



# New Horizons in Teaching Decision Making in Complex and Dynamic Work Fields?

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## General problems in Decision Making

1. DM can be difficult simply because of the complexity of the matter
2. Increases in choice options make for poorer decisions or failure to decide at all (paradox of choice)
3. Social DM can mean competing decision makers
4. Traps in acting under time pressure
  - Tendency to act too fast and too spontaneous
  - Underestimate risks and dangers
  - Subscribe to hypotheses or results too fast, which have proven to be helpful in similar situations
  - Urge to give in too quickly after problem diagnosis and merely search for confirmation
  - Neglecting changes of the situation
5. And so on ...

# What is Decision Making?

... Rational or irrational reasoning process: to significant degree dependent on personal styles (Myers-Briggs Type Indicator)

- Thinking and feeling
- Judgment and perception
- Extroversion and introversion
- Sensing and intuition

Furthermore, biases influence DM process

- Confirmation bias (selectivity in search for evidence)
- Premature termination of search and selective perception
- Inertia, recency, anchoring and repetition bias
- Group think and social pressure or influence
- Optimism bias (wishful thinking)

## Thus, need for decisional structuration?

1. Goal definition including partial goals, prioritization
2. Information management: gaining, structuring and judging information
3. Model definition: overview, critical points, prognoses
4. Forming shared mental models
5. Planning: steps, alternatives, distribution of tasks, safety buffers, connection points
6. Decision
7. Control
8. Self reflection

Does that necessarily lead to usage of mental checklists?

- DODAR
- DECIDE
- FOR DEC
  1. Facts
  2. Options
  3. Risks and benefits
  4. Decision
  5. Execution
  6. Check



Another aspect: decisions under  
time constraint

## Recognition Primed Decisions (RPD)

Operators make quick decisions – normally effective – when faced with complex, dynamic and risky situations

1. Generation of possible course of action
2. Comparison with specifics of situation
3. Selection of first course of action that is not rejected

Prone to failure in unknown or misinterpreted situations

Thus, difference in being experienced or not is a big factor

- Experienced: quicker decision, because situation might be known; with higher stakes or increased ambiguities intuition is used!
- Inexperienced: cycle through different options and tend to use first suitable option



# Impact of Naturalistic Decision Making

## What is it?

NDM is about how experts (later: novices) make decisions in real world situations (often characterized by uncertainty, time constraint, risks, multiple and changing goals) → done as LOSA or simulator mission debriefings!

Aim: understand cognitive work as it is performed in complex, risky and dynamic socio-technical systems.

DM is not considered a gamble any more; research shows no option list or utility analysis are done:

- Decisions often are high stakes decision with time pressure and more than one plausible option

## Microcognition vs macrocognition

### Discrimination of microcognition vs macrocognition

- Reductionism vs phenomenology of cognitive work
- Experimentalism vs naturalism
- Formalism vs functionalism

NDM expands focus from mere DM to cognitive functionalities, e.g. sense making, planning, mental modelling, reconsidering etc.

- Microcognition was widely rejected
- Macrocognition seemed to be topic of choice, since...

...Macrocognitive functions are unlikely to emerge in lab setting experiments.

Both are complementary: macrocognition provides observation and models while microcognition provides testing and formalisation.



# Pilots as Expected Value Decision Maker

## Safety Culture

- Tried and tested over decades
- Major aspect is the decisional freedom of competent operators
  - Can be plotted by audits (e.g. organisational - Air Safety Audit, individual - LOSA)
- Time critical decisions under stress with thus limited judgmental ability
  1. Pilots should not be regarded as being stimulus-response machines, merely running down procedures (competence erosion)
  2. Is influenced by learning about success in following or disregarding rules, company policies and publications, training as well as social interactions, especially with instructors

## Expected Value Decision Makers

- Decision makers decide according to highest priority of the choices: directly connected to expectations about the Expected Value
  1. Gamblers
  2. Expected Value Decision Makers (EVDMeRS)
  3. Conservative decision makers

Pilots as managers and especially responsible for the economic outcome of an operation have to make decisions, taking into consideration the effective expected outcome!

- EVDMeRS decide to gain highest effective Expected Value (product of probability of occurrence and real value of the choice)
  - Risks will be denied if they are perceived as being unlikely to occur, even if probable outcome might be catastrophic!

## The backside of Expected Value-based decisions

- Man is unable to intuitively grasp the overall dimensions of a case
- That, in turn, makes Expected Value always look more favourable, because it can always be understood intuitively
- At this point it should become clear, why a company has to implement rules which excludes subjective risk assessment in such dynamic and complex moments
- “Losses loom larger than gains”: subjective estimations are influenced by mentioned biases and own knowledge base (see: subjective risk assessment vs evidence based risk management)

## What to do about decisions based on Expected Value

- Relevance of effective Expected Value for the operator has to be reduced: make it possible to opt for risk-minimizing procedure instead of expected outcome
- Reconsider company policies: Individual considers choice for Expected Value that is in tune with company culture, rather than merely follow rules specified in OMs
  - Even more, the more competent the individual is

# Groups: more knowledge = better decisions?

## Manifest Profiles vs Hidden Profiles

1. Shared vs unshared vs partially shared knowledge
2. Premature consensus: sharing of individual preferences
3. Asymmetric discussion / exchange of information:
  - More shared, than unshared information will be exchanged
  - More information of own preference is shared
4. Asymmetric judgement of information
  - Information seem more reliable the more persons know them
  - Information seem more unreliable the more they contradict own preferences



# Emotions in Decision Making

## Emotions are an additional source for informations

EVDMeMers usually weigh severity and likelihood of possible outcomes of different alternatives. This approach ignores emotional influences.

- Anticipatory emotions (immediate states: fear, anxiety)
- Anticipated emotions (future experiences: disappointment)
- Anticipated pleasure is taken into account as additional source of information
- Processes will be more effective when tasks are important, meaningful or interesting to DMeM
- Positive affect widens the scope and grants a more favourable social climate



What can be the conclusion?

## What should be done?

- Teach solid basics of Risk Evaluation and Decision Making to make operators aware of possibly problematic areas
- Use appropriate Mental Models

# Fly the A/C

Interest: (personal) relevance



FIT

FOR

DEC

CANNED DECISIONS

**Not time critical**  
aim for **best** solution

Facts								
Options	→	O <sub>1</sub>	→	O <sub>2</sub>	→	O <sub>3</sub>	→	O <sub>4</sub>
Risks/Benefits								
Essential Criteriae, e.g.: RWY, W/X, ILS	a	-	+	+	+	+	+	+
	b	+	+	+	+	+	-	-
	c	-	+	+	+	+	+	+
Additional Criteriae, e.g. Maintenance, PAX handling	d	-	-	+	+	+	+	+
	e	-	+	+	+	+	-	-

Decision  
Execution  
Check

**Time critical**  
aim for **first suitable** option

Facts				
Options	→	O <sub>1</sub>	→	O <sub>2</sub>
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Essential Criteriae, e.g.: RWY, W/X, ILS	a	-	+	+
	b	+	+	+
	c	-	+	+

Decision  
Execution  
Check

## What should be done?

- Teach solid basics of Risk Evaluation and Decision Making to make operators aware of possibly problematic areas
- Use appropriate Mental Models
- Which form of automation management: by consent or by exception?
- Include emotions into development of Mental Models
- Determine, who can accomplish what at which time
- Be aware of probable biases
- Use procedures as basic of decision making process, but determine, when over-proceduralisation is about to begin
- Include known aspects of RPD into development of procedures
- Be aware of EVDM in DM process and cover it in procedures
- Include known aspects of NDM into development of work
- Determine group processes, anticipate intercultural constraints and trans-social difficulties and train countermeasures



... opting for the creative decision maker.