



Contingency Effects on Event-driven Collaborative Decision-making

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ICCRTS

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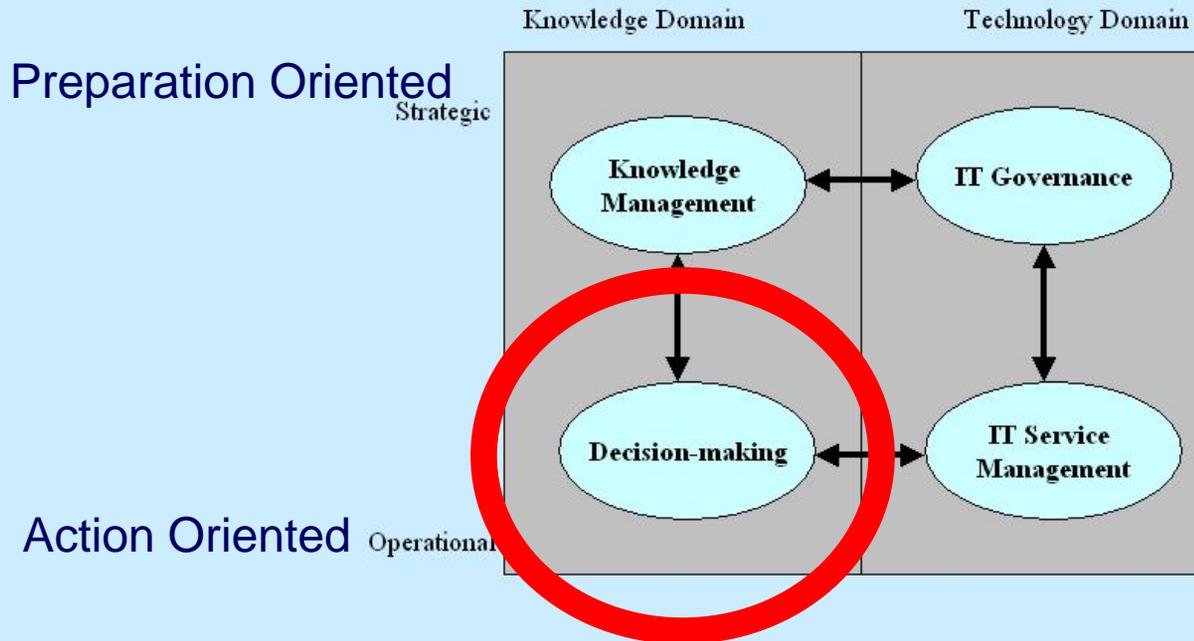


Outline

- Background – the broader research task
- Concepts and theory
- The research model, propositions and experimental design
- Outcomes
- Limitations and future research

Background

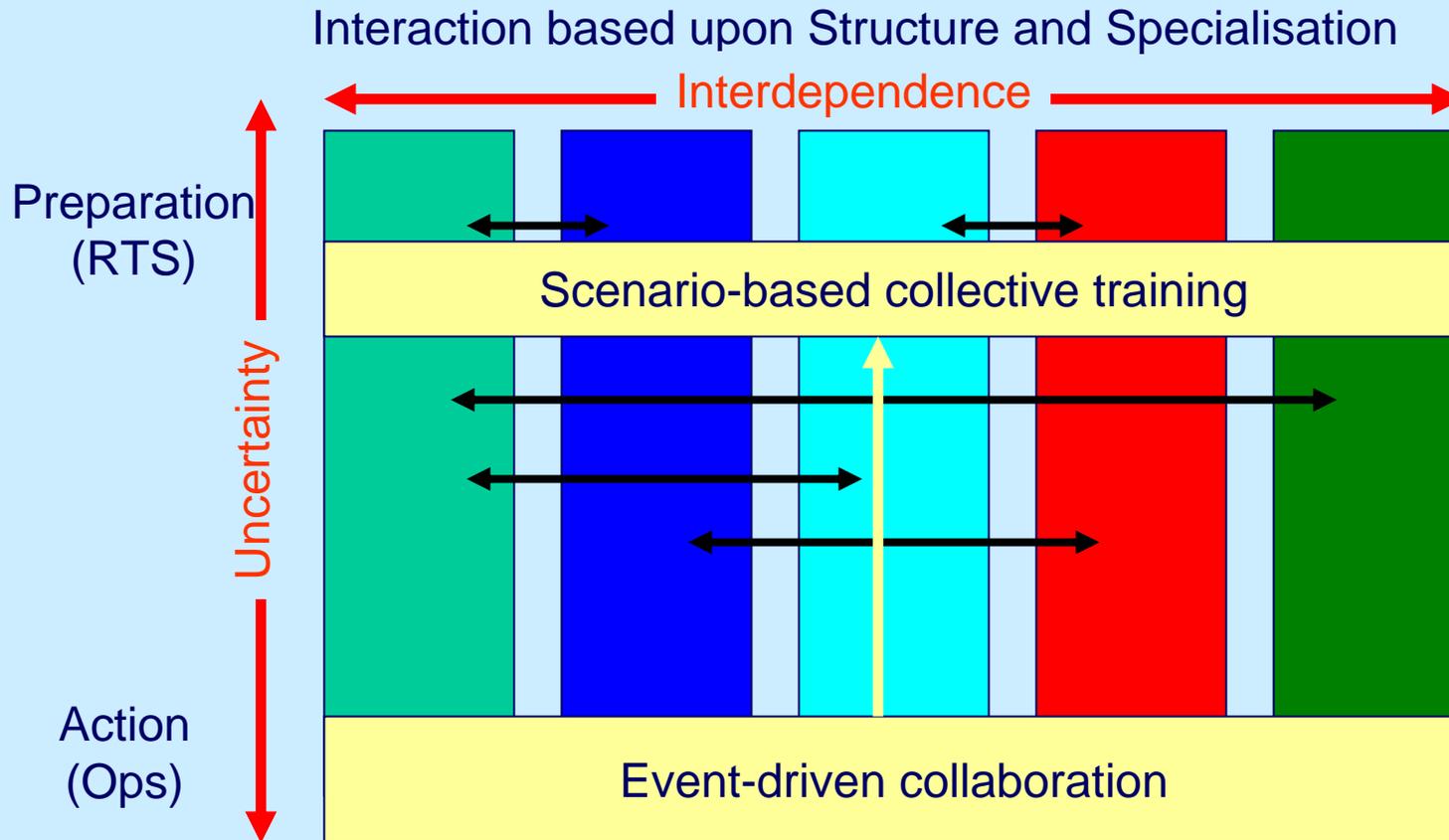
- Research into balance of diversity and commonality in organisations



Relevance of Organisational Theorists

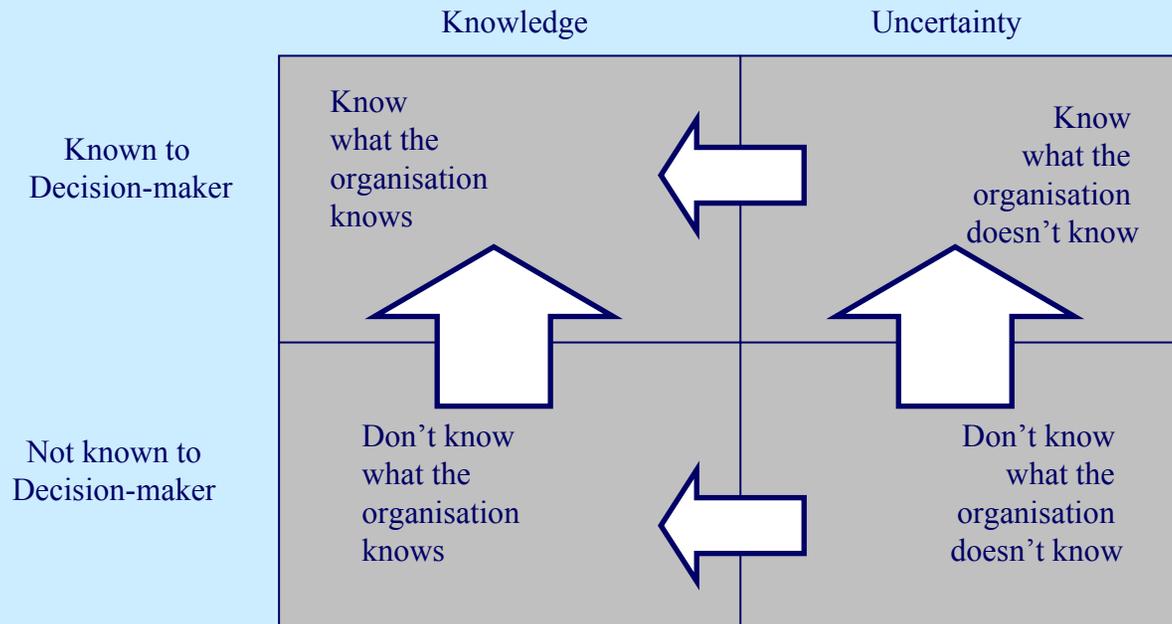
- Dynamic conditions → high task uncertainty → organic arrangements (Burns and Stalker, 1961)
- Misalignment of environment and structure → increased task interdependence → lateral coordination mechanisms (Thompson, 1967; Galbraith, 1973)
- Diverse organisations → balance of differentiation (for requisite variety) and integration (Lawrence and Lorsch, 1967)
- Collaborative decision making within virtual groups as an integrative mechanism

A Net-centric view of decision-making



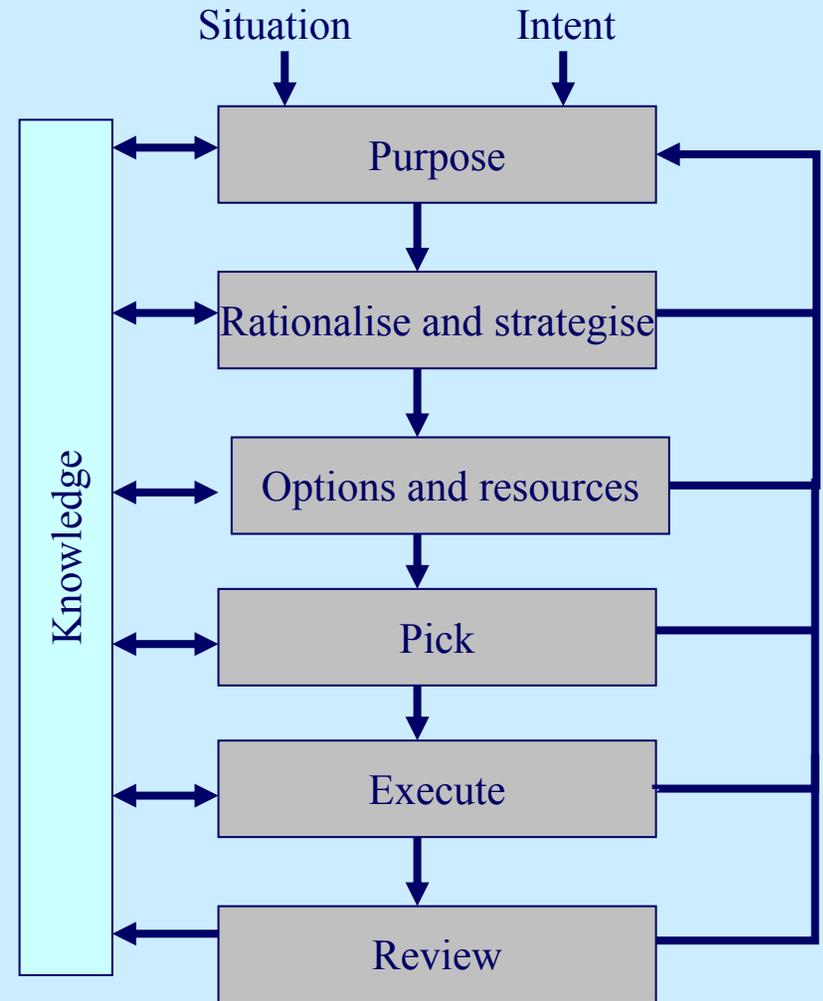
Collaborative Decision-making

- Decision-making effort is optimised on the principle of least action (Zipf, 1949; Payne et al, 1993; Simon, 1957)
- Depth and breadth of search effort related to task uncertainty and interdependence respectively
- Dispersion of knowledge is itself a source of uncertainty (Becker, 2001)
- Uncertainty can be reduced through collaborative search and input to decisions

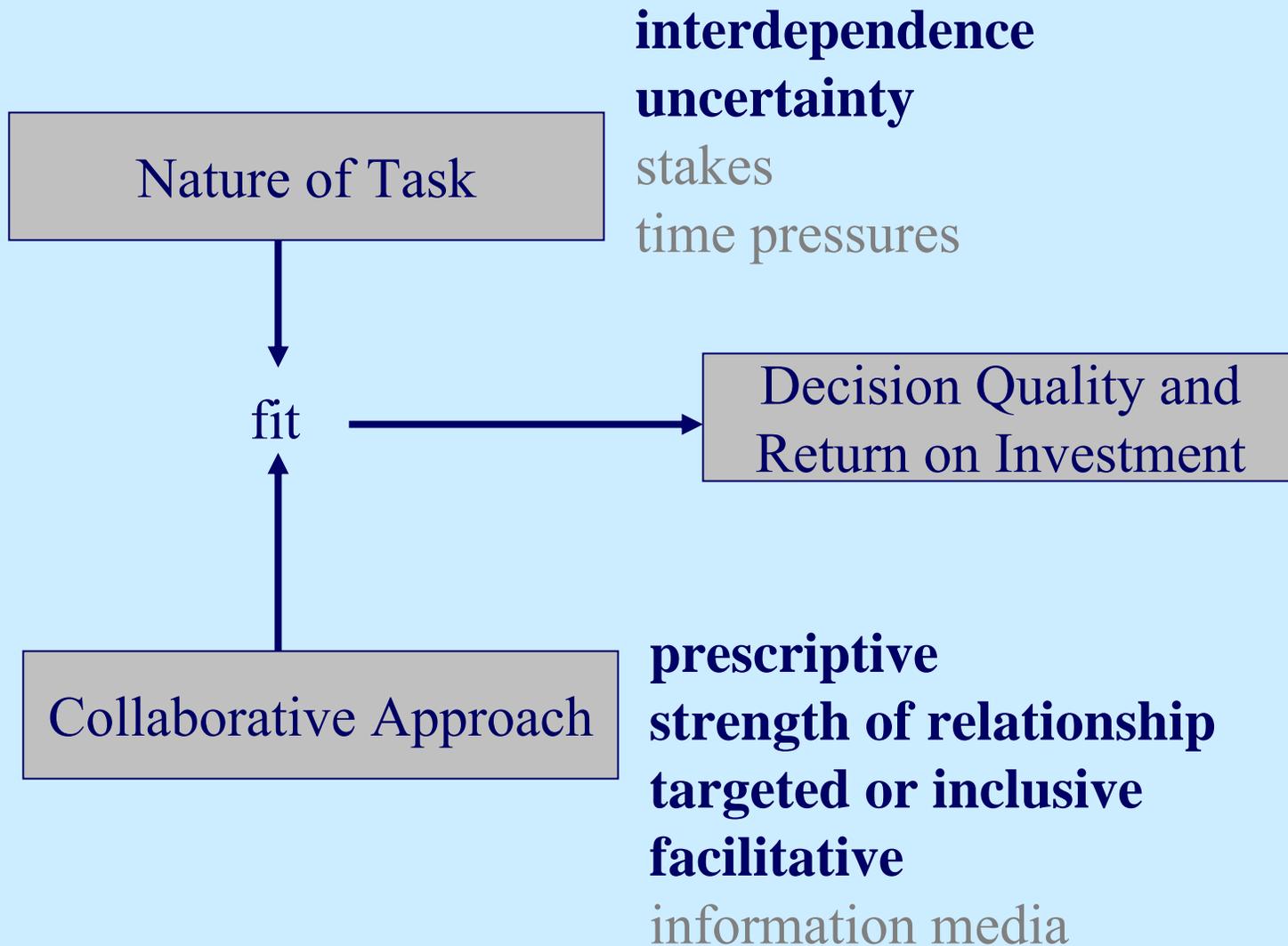


Collaborative Decision Process

- Key elements: situation, intent and knowledge
- Modified POWER framework used to prescribe collaborative processes (PROPER)
- Participative roles can be further developed (see paper)



Collaborative Decision Model



Research Propositions

- P1 Use of a prescribed approach to collaborative decision-making is positively associated with the quality of decisions
- P2 The derived value of collaborative decision-making is positively associated with the complexity of the problem
- P3 Decision-making return on investment is optimised with targeted collaboration
- P4 The level of innovation in problem solving is positively associated with the level of collaborative participation
- P5 The derived value of collaborative decision-making is positively associated with the strength of relationship between the participants

Experimental Design

- Independent variables:
 - nature of collaboration: assigned to participants
 - task complexity (uncertainty and interdependence): varied across experiment
- Scenarios, participants selected to minimise nuisance variables
- Collaborative forms and communications facilities designed using Groove.
- 8 sessions, 60 participants, 96 decision events
- 3 concurrent decision-makers and multiple collaborative participants.
- Decision performance scored blind to the nature of collaboration, then results analysed

Issues

Update Save and Create Another Revert Cancel Print

PROPER Immediate Planning Tool

Round:

1

ID:

AD0E-C46DF5A34

SECTOR

ALPHA

Entered by

Andrew Dowse/Contoso

Title*

JAMMING

Mission: To secure this sector of space, maintaining operational continuity of space operations and defeating any space-based threats to the interests of the federation.

Situation

The I9 multi-spectral intelligence satellite in this sector is being jammed by advanced optical countermeasures, significantly affecting the performance of collection but not causing any damage. The source of the jamming appears to be from within the territory of a non-aligned state. The jamming is reducing the situational awareness of naval units operating in international waters near the state.

PRO PEr

Purpose

To secure alpha sector of space by providing correct intelligence of possible threats. A satellite is being jammed but not damaged. We must find a solution which will ensure that information can be gathered effectively to regain security of alpha section.

Rationalise

Recognised task with some variation +

Strategise

Known options, collaboration needed +

Options

- Option 1 Neutralise source of jamming via non leathal methods
- Option 2 neutralise source of jamming using leathal methods
- Option 3 shut down satellite, develop progam to evade jamming and shift orbit of satellite
- Option 4 leave satellite as is, and utilise another to serve as spy satellite in new area
- Option 5

Last Modified By COMDAAlpha/Contoso

Current View: All

Workspace Members

- In Workspace
- Andrew Dowse/Cont...
- A Dowse/Contoso
- COMDAAlpha/Contoso
- LegalInt/Contoso
- SciTech/Contoso
- StratStrike/Contoso
- TerrCom/Contoso
- Online
- Offline
- Invite to Workspace: More
- Enter name or email- Go

Chat 2

yeah.blow it up!

TerrCom/Contoso: 24/08/06 16:04

terr command requires you to keep operating, so recommend either options 1 or 2

COMDAAlpha/Contoso: 24/08/06 16:04

one whould be politically correct ?

StratStrike/Contoso: 24/08/06 16:05

we can take out the target if legally justified and if we get the coordinates

LegalInt/Contoso: 24/08/06 16:05

interference of to intel info isnt acceptable, so do anything possible

COMDAAlpha/Contoso: 24/08/06 16:05

ok, int how about it?

LegalInt/Contoso: 24/08/06 16:05

read last

COMDAAlpha/Contoso: 24/08/06 16:05

so were destroying it.)

COMDAAlpha/Contoso: 24/08/06 16:05

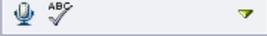
hang on, im updating

COMDAAlpha/Contoso: 24/08/06 16:06

what about op 4?

COMDAAlpha/Contoso: 24/08/06 16:06

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Common Tasks

About Issue Tracking

Issues 7

Discussion



Issues

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PRO PEr

Pick Option

Option 2

Execute

Task Status

Execute

Assigned to:

Sector Alpha

Final Remarks:

Source of jamming is considered hostile, so is a legitimate target

Last Modified By

COMDAIpha/Contoso

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- Enter name or email- Go

Chat 2

24/08/06 16:03 jamming task

COMDAIpha/Contoso: 24/08/06 16:03 ok what do ya htink?

COMDAIpha/Contoso: 24/08/06 16:03 *think

COMDAIpha/Contoso: 24/08/06 16:03 maybe another option?

LegalInt/Contoso: 24/08/06 16:04 no, RDE states non leathal first

SciTech/Contoso: 24/08/06 16:04 with the jamming, we may need to remove the source

COMDAIpha/Contoso: 24/08/06 16:04 yeah.blow it up!

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-Type here- Go

Current View: All

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Issues 7

Discussion

Common Tasks

Issues

Update Save and Create Another Revert Cancel Print

Immediate Planning Tool

Round: 3
ID: AD0E-C46EA3B6B

SECTOR: TANGO

Entered by: Andrew Dowse/Contoso

Title: SOLAR STORM

Mission: To secure this sector of space, maintaining operational continuity of space operations and defeating any space-based threats to the interests of the federation.

Situation
Solar flare activity appears to herald a significant solar storm, expected to reach Earth tonight. The orientation of its magnetic field will not be known until the storm hits, however the proton barrage is likely to cause disruption and possibly damage to communications satellites.

Plan Decide and Execute

Purpose
Prevent destruction of satellites.

Last Modified By: COMDTango/Contoso

Workspace Members

- In Workspace
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- COMDTango/Contoso
- LegalInt/Contoso
- SciTech/Contoso
- StratStrike/Contoso
- TerrCom/Contoso

Online Offline
Invite to Workspace: More
-Enter name or email- Go

Chat 7

TerrCom/Contoso: 29/08/06 13:54
Problem 4:TerCOMD can retrieve the nuclear payload of the satellite if it strikes land, if it hits the sea no action is required

SciTech/Contoso: 29/08/06 13:56
The best solution for problem 3 is to safeguard against damage by switching the satellites into standby mode. The storm will last a couple of days but main damage will be done in the initial window of a 2-3 hours. The storm is more likely to effect space systems than systems on earth.

LegalInt/Contoso: 29/08/06 13:56
our intel suggests cosmos sat 998 is carrying a generator that uses a 30kg payload

TerrCom/Contoso: 29/08/06 13:58
shouldn't be a problem for us, chances are it will hit the ocean and we won't have to worry anyway

SciTech/Contoso: 29/08/06 13:58
Nuclear payloads over 50kg should not be allowed to enter the atmosphere.

-Type here- Go

Issues

Update Save and Create Another Revert Cancel Print

Revert to the previously saved field values for this record.

Immediate Planning Tool

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Plan Decide and Execute

Task Status: Execute Assigned to: Sector Tango

Decision:
Switch all satellites into stand by mode

Last Modified By: COMDTango/Contoso

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Common Tasks

P1 Prescriptive Decision Making

- Supported for average performance to a level of significance of 0.05 using the Mann-Whitney U test.
- Improved performance specifically in cases of **high uncertainty** and **low interdependence**.
- High uncertainty leads to requisite variety of options; benefit of prescription dependent upon cognitive ability of decision-maker
- Low interdependence – lack of compensating assistance from collaborators

P2 Value of Collaboration

- Strongly supported for task interdependence
- Not supported for task uncertainty, other than uncertainty resulting from dispersed knowledge (ie, interdependence)

P3 Decisions Optimised through Targeted Collaboration

- Targeted: IM; Inclusive: chat rooms (1 per DM)
- No support for improved decision performance for targeted, in fact partial support for the opposite
- Evidence of reduced effort invested into decisions in targeted approach
- IM favoured by participants, provided more control but restricted participation
- Other potential contingent factors, eg time pressure

P4 Collaboration and Innovation

- No support that collaboration enables innovation and creation of new knowledge
- Possible reasons:
 - Groupthink or realism/reactive limitation
 - Focus on satisficing rather than optimisation
 - Time pressures and event driven focus
 - Difficulty for participants in assimilating knowledge then venturing outside comfort zone

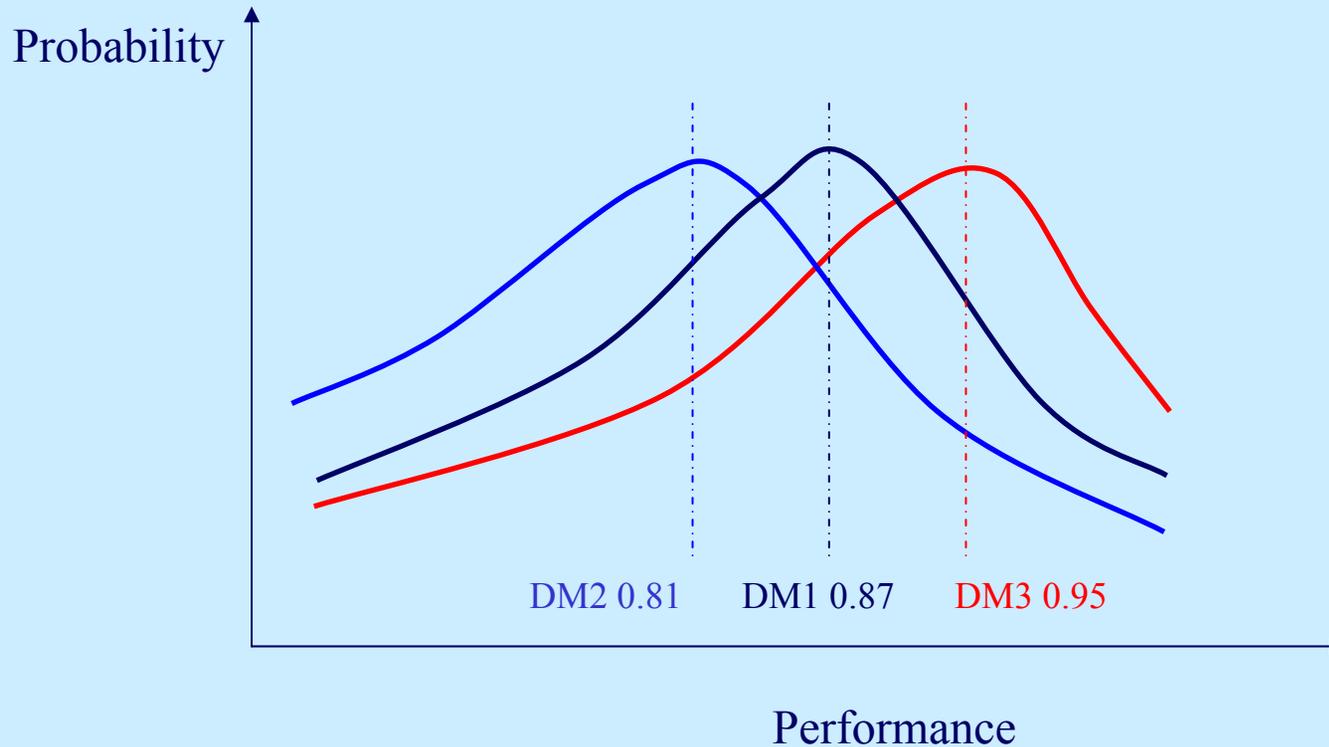
P5 Strength of Relationship

- Constructed through direction to support ‘favoured’ DM over control DM
- Probability of H_0 of 0.06
- Partial support suggests ad hoc collaborations may not be as effective as established relationships

Limitations

- Realism (not applicable to all decision situations)
- May not account for all contingent factors
- Reactivity (different approaches of participants)
- Potential internal validity issues with sample size and scoring method
- Individual cognitive variances

Variance of Individual Capabilities

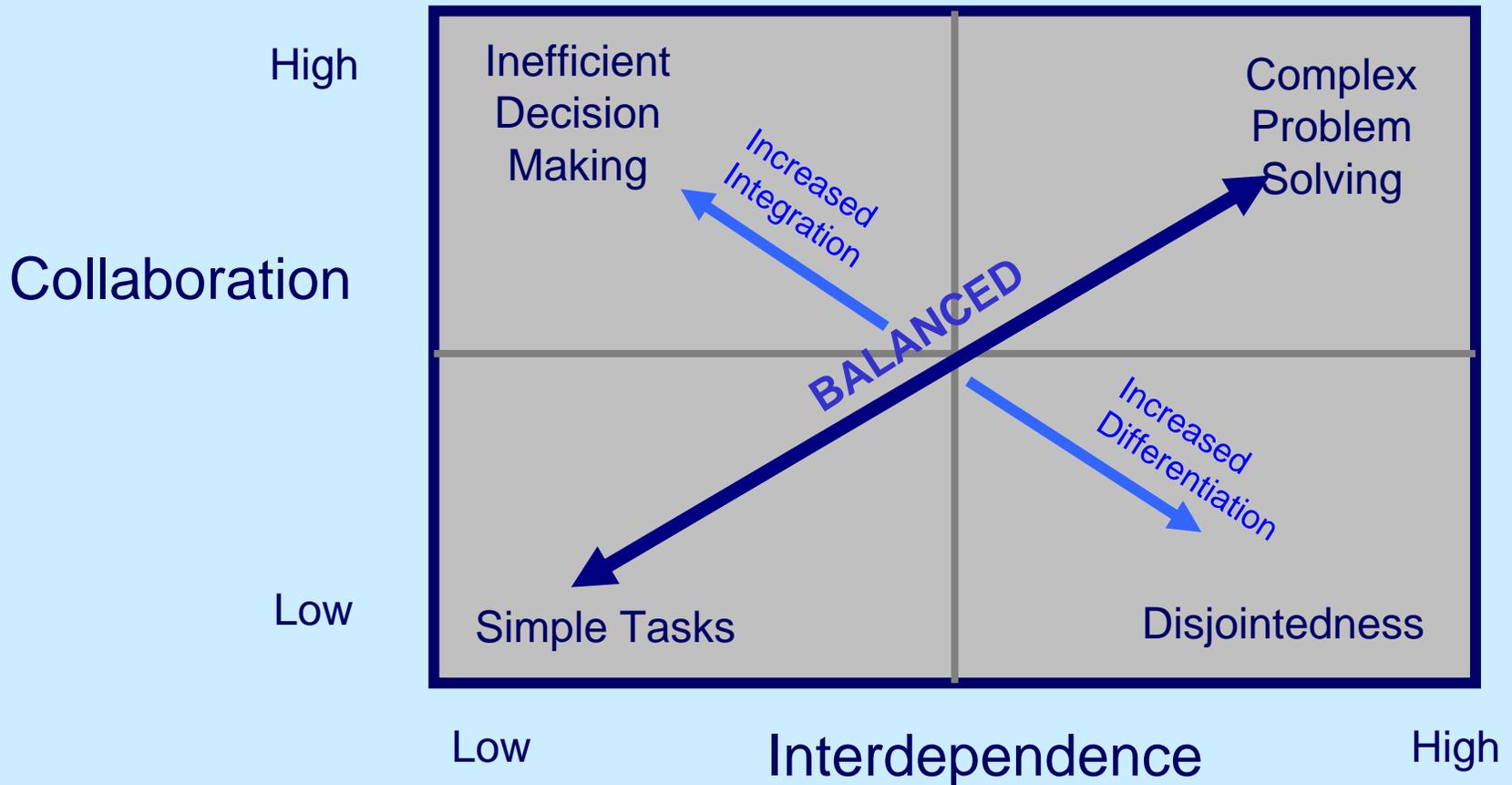


- DM1 Prescriptive, DM2 Natural, DM3 Favoured
- Friedman 2 way analysis: $P(H_0)$ of 0.07

Findings

- Strong support for value of collaboration contingent upon interdependence but not on uncertainty
- Partial support for a prescriptive approach to decision-making and for the effect of a good relationship between participants, but both subject to variances of individual abilities
- No support for collaboratively induced innovation
- Mixed results for targeted versus inclusive approaches.

Collaboration and Interdependence



Conclusion

- Demonstrated importance of electronic collaboration as an integrating mechanism in C2 decisions
- Support for prescription and inclusion of meta-planning step within the decision-making process
- Potential for future research
 - Targeted versus inclusive approaches in electronic collaboration
 - Expansion of electronic collaboration implications on C2 arrangements (eg, CAR dimensions)
 - Use of model for other decision-making applications
 - Exploration of participant relationships (game theory variation of the experiment)

Questions?

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