delay action	0.69	20
Solicit advice	0.78	20
Follow guidelines	1.00	20
Preempting	1.00	20
Weighing pros and cons	0.73	20
Avoid irreversible actions	1.00	20
No discussion of uncertainty	1.00	20
Delegate decision to patient	1.00	20
Influence factors		
Hierarchy	0.68	18
Coaching behavior	0.83	18
Need for consensus	1.00	**20**
Degree of structure (active leading)	0.88	20

Table 1.8 – *Strategies of coping with uncertainty (questionnaire), with inter-rater reliability calculated using Cohen's kappa*

1.3.3 Collecting questionnaire data

Every questionnaire was inserted into a single blank self-adhesive envelope that was left open so participants could use the envelopes to return their answers confidentially. Questionnaires were sent to the contact person at the cooperating academic medical center who distributed them to the physicians attending the head and neck cancer MDM on a regular basis. The same contact person collected the filled in questionnaires after two weeks and sent them back to TU Berlin.

1.3.4 Collecting evaluation questionnaire data

After the first and the second case discussion, the contact person handed out a copy of the *evaluation questionnaire* to each participating member of the cancer MDM. Both completed questionnaires were collected at the end of the MDM. A hospital secretary generated an electronic file with raw data from all *evaluation questionnaires* over a period of three months. This file was made available to the first two authors of this report.

1.4 Data analysis

Observation data and questionnaire data were initially coded separately, resulting in two separate coding frames. Themes that were relevant to both were then interpreted by the researchers working in a group context, with the questionnaire data being used to confirm, challenge, or clarify the observational findings.

1.4.1 Observation data

Non-participatory observation data were loaded into SPSS and Microsoft Excel, and analyses, tables, and graphical diagrams were generated to show relevant results. For all categories (*e.g.* strategies used) which were analyzed by two independent raters, the inter-rater-reliability was calculated using Cohen's kappa. Cohen's kappa for the conducted analysis ranges from 0.68 to 1.00 (table 1.8) and can therefore be considered *sufficient* to *perfect* **[Bortz and Döring 2002]**.

1.4.2 Questionnaire

Data from the *questionnaire* was loaded into SPSS and Microsoft Excel. To show relevant results of close-ended questions analyses, tables and graphical diagrams were generated. Statements concerning the open questions on attributes of poor and effective group decisions were simplified and analyzed in terms of recurrent themes.

1.4.3 Evaluation questionnaire

Data from the *evaluation questionnaire* was loaded into SPSS and Microsoft Excel. Analyses were run for each patient case discussed at the MDM (mean, denoted *M*, standard deviation, denoted *SD*, and frequencies).

1.5 Subjects

1.5.1 Observation

A total of 20 case discussions from 10 MDMs were analyzed (N=20). The participants of the MDMs were practitioners attending the weekly head and neck cancer MDM over a period of three months. Members with different areas of expertise joined the meetings. Membership of the MDM included otolaryngologists, oral and maxillofacial surgeons, oncologists, pathologists, radiologists, radiotherapists and nuclear physicians. At each meeting between six and 16 people (M=10) attended the meeting. Each patient case consultation lasted in the mean 4.80 minutes (min=2 minutes, max=10 minutes).

1.5.2 Questionnaire

15 physicians participated in the questionnaire study. Most of them are otolaryngologists (f=8) but a variety of different medical disciplines typically attending head and neck cancer MDMs is covered (figure 1.4, left). Moreover, the sample covers all hierarchical positions (figure 1.4, right).

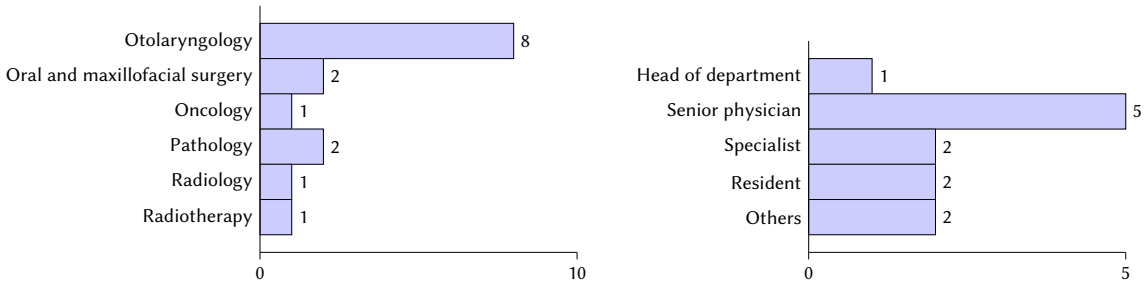

Figure 1.4 – *Distribution of hierarchical position (left) and medical disciplines (right)*

1.5.3 Evaluation questionnaire

Participating members of the MDM filled in an *evaluation questionnaire* for each of the 20 analyzed cases. Each meeting was attended by six to 16 people (M=10). As not everyone filled in the voluntary *evaluation questionnaire*, the sample size for the single case discussions ranges from six to 10 (M=7.75; SD=1.12).

2

Results of the study

This chapter presents the results obtained during the field work. Firstly, an overall description of the MDMs is given. Then, relevant aspects of a group decision-making process under uncertainty are considered in more detail. Data stemming from the observation as well as data stemming from the questionnaire are reported in the sequence of analyzed aspects.

2.1 Description of the MDM

The meeting routinely opened with a junior doctor (assistant physician) introducing a patient by providing a summary of his/her medical condition. In most of the cases, the otolaryngologists introduced the patient cases. Just 15% of the cases were presented by other disciplines (table 2.1). This might be due to the fact that the contact person selecting the cases for inclusion in the present study was an otolaryngologist himself. He might have been better able to judge cases in his own area of expertise as being affected by uncertainties. Presenters in 65% of the cases were assistant physicians (table 2.2). In 50% of all cases, the head of the department was attending the meeting.

Physicians	Frequency	Percent
Otolaryngologists	17	85
Oral and maxillofacial surgery	2	10
Radiotherapy	1	5
Total	20	100

Table 2.1 – *Case introducing discipline*

Status	Frequency	Percent
Resident	4	20
Assistant physician	13	65
Specialist	1	5
Senior physician	2	10
Total	20	100

Table 2.2 – *Case presenter (status level)*

The first question (table 2.3) that board members wanted to discuss during the meeting concerned therapy options (40%) in most of the cases. Another reason for consultation was found in discussing images (35%) and also in possible adjuvant therapy (25%). Data on how participants judged the information source for each case discussed could be obtained from the *evaluation questionnaire*. The information source regarding the patient cases was rated pretty well (M=4.08, SD=0.36 on the scale from 1=low to 5=high). However, in seven out of 20 cases (35%) the information regarding the case was rated below average.

Question	Frequency	Percent
Therapy options	8	40
Adjuvant therapy	5	25
Imaging	7	35
Total	20	100

Table 2.3 – *Initial question for consultation*

2.2 Sources of uncertainty

Results from questionnaire

Data concerning sources of uncertainty at cancer MDMs was solely provided by the questionnaire. Asked to rate different sources of uncertainty (on a scale from 1=*never* to 5=*very often*), members of the head and neck cancer MDM indicated that they were most often confronted with seemingly equivalent alternatives (M=3.20) and divergent opinions of colleagues (M=3.13) as sources of uncertainty (table 2.4).

Source	M	SD	n
Completely or partly lacking information	2.80	0.86	15
Inadequate understanding owing to equivocal information	2.07	0.46	15
Seemingly equivalent alternatives	3.20	0.56	15
Lack of knowledge, skills, or expertise	2.53	0.52	15
Divergent opinions	3.13	0.64	15
Ambiguous purposes of others	2.47	0.64	15

Table 2.4 – *Sources of uncertainty (questionnaire)*

2.3 Communication of uncertainty

Results from observations

Across all 20 cases, uncertainty was very rarely expressed explicitly (f=8 in a total of only 4 cases). Implicit statements pointing to uncertainty were found much more frequently (f=26; 13 cases). Yet, in seven out of 20 cases, no type of uncertainty expression was observed at all.

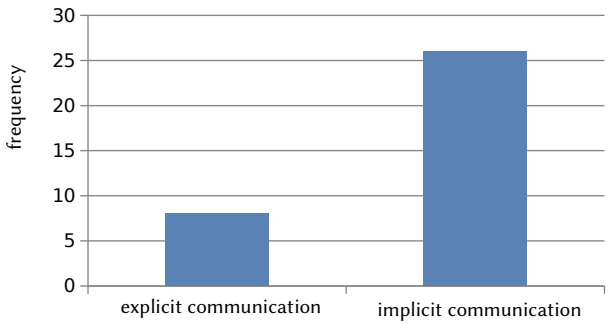

Figure 2.1 – *Uncertainty communication*

2.4 Strategies used to handle uncertainties

Results from observations

To find out which kind of strategies members use to handle uncertainties, each strategy was counted and rated regarding the type (*reduction, acknowledgment, suppression*). In figure 2.2 the strategies are listed and the observed frequency is displayed on the horizontal axis. The most frequently observed strategies were *collect additional information* (f=41) and *solicit advice* (f=47) as part of the *reduction* strategy. Another tactic belonging to this strategy was *delay action*, which was observed ten times (f=10) across all cases.

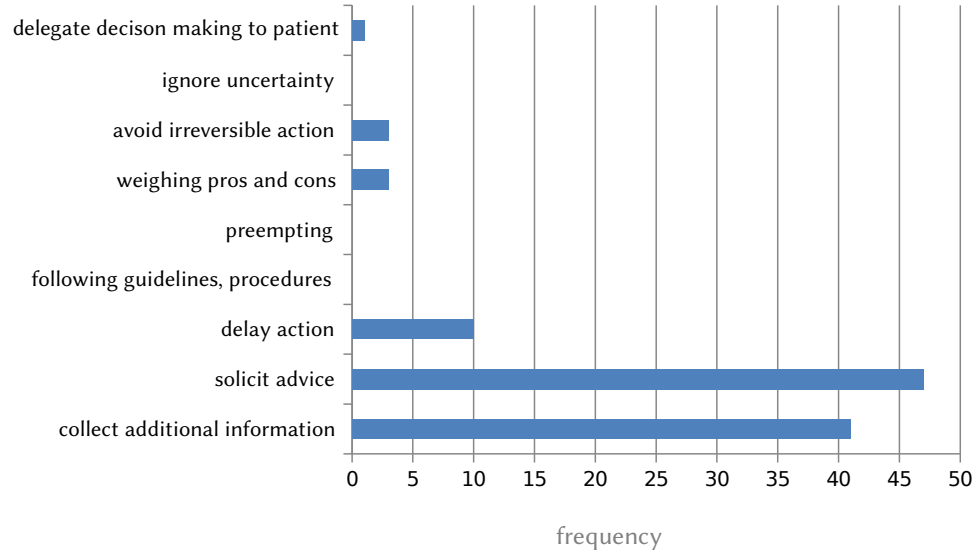

Figure 2.2 – *Strategies used in handling uncertainty*

In more detail, figure 2.3 displays how many times each kind of strategy (vertical axis) was observed at what time (horizontal axis) during the whole process of handling uncertainty[1].

Reduction tactics, *e.g.* collect additional information (f_{total} = 41) are those which were used right in the beginning of the patient consultation (to the left of figure 2.3). Especially in the first 3 sequences (f_{one} =19, f_{two} =4, f_{three} =8) this strategy was applied very often to reduce uncertainty. In the course of discussion, strategies to *acknowledge* uncertainty like *weighing pros and cons* (f_{total} = 3) or *avoid irreversible actions* (f_{total} = 3) were chosen. In a single case, the decision was *delegated to the patient* (f_{total} = 1). Not observed were tactics of *suppression* (f_{total} =0) and the *reduction* tactic *following guidelines* (f_{total} =0).

Results from questionnaire

Data concerning strategies to handle uncertainties at the head and neck cancer MDM under study is also provided by the questionnaire. The participants (N=15) evaluated the handling of strategies on a scale from never (1) to very often (5).

Strategies of *reduction* are most often used to handle uncertainties (M=3.15) followed by strategies of *acknowledgement* of uncertainty (M=2.91). Less prominent are strategies of delegation (M=2.13) and strategies of suppression (M=2.04) (see table 2.5).

The dominating single tactics are *weighing pros and cons* (M=4.07), *following norms and SOPs* (M=3.87) and *collecting additional information* (M=3.67). But even strategies of *suppression* are in use. In particular, *relying on intuition* seems to be an appropriate tactic (M=2.40) which naturally cannot be assessed on the basis of observational data.

[1] This type of visualization is known as a *stacked graph* or *steam graph* **[Byron and Wattenberg 2008]**. The figures in this document were drawn using software developed by Xach Beane and Eric Marsden.

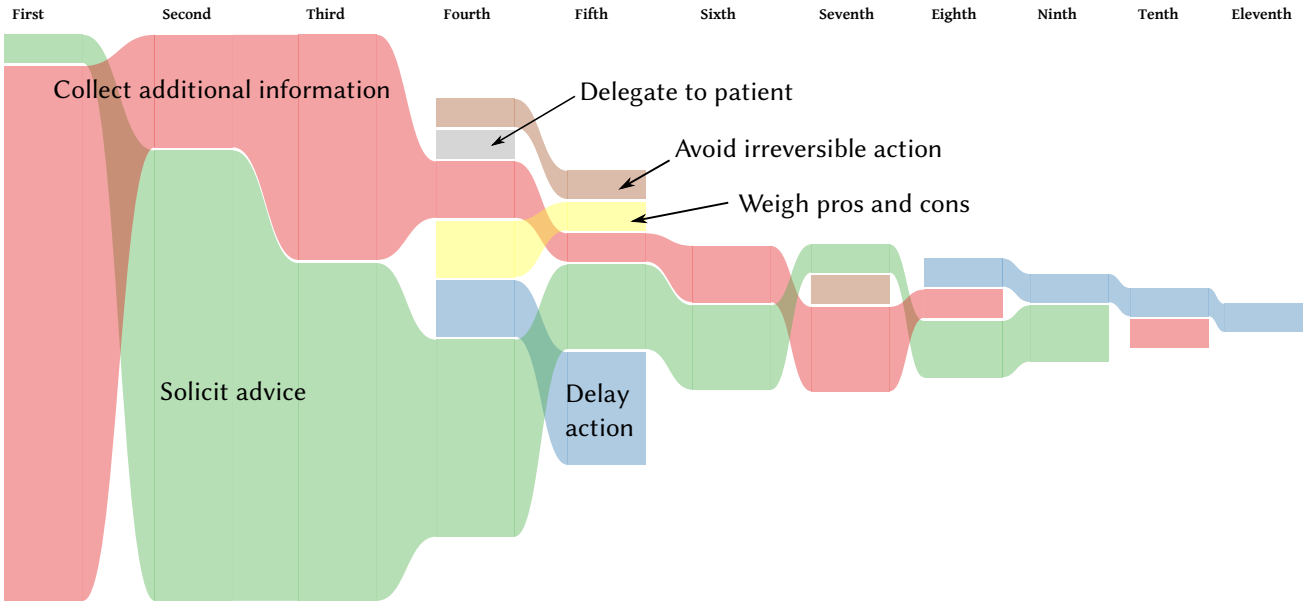

Figure 2.3 – *Strategies used when handling uncertainties, in chronological order of their use*

	M	SD	n
Strategies of reduction	**3.15**	**0.70**	**15**
Collect additional information	3.67	0.62	15
Delay action	2.93	0.70	15
Solicit advice	2.93	0.59	15
Follow norms, SOPs, *etc.*	3.87	0.52	15
Assumption based reasoning	2.33	0.05	15
Strategies of acknowledgement	**2.91**	**0.72**	
Preempting	1.92	0.76	13
Improve readiness	2.73	0.80	15
Weighing pros and cons	4.07	0.59	15
Strategies of suppression	**2.04**	**0.78**	**15**
Ignore uncertainty	1.67	0.72	15
Rely on “intuition”	2.40	0.83	15
Strategies of delegation	**2.13**	**0.74**	**15**
Delegate to patient	2.13	0.74	15

Table 2.5 – *Strategies of coping with uncertainty (questionnaire)*

2.5 Influences on group decision-making

Results from observations

The factors that influence the decision-making process were rated by observers on a scale from *1=not observed*, *2=observed* and *3=strong occurrence*.

Hierarchy. The influence on the decision-making process stemming from hierarchy was clearly observed (table 2.6) and rated from medium to high (M=1.89, SD=5.83). In figure 2.4 the observed degree of dominant behavior is displayed in accordance to the number of cases. In two out of 20 cases a strong dominant behavior was observed. In twelve cases the dominant behavior appeared abundantly clear. The influence of the highest status member was rated lower (M=1.70, SD=0.68) when the head of the department was not attending the meeting. In these cases his deputy (a senior physician) was the group member with the highest status and in charge. The behavior of the deputy was rated to be more dominant than the behavior of the head of department. This led to differences in the degree of dominant behavior depending on the presence of the head of department.

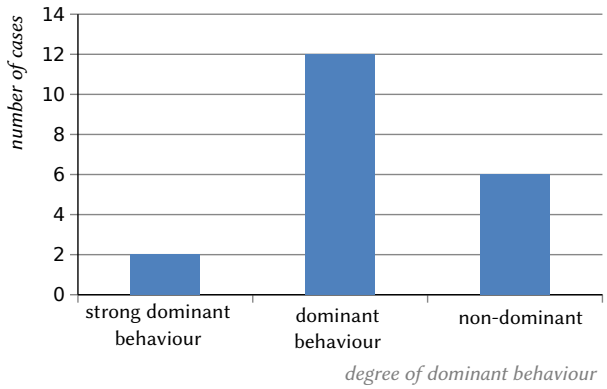

Figure 2.4 – *Degree of influence of hierarchy on the decision-making process*

In addition to assessing the behavior of the highest status group member, observers counted how often lower status group members challenged higher status group members. This happened only a small number of times. Physicians rarely came up with a different opinion (f=7, distributed over six cases). Looking not only at challenging higher-status group members but challenging any other group members, similar patterns resulted. Physicians seldom stated concrete proposals which questioned comments of other board members (f=9 over 8 cases).

Discussion culture. In the cases studied, board members very often interrupted someone's contribution (f =49 over 16 cases). In just four out of 20 cases no interruptions were observed. Very low ratings were yielded regarding the coaching behavior of board members with higher status (M=1.22, SD=0.43). In four cases, aspects of coaching behavior could be noticed (*e.g.* turning toward other board members, asking for comments). In those situations where the head of department was not attending the meeting, the interruptions were reduced by 50% (f=22).

Need for consensus. At the end of the decision-making process, the highest status member sometimes asked whether all group members shared the final decisions. This behavior was found very rarely (M=1.15, SD=0.49). In a single case, consensus was asked for explicitly and in a second case this was done indirectly (table 2.6). The question regarding consensus was brought up by the head of department.

Structure. Concerning the structure of the whole process, we analyzed whether an active leading behavior could be noticed. In just six out of the 20 cases, very low aspects of leading behavior with regard to the process (M=1.30, SD=0.47) were observed (table 2.6).

Influence factor	M	SD	n
Dominant behavior	1.89	0.58	18
Coaching behavior	1.22	0.43	18
Demanding consensus	1.15	0.49	20
Actively leading the decision-making process	1.30	0.47	20

Table 2.6 – *Influences on the decision-making process*

Results from the questionnaire

To assess the appearance of promoting and inhibiting influences on decision-making group processes, participants rated their agreement with 13 items (see table 1.5) on a scale from *1 = disagree at all* to *5 = totally agree*. Table 2.7 presents the results for the subset of promoting influences. Participants especially agreed with the statement that one was not blamed for errors at the cancer MDM under study (M=4.13) and that the MDM was conducted in a respectful atmosphere (M=3.80). Participants more or less agreed with the existence of inhibiting as well as promoting influences (means from 4.13 to 3.20). One exception is the evaluation of a clear separation between analysis and search for solutions (M=2.93).

Promoting influences	Min	Max	M	SD	N
Psychological safety					
No blame	3	5	4.13	0.74	15
Skills valued	2	5	3.60	0.91	15
Degree of structure					
Clear structure	2	5	3.53	1.13	15
Communicated criteria	2	5	3.40	0.91	15
Separated analysis and solution	2	4	2.93	0.59	15
Discussion culture					
Raised doubt	2	5	3.20	0.86	15
Conveyed ideas and concerns	2	5	3.33	0.90	15
Respectful atmosphere	3	5	3.80	0.68	15

Table 2.7 – *Promoting influences on the decision-making process (questionnaire)*

Looking at the inhibiting influences it is noticeable that items assessing hierarchy gradient are evaluated relatively high compared to the other statements (M=3.33; M=3.73) (table 2.8). Lacking encouragement of persons high in status and rank is strongly perceived (M=3.73). Items assessing influences related to need for consensus are evaluated as having a quite weak influence (M=2.40; M=2.00).

The inhibiting influences are presented in table 2.8. It is noticeable that items assessing hierarchy gradient are evaluated relatively highly compared to the other statements (M=3.33; M=3.73). A lack of encouragement of persons high in status and rank is strongly perceived (M=3.73). Items assessing influences related to need for consensus are evaluated as having a fairly low influence (M=2.40; M=2.00).

Inhibiting influences	Min	Max	M	SD	N
Hierarchy gradient					
Hierarchical differences	1	5	3.33	1.29	15
Lack of encouragement	3	5	3.73	0.70	15
Need for consensus					
Denial of divergent opinions	1	4	2.40	0.91	15
Suppression to state uncertainty	1	5	2.00	1.13	15
Time pressure					
Time pressure	1	5	2.73	1.16	15

Table 2.8 – *Inhibiting influences on the decision-making process (questionnaire)*

As displayed in figure 2.5, promoting influences (wavy bars) in tendency outbalance inhibiting influences (solid bars). With regard to the promoting influences, there is room for improvement regarding the structure of group decision processes.

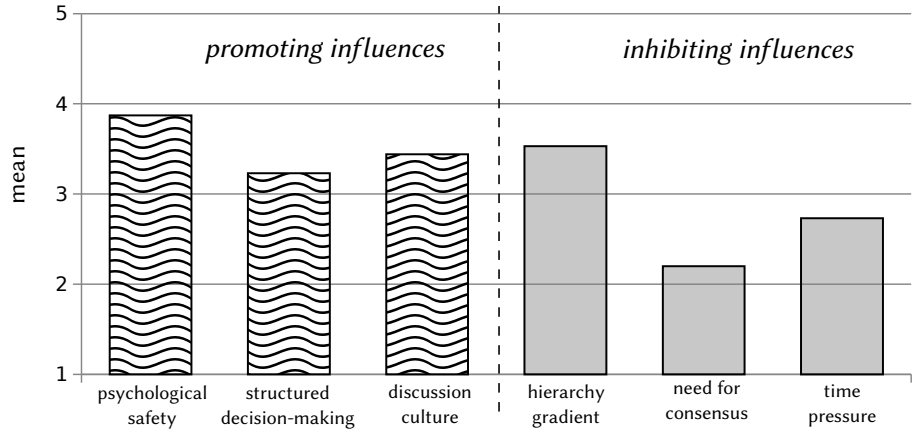

Figure 2.5 – *Promoting and inhibiting influences (questionnaire)*

2.6 Final decision

Data from observations

The final decision was communicated at the end of the case consultation in half of the cases (55%). Furthermore, board members did not separate the whole decision-making process into distinct steps of information search and evaluation. In figure 2.6 the options and their frequencies are described. More specifically, in 45% of the cases an active therapy was defined and in 35% of the cases further diagnostic steps were identified as necessary before a decision concerning a specific therapy could be reached.

In just one of the cases, no therapy had been envisaged and only palliative care was recommended. In two of the cases the final decision could not be observed because of missing information at the end of the videos.

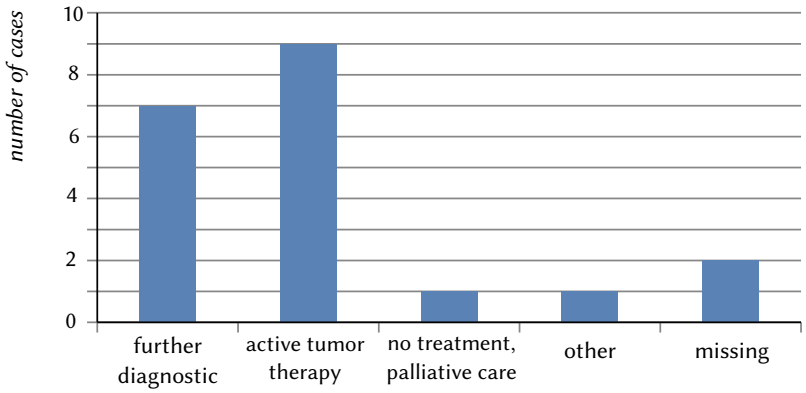

Figure 2.6 – *Final decision at the MDM*

2.7 Characteristics of a good or acceptable decision

Data from evaluation questionnaire and observation

At the end of each case consultation, all physicians participating in the MDM completed a questionnaire providing their evaluation of the decision-making process. The questionnaire contained questions concerning the level of structure, communication, basis of information, documentation, and participation. Ratings for each dimension were provided on a scale from 1 (*disagree*) to 5 (*agree*).

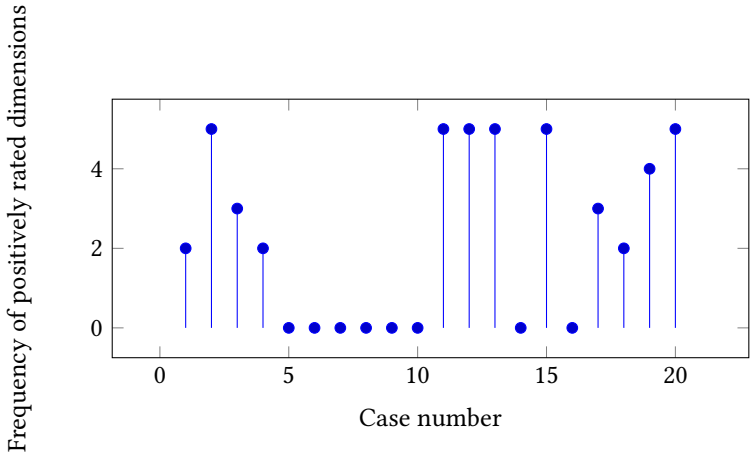

Figure 2.7 – *Frequency of positive rated decision-making aspects, by case*

To further describe possible differences in the decision-making process, the cases were divided into two groups:

- **Good decision-making process**: cases where all dimensions were rated above average (n=6);
- **Poor decision-making process**: all other cases, *i.e.* those cases where at least one of the dimensions was rated as poor (score of 2 or below) (n=14).

In the next sections, we analyze which factors are correlated with a good or poor decision-making process.

2.7.1 Effect of uncertainty communication

The relationship between cases where uncertainty was communicated (implicitly or explicitly) and the rating of the decision-making in that case (as good or poor performance) is depicted in figure 2.8. In all 14 cases with a decision-making process judged to be poor, uncertainty was rarely expressed explicitly (f=2). Much more frequently, uncertainty was stated implicitly (f=13). In those cases (n=6) with a good decision-making process, uncertainty was far more often communicated (implicitly f=13 and explicitly f=6).

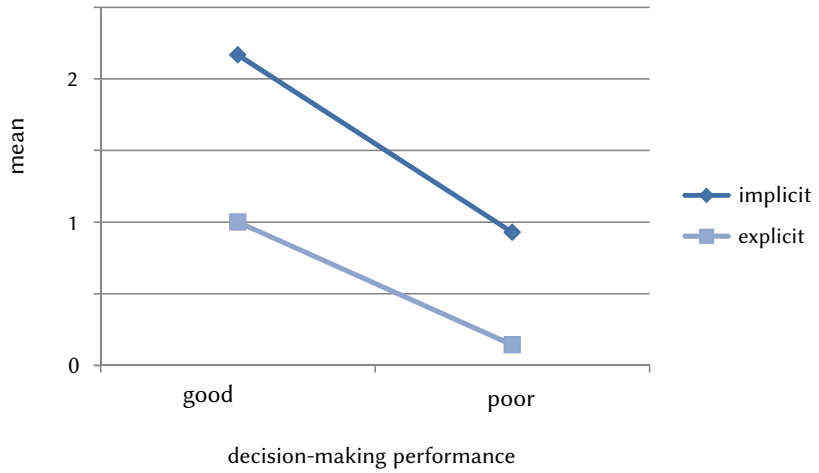

Figure 2.8 – *Correlation between uncertainty communication (implicit and explicit) and decision-making performance*

2.7.2 Effect of strategies used to handle uncertainty

It seems that the overall adjudged quality of the decision-making process is not affected by the strategies used to handle uncertainties.

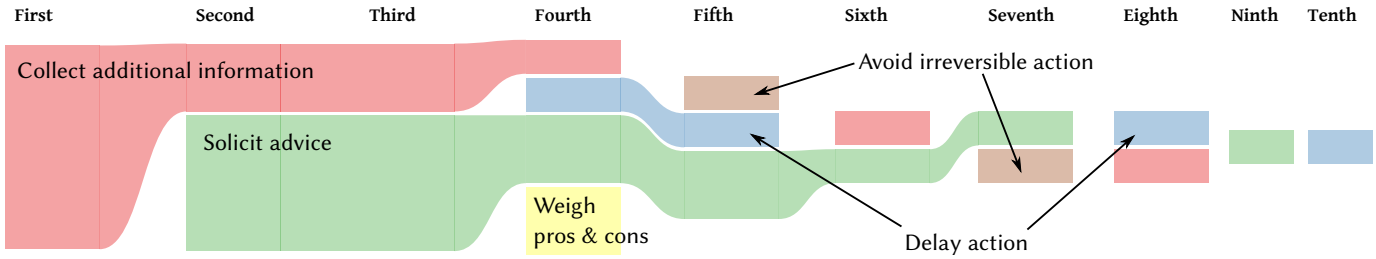

Figure 2.9 – *Strategies used to handle uncertainties in chronological order, for decision-making processes rated as good (n=12)*

In cases judged to have good (figure 2.9) and poor (figure 2.10) decision-making processes, similar strategies are used (most frequently *collecting additional information* and *solicit advice*).

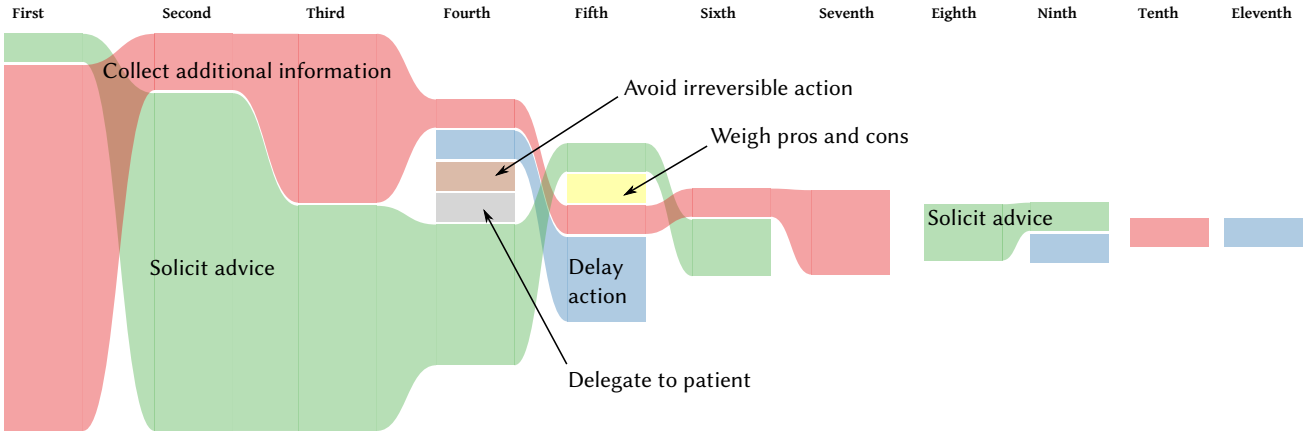

Figure 2.10 – *Strategies used to handle uncertainties in their chronological order, for decision-making processes rated as poor*

2.7.3 Effect of group decision-making influence factors

Hierarchy. In those cases where the decision-making process was rated as good (wavy bars in figure 2.11), dominant behavior of the highest status member was observed to a medium extent whereas in the cases with a poor process evaluation (solid bars in figure 2.11), dominant behavior was rated either as *not observed* (f=4) or as *strong dominant* (f=2) (figure 2.11).

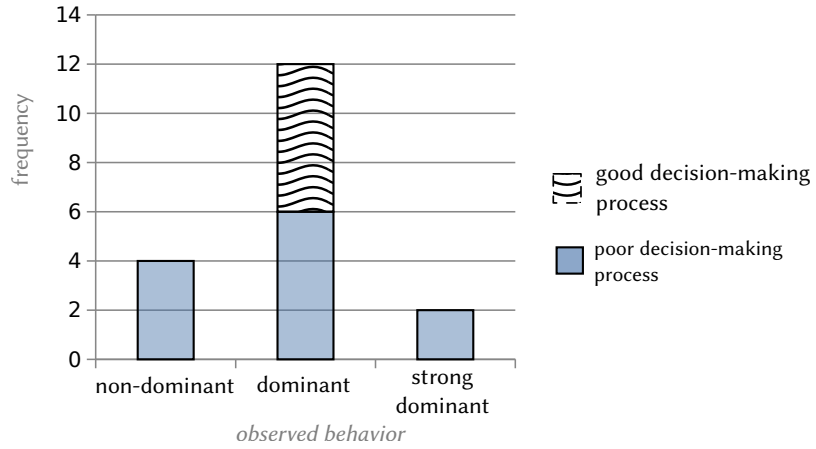

Figure 2.11 – *Dominant behavior during decision-making processes rated as good*

Discussion culture. Only one case in the sample of poor decision-making processes was observed where one of the board members disagreed with the highest status member (f=1). In cases with positively evaluated processes disagreement was stated six times during discussion. Interruptions during the discussion were more often observed under good performance conditions (f=22 over 6 cases) than under poor performance conditions (f=27 over 14 cases).

Structure. With respect to leading behaviour, in just three of the 14 decision-making processes evaluated as poor some tendencies for that behavior were observed. In most of the cases (n=11), no leading behavior could be found.

With respect to leading behaviour, in just three of the 14 decision-making processes evaluated as poor some tendencies for that behavior were observed. In most of the cases (n=11), no leading behavior could be found.

Final decision. In 50% of the process cases where the decision-making process was evaluated

as being poor, the final decision was communicated again[2] to the group members (f=7), whereas for the other 50% it was not communicated. In the good performance cases, four out of six decisions were communicated explicitly at the end of the patient case consultation.

Data from the questionnaire

At the end of the questionnaire, participants were asked to write down in their own words what were good and what were poor group decisions in their point of view. Concerning features of good group decisions, ten physicians stated 13 aspects. One aspect was unreadable and therefore not further processed. Most often participating physicians named consensus after interexchange as an attribute of good group decisions (f=5). Two persons respectively stated inclusion of facts and data and involvement of all medical disciplines as attributes of good group decisions. Figure 2.12 depicts all stated attributes in font size representing proportion of nominations.

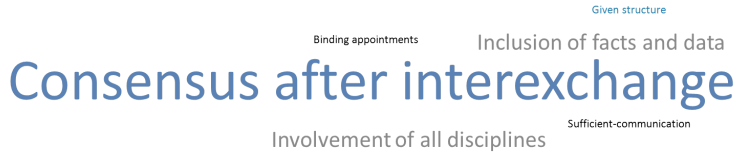

Figure 2.12 – *Attributes of a good group decision-making process*

Concerning features of poor group decisions, 11 participants stated 12 aspects. The two named attributes named most often are lack of discussion and exchange and a hierarchical decision (each f=4). Figure 2.13 depicts all stated attributes in font size representing proportion of nominations.

Figure 2.13 – *Attributes of a poor group decision-making process*

2.8 Characteristics of a decision process without non-postponed decisions

Data from evaluation questionnaire and observation

Sometimes, there are decisions which cannot be finalized during the time of discussion. In this section, special characteristics of such kinds of decision, so-called *postponed* decisions, are described. In this study, there were seven cases which could not be resolved at the time they were presented to the MDM members.

Characteristics of case consultation process. The consultation of cases, where the decision was finally postponed took a little longer (M=6.53 minutes) than the consultation of the cases with non-postponed decisions (M=4.80 minutes). The differences between postponed and non-postponed decisions regarding the overall time needed for the consultation are depicted in figure 2.14.

Informational background for those cases was rated lower (M=3.98) than for cases with non-postponed decisions (M=4.14). All the cases leading to postponed decisions were presented at the head and neck MDM the first time. In five of the seven cases the discussion of the images was the initial question for the meeting. In six cases, the head of department did not attend the meeting.

[2] Oral communication, during the meeting.

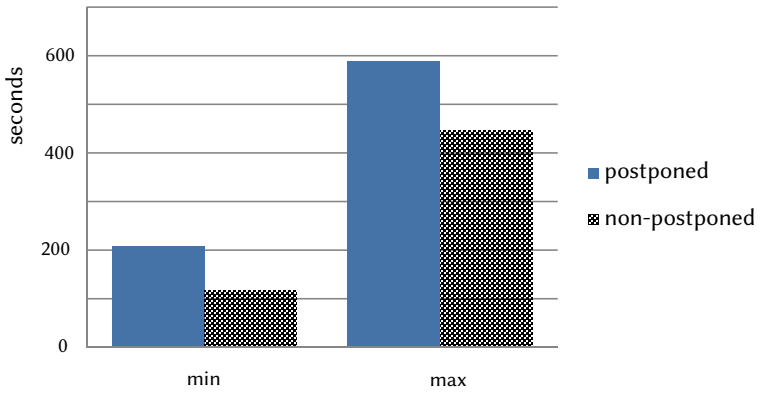

Figure 2.14 – *Duration of case consultation for non-postponed and postponed decisions*

Uncertainty communication. In cases where the final decision was postponed during the decision-making process, uncertainty was communicated to a greater extent, as seen in figure 2.15. In particular, all the explicit communication (solid bars in figure 2.15) of uncertainty was found in those postponed cases (f=8 in 4 cases). The difference with non-postponed decisions was tested to be significant, x^2 (3)=9.3, p=0.023.

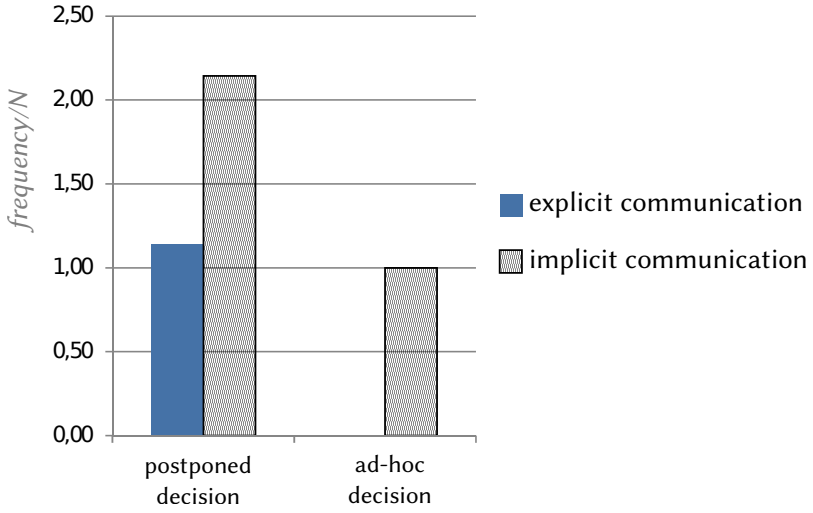

Figure 2.15 – *Explicit and implicit communication of uncertainty: postponed vs. non-postponed decisions*

In addition, the implicit communication of uncertainties was much higher in the postponed decisions (f=15 over 7 cases) than in the non-postponed decisions (f=11 over 13 cases). In reference to the number of cases this difference is also tested significant, x^2 (4)=10.84, p=0.028.

Strategies of handling uncertainties by postponed decision-making. When decisions were finally postponed, it could be observed that the strategy of *delaying action* is used more frequently (f=8) than in those cases where a decision could be made (f=2). This difference is tested as marginally significant, x^2 (3) = 7.3, p=0.063. On the higher level of *reduction*, *acknowledging* and *ignoring*, the differences are without any statistical meaning.

Influences. Regarding possible influences on the decision-making process there were no differences in observing postponed or non-postponed decisions. The dominant behavior was rated a little higher in the postponed decision sample (M=2.00) than in the non-postponed sample (M=1.82). The active leading of the whole process is also rated higher for postponed decisions (M=1.41) than for non-postponed decisions (M=1.23). Regarding the other aspects, like disagreement or interruptions, no differences were found.

Final decision. The result of the decision-making process was communicated explicitly in four out of the seven cases (57%).

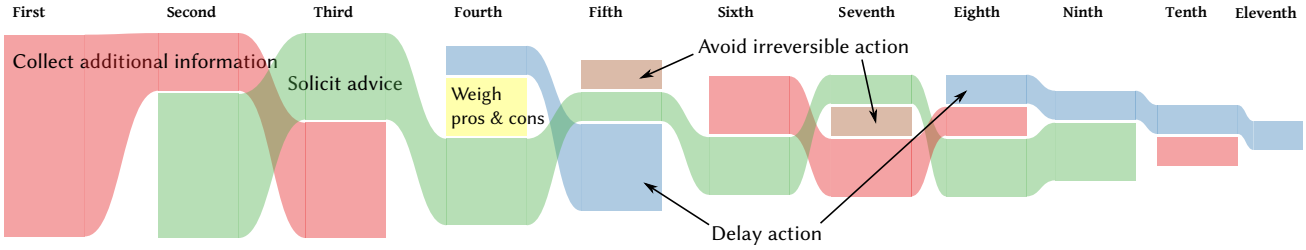

Figure 2.16 – *Strategies in handling uncertainties in chronological order (for postponed decisions)*

2.9 Decision criteria

Data from questionnaire

Participants were asked to evaluate how often different decision criteria were applied in the MDM under study, using a scale from 1 = *never* to 5 = *very often*. The results are presented in table 2.9.

Criteria	M	SD	n
Hierarchy	3.64	0.63	14
Patients' interest	4.00	0.68	14
Professional competence	4.14	1.01	14
Medical facts	4.54	0.66	13
Consensus	4.07	0.83	14
Guidelines	3.93	1.00	14

Table 2.9 – *Decision criteria (data from questionnaire)*

Each of the six proposed criteria was implemented quite often with regard to its evaluation. This is particularly often the case when the final decision is based on the medical facts in the given case (M=4.54). Following the opinion of the person highest in hierarchy is the second most widely used decision criterion (M=3.64).

3

Discussion

3.1 Key findings

In principle, handling uncertainty during clinical decision-making in a multidisciplinary team has at least one big benefit compared to decision-making by individual experts: it may be safer because team members assemble to **share their expertise** and create additional defenses against error. However, in practice this obvious benefit can be offset by several inhibiting factors related to, *e.g.*, the hierarchical gradient within a group or a suboptimal discussion culture. This was suggested by the results of our first study addressing decision-making under uncertainty in groups [Marold et al. 2012]. To develop effective MDMs, it is necessary to understand how experts work together and how they handle uncertainties. The aim of this study was to develop this knowledge base by exploring the factors that influence decision-making under uncertainty in a head and neck cancer MDM.

3.1.1 Sources of uncertainty

It is very interesting in the context of the kind of MDMs investigated in this study that respondents of the questionnaire stated that *divergent opinions* of other board members represented a relatively frequent source of uncertainty during the decision-making process of the board. This is a new aspect not covered by existing taxonomies of uncertainty sources. It emphasizes the importance of involving the social side of uncertainty in the whole framework on group decision-making, confirming similar findings by [Marold et al. 2012].

Divergent opinions of decision-makers is a source of uncertainty not found in previous studies

Another important source of uncertainty in this context reported by the physicians in our study relates to *seemingly equivalent alternatives* in the decision-making process.

Though not adding new aspects to sources of uncertainty, it confirms the results of the first study in the context of medical decision-making [Marold et al. 2012], where this kind of strategy was also named very often. Seemingly equivalent alternatives seem to be especially frequent in the medical context.

3.1.2 Strategies in handling uncertainty

Overall it seems to be clear and less surprising that *reduction* strategies are used most frequently to handle uncertainty in the context of medical group decisions. As stated in the questionnaire and also observed at the MDMs, *collecting additional information, soliciting advice, delaying action or following norms* are often applied to reduce the uncertainty related to the case under discussion.

Interestingly, differences between the questionnaire and observational data emerged for other strategies, especially when it comes to acknowledging uncertainty. One of the dominating strategies found in the questionnaire data, *following norms and SOPs*, was not identified during video analysis at all. This could be due to the fact that observers were not familiar with SOPs *(standard operating procedures)* in the field of cancer treatment and did not recognize relevant communication centered on SOPs.

Similar differences emerged for the strategies *weighing pros and cons* and also for the strategy of *relying on intuition*. Both were identified as often-used strategies based on subjective data (questionnaires) but could not be observed with the same frequency.

Maybe all of the three strategies have something in common, which could be described as a more internal processing procedure. Physicians stated that they often weigh pros and cons, but this may not be a strategy they use explicitly as they do not share their ideas with the other board members. This could also be true for *relying on intuition*. Gary Klein [Klein 2003] studied situations where people do not have enough time to apply extensive decision-making procedures (do-or-die decisions). They have to rely on experience and follow their intuition. Certainly, intuition plays an important role also in the area of MDMs. Very often, experts remember other cases and go along with this information.

Delegation to the patient as a strategy to handle uncertainty is very seldom used. This can be seen in the questionnaire results as well as in the observational data.

Furthermore, observation data provide insight into the chronological sequence of strategies. Here, it became obvious that first of all *reduction* strategies are used followed by strategies which acknowledge the perceived or even discussed uncertainty. This suggests that physicians follow a very rational approach by first trying to reduce the uncertainty and only using other sorts of coping strategies if uncertainty *reduction* turns out to be impossible.

3.1.3 Influencing factors

During the observation of the MDM decision-making processes, clear influences of **hierarchy differences** within the group could be observed. Dominant behavior of the highest status members of the board was assessed.

This behavior corresponds to certain aspects of communication behavior such as interrupting other board members' contributions. The consequences of such a steep hierarchy gradient on the behavior of other group members were also observed.

In just a small number of cases, statements questioning/challenging the highest status members were recorded. The willingness to speak up evidently decreased. As became evident from the questionnaire data, the hierarchy gradient is again perceived (see also [Marold et al. 2012]) as a strong inhibiting factor during decision-making. And regarding the question "what kind of factors characterize poor decision-making", hierarchical decisions have the highest ranking.

Closely related to speak up behavior and the willingness to challenge higher status group members is the existence of a positive atmosphere during discussions. Results from the questionnaire confirm a respectful atmosphere at the MDM under study. Nevertheless, lack of encouragement is not only perceived by respondents of the questionnaire but also observed in the MDM data (*i.e.* missing or deficient coaching behavior). In line with the medium evaluation of *raising doubt during the discussion* in the questionnaire study, *explicit communication of uncertainty* was observed very rarely during the patient case consultations. One possible factor which could promote such behavior is seen in the concept of **psychological safety**.

Psychological safety

A shared belief held by members of a team that the team is safe for inter-personal risk taking [Edmondson 1999]. The primary differences between psychological safety and the related concept of *trust* are that psychological safety focuses on a belief about a group norm, whereas trust focuses on a belief that one person has about another.

To measure aspects of psychological safety, we used the questionnaire items which asked for the consequences of errors (not being blamed) or how skills are valued. Both items were not rated as fully established; there is room for improvement with regard to these aspects.

Generally, a positive discussion culture seems to be in line with the need for consensus (agreement between board members after discussing different options). On the other side, striving for consensus can also be a warning signal for the appearance of decision biases, which might lead to faulty decisions (for instance due to groupthink). During the MDM the *need for consensus* was observed with respect to explicit communication behavior. In only one case, the highest status member explicitly asked the whole board for consensus. In other cases, discussion ended without any explicit voting procedure. In most cases, the final decision was not explicitly repeated at the end of the meeting. Rather, discussion ended in an implicit kind of manner (*e.g.* at the time when no more contributions were brought up by any board member).

In the literature, a greater degree of structure of decision-making processes is seen as helping to ensure robust decisions. The formalized decision-making processes described in the literature always include the analysis of the presented information and the subsequent evaluation. During the observation of the MDMs, we did not record any distinction between these two steps. Rather, MDM members are inconsistent in how they come to decisions. Furthermore, no guidelines or similar mechanism are used to structure the whole process. Although participants in the questionnaire study refer to structuring as an important factor for good decision-making practices, questionnaire data also revealed the largest space for improvement with regard to structuring decision-making processes.

Figure 3.1 summarizes key findings regarding the influencing factors in this field study.

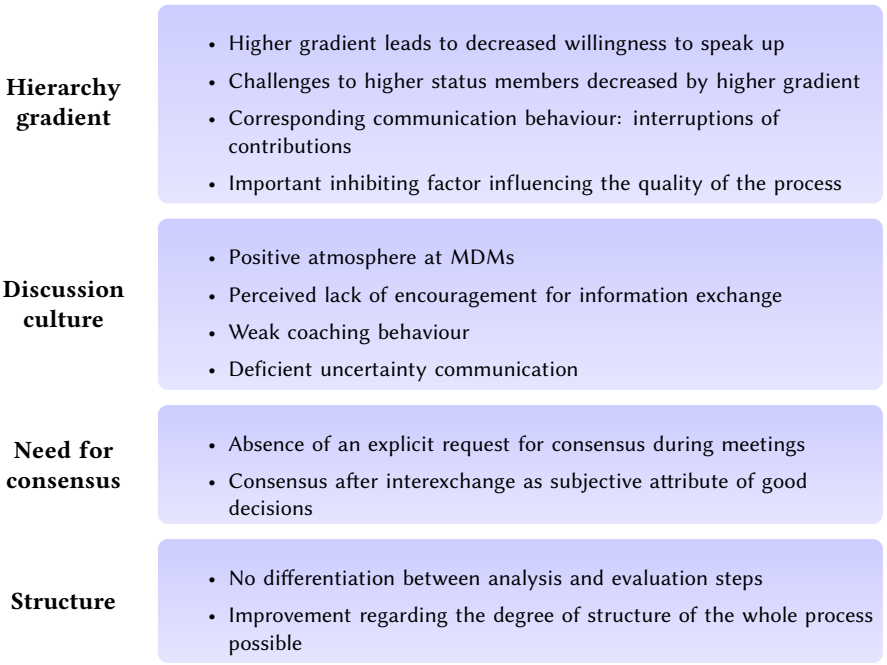

Figure 3.1 – *Summary of key findings regarding factors influencing perceived quality of MDM decision-making process*

3.1.4 Characteristics of a good decision-making process

To draw further findings from the different data sources, we analyzed especially those cases where members of the MDM rated the overall decision-making process (subjective rating) with the benefit of hindsight as a good one.

As a result, different behaviors and attributes could be identified which characterize a good/acceptable process on the basis of the observations:

- ▷ communicating uncertainties
- ▷ behavior of the highest status member (especially degree of dominance)
- ▷ leading behavior
- ▷ willingness to speak up
- ▷ explicit communication of the final decisions
- ▷ consensus after exchange
- ▷ involvement of all disciplines
- ▷ inclusion of facts and data

3.1.5 Characteristics of a postponed decision

Some decisions could not be made during the meeting. A comparison of the characteristics of decision-making processes between postponed and non-postponed decisions revealed that postponed decisions were discussed longer at the board and the upcoming uncertainties related to these decisions were much more frequently communicated explicitly as well as implicitly.

To handle these uncertainties board members used the same strategies for the postponed and non-postponed decisions but the strategy of *delaying action* was used to a higher degree regarding the postponed decisions.

To sum up, these results suggest that the quality of the decision-making process first of all depends on factors like the availability of data and information and the expertise of the decision-maker. However, the final outcome of the decision is also affected by situational factors (*e.g.* time pressure) and, in case of group decisions, also by intragroup factors like active leading of the decision-making process or explicit and implicit communication of uncertainty.

3.2 Implications

Clearly, MDMs have become an important mechanism in the delivery of cancer care. The intent of the cancer multidisciplinary meetings is to prospectively review individual cancer patients and make recommendations on best management, keeping in mind that individual physicians are responsible for making the ultimate treatment decision. Many strategies have been proposed in the literature to enhance the effectiveness of this type of meeting. In the light of the results of our study, some of these are outlined below.

3.2.1 Train the leaders in their coaching behavior to establish psychological safety

In MDMs, leadership has been identified as a key aspect contributing to success **[Haward et al. 2003]**. As known from many studies, in particular the decisions and behaviors of leaders influence team effectiveness and the overall quality of the decision-making process.

Leaders who listen to members and incorporate their ideas in their own decision-making usually improve the quality of overall team decisions **[Norrgren and Schaller 1999]**.

psychological safety

First of all, successful leadership is reflected in an appropriate management of status differences and in free information flow in order to ground decisions on a sufficient informational basis. To achieve this, leaders need to create an atmosphere where individuals are not worrying of being embarrassed, criticized or punished. This team climate is characterized and described as *psychological safety* **[Edmondson 1999]**. The introduction of psychological safety may improve the discussion culture but also the way in which board members talk about uncertainty and also increase the chance to make the group talk about it at all. Our results revealed that very often uncertainty is not explicitly brought up into discussion, despite its explicit discussion being considered to be an attribute of good decisions. If psychological safety increases, the willingness to lower one's guard should increase.

coaching behaviour

One possible way for team leaders to promote a positive *discussion culture* and to create psychological safety in the context of a MDM is seen in the concept of *coaching behavior* **[Edmondson 1999, 2003; Marold et al. 2012]**. It is described as direct interaction with the team. Coaching oriented leaders are characterized through the following aspects: modeling openness, being accessible, inviting input, non-defensive responds to challenges and questions.

Coaching behavior can encourage members to talk to others in the board (speak-up) and to reduce power-based barriers.

Some of the shortcomings observed in this study regarding leadership behavior could be suitably addressed by leadership skill training. Others could easily be changed, *e.g.* by the use of an appropriate meeting room that allows a circular pattern of seating. Classroom rows as used in the observed MDM tend to inhibit contributions from the back rows.

3.2.2 Train the group in their competence to speak up

As in other decision-making groups, one can find instances in health care where group members are being silenced with a comment **[Edmondson 2003]**. For example, a physician who, in response to challenging the opinion of a senior colleague, gets sarcastic or condescending comments back which keeps him/her silent in the future. This can happen in any communication with a strong power differential, *e.g.* between senior and junior health-care professionals.

Physicians in our study perceive the courage to speak up as promoting group decision-making processes. During the observations, board members very seldom brought up new information, questions, ideas, or concerns. The key target to promote adequate *speak up behavior* of all board members in a MDM on the individual level is seen in *assertiveness*.

Assertiveness

DEFINITION

Assertiveness is defined as "a form of behavior characterized by a confident declaration or affirmation of a statement without need of proof; this affirms the person's rights or point of view without either aggressively threatening the rights of another (assuming a position of dominance) or submissively permitting another to ignore or deny one's rights or point of view" [Dorland].

Assertiveness occurs when an individual declares her or his opinion through questions and statements and does so with appropriate persistence until it is reacted upon (figure 3.2). It involves clearly and directly communicating one's own feelings, ideas, and concerns **[Jentsch and Smith-Jentsch 2001]**. *Assertiveness* can be trained and the need is also recognized in the health-care community (*e.g.* **[Baker et al. 2006; Lyndon 2006]**).

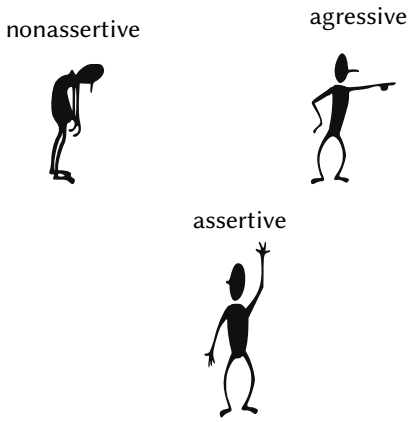

Figure 3.2 – *Communication style: assertive behavior* **[Pennell 2002]**

Assertiveness training was first introduced by Andrew Salter **[Salter 1949]** and popularized by Joseph Wolpe **[Wolpe 1958]**. It contains various aspects like:

- ▷ Dealing with delegate's feelings
- ▷ Setting boundaries for others
- ▷ Presenting clear messages
- ▷ Closing conversations
- ▷ Gaining increased confidence
- ▷ Handling difficult people and situations
- ▷ Practicing the art of saying No

Teaching practitioners how to *speak up* and create an environment in which they can express concerns is an important method to enhance patient safety and ensure the quality of the process.

3.2.3 Structuring the process to ensure information exchange

As seen in our field study, there is no standardized method of conducting the MDM currently. Patient case discussions can sometimes be rapid and highly pressured.

It is conceivable that standardizing the process might improve the decision-making by ensuring minimum requirements for the presentation of information and the participation of team members in the discussion. **Checklists** are tools that can be used in complex, high-intensity fields of work to improve safety and accuracy of service delivery **[Lamb et al. 2011b]**.

checklists

[Lamb et al. 2011b] developed a checklist which could be easily used at the meetings: "Teams may benefit from integrating the checklist with current MDT structures, such as electronic patient records, to ensure that clinical decision-making is comprehensive and patient centered across the whole care pathway". Parts of the checklist are information boxes like lists of contributing medical disciplines or final decisions, which need to be completed. In general, checklists are designed to standardize certain baseline functions. A checklist can be designed to serve as an orientation tool and to guarantee a standard procedure.

Each decision-making process should end with an evaluation phase. An evaluation system should provide feedback on how well the decision is being implemented, what the results are, and what adjustments are necessary to get the results that were intended when the solution was chosen. This can easily be done by monitoring concordance between MDM treatment decisions and final treatment implementation **[Blazeby et al. 2006]**. Decisions made at MDMs are not always implemented, nor are they documented consistently. The most common reason for a decision being changed after the meeting is new information (*e.g.* co-morbid health-status) or patient wishes/preferences which were not available before.

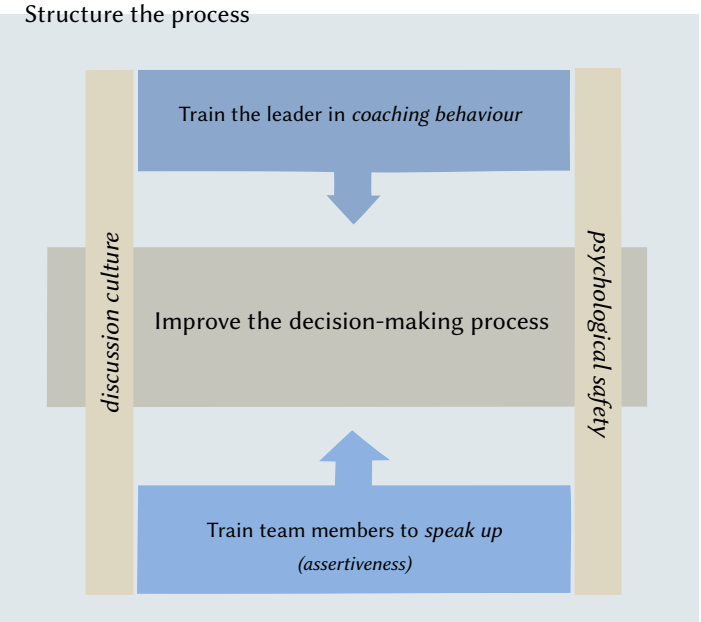

Figure 3.3 – *Implications of the study*

Bibliography

Baker, D. P., Day, R., and Salas, E. (2006). Teamwork as an essential component of high-reliability organizations. *Health Services Research*, 41(4p2):1576–1598. DOI: 10.1111/j.1475-6773.2006.00566.x.

Blazeby, J. M., Wilson, L., Metcalfe, C., Nicklin, J., English, R., and Donovan, J. L. (2006). Analysis of clinical decision-making in multi-disciplinary cancer teams. *Annals of Oncology*, 17(3):457–460. DOI: 10.1093/annonc/mdj102.

Bortz, J. and Döring, N. (2002). *Forschungsmethoden und Evaluation für Human- und Sozialwissenschaftler*. Springer-Verlag. ISBN: 978-3540419402, 827 pages.

Byron, L. and Wattenberg, M. (2008). Stacked graphs — geometry & aesthetics. *IEEE Transactions on Visualization and Computer Graphics*, 14(6):1245–1252. DOI: 10.1109/TVCG.2008.166.

Edmondson, A. C. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly*, 44(2):350–383. DOI: 10.2307/2666999.

Edmondson, A. C. (2003). Speaking up in the operating room: How team leaders promote learning in interdisciplinary action teams. *Journal of Management Studies*, 40(6):1419–1452. DOI: 10.1111/1467-6486.00386.

Fleissig, A., Jenkins, V., Catt, S., and Fallowfield, L. (2006). Multidisciplinary teams in cancer care: are they effective in the UK? *Lancet Oncology*, 7(11):935–943.

Flin, R., Winter, J., Sarak, C., and Raduma, M. (2009). Human factors in patient safety: Review of topics and tools. Technical report, World Health Organization. Available at http://www.who.int/entity/patientsafety/research/methods_measures/human_factors/human_factors_review.pdf.

Forrest, L. M., McMillan, D. C., McArdle, C. S., and Dunlop, D. J. (2005). An evaluation of the impact of a multidisciplinary team, in a single centre, on treatment and survival in patients with inoperable non-small-cell lung cancer. *British Journal of Cancer*, 93(9):977–978. DOI: 10.1038/sj.bjc.6602825.

Hansson, S. O. (1996). Decision making under great uncertainty. *Philosophy of the Social Sciences*, 26(3):369–386. DOI: 10.1177/004839319602600304.

Haward, R., Amir, Z., Borrill, C., Dawson, J., Scully, J., West, M., and Sainsbury, R. (2003). Breast cancer teams: the impact of constitution, new cancer workload, and methods of operation on their effectiveness. *British Journal of Cancer*, 89(1):15–22. DOI: 10.1038/sj.bjc.6601073.

Ho, D., Xiao, Y., Vaidya, V., and Hu, P. (2007). Communication and sense-making in intensive care: an observation study of multi-disciplinary rounds to design computerized supporting tools. *AMIA Annual Symposium Proceedings*, pages 329–333. Available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2655920/.

Jentsch, F. and Smith-Jentsch, K. A. (2001). Chapter *Assertiveness and team performance: More than "just say no"* in *Improving Teamwork in Organizations: Applications of Resource Management Training* (Salas, E., Bowers, C., and Edens, E., Ed.). CRC Press. ISBN: 978-0805828443.

Kee, F., Owen, T., and Leathem, R. (2004). Decision making in a multidisciplinary cancer team: Does team discussion result in better quality decisions? *Medical Decision Making*, 24(6):602–613. DOI: 10.1177/0272989X04271047.

Klein, G. (2003). *Intuition at work: Why Developing Your Gut Instincts Will Make You Better at What You Do*. Doubleday Business, New York. ISBN: 978-0385502887, 288 pages.

Lamb, B. W., Brown, K. F., Nagpal, K., Vincent, C., Green, J. S. A., and Sevdalis, N. (2011a). Quality of care management decisions by multidisciplinary cancer teams: A systematic review. *Annals of Surgical Oncology*, 18(8):2116–2125.

Lamb, B. W., Sevdalis, N., Vincent, C., and Green, J. S. A. (2012). Development and evaluation of a checklist to support decision making in multidisciplinary team meetings: MDT-QuIC. *Annals of Surgical Oncology*, 19(6):1759–1765. DOI: 10.1245/s10434-011-2187-0.

Lamb, B. W., Wong, H. W. L., Vincent, C., Green, J. S. A., and Sevdalis, N. (2011b). Teamwork and team performance in multidisciplinary cancer teams: development and evaluation of an observational assessment tool. *BMJ Quality and Safety*, 20(10):849–856. Available at http://dx.doi.org/10.1136/bmjqs.2010.048660, DOI: 10.1136/bmjqs.2010.048660.

Lipshitz, R. and Strauss, O. (1997). Coping with uncertainty: A naturalistic decision-making analysis. *Organizational Behavior and Human Decision Processes*, 69(2):149–163. DOI: 10.1006/obhd.1997.2679.

Lutterbach, J., Pagenstecher, A., Spreer, J., Hetzel, A., Velthoven, V. v., Nikkhah, G., Frommhold, H., Volk, B., Schumacher, M., Lücking, C., Zentner, J., and Ostertag, C. (2005). The brain tumor board: lessons to be learned from an interdisciplinary conference. *Onkologie*, 28(1):22–26. DOI: 10.1159/000082124.

Lyndon, A. (2006). Communication and teamwork in patient care: How much can we learn from aviation? *Journal of Obstetric, Gynecologic & Neonatal Nursing*, 35(4):538–546. DOI: 10.1111/j.1552-6909.2006.00074.x.

Marold, J., Wagner, R., Schöbel, M., and Manzey, D. (2012). Decision-making in groups under uncertainty. Cahiers de la Sécurité Industrielle 2012-05, Fondation pour une Culture de Sécurité Industrielle, Toulouse, France. Available at http://www.foncsi.org/.

Norrgren, F. and Schaller, J. (1999). Leadership style: Its impact on cross-functional product development. *Journal of Product Innovation Management*, 16(4):377–384. DOI: 10.1111/1540-5885.1640377.

Patkar, V., Acosta, D., Davidson, T., Jones, A., Fox, J., and Keshtgar, M. (2011). Cancer multidisciplinary team meetings: Evidence, challenges, and the role of clinical decision support technology. *International Journal of Breast Cancer*. DOI: 10.4061/2011/831605.

Pennell, R. L. (2002). *Speak Up! Guide*. Steps Toward Independence and Responsibility and Shifting the Power.

Salter, A. (1949). *Conditioned Reflex Therapy: the Direct Approach to the Reconstruction of Personality*. New York Creative Age Press.

Tattersall, M. H. N. (2006). Multidisciplinary team meetings: where is the value? *The Lancet Oncology*, 7(11):886–888.

Tversky, A. and Kahneman, D. (1974). Judgment under uncertainty: heuristics and biases. *Science*, 185:1124–1131. DOI: 10.1126/science.185.4157.1124.

Wolpe, J. (1958). *Psychotherapy by Reciprocal Inhibition*. Stanford University Press. ISBN: 978-0804705097, 254 pages.

Wright, F. C., Vito, C. D., Langer, B., and Hunter, A. (2007). Multidisciplinary cancer conferences: A systematic review and development of practice standards. *European Journal of Cancer*, 43(6):1002–1010.

You can save these bibliographic entries in BibTeX format by clicking on the paper clip icon to the left.

Reproducing this document

You can download this document, and others in the *Cahiers de la Sécurité Industrielle* collection, from FonCSI's web site. Documents are available in PDF, EPUB (for tablets and e-readers) and MOBI (for Kindle e-readers). Paper versions can be ordered online from a print-on-demand service.

Foundation for an Industrial Safety Culture
a public interest research foundation
http://www.FonCSI.org/

6 allée Émile Monso – BP 34038
31029 Toulouse cedex 4
France

Telephone: +33 534 32 32 00
Twitter: @TheFonCSI
Email: contact@FonCSI.org

ISSN 2100-3874

6 allée Émile Monso
ZAC du Palays - BP 34038
31029 Toulouse cedex 4

www.foncsi.org