29ISMOR
Approaches for Vignette Based Analysis in a Changing World

Jenny Young & Alistair Morley

Operational Analysis, MBDA UK

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Contents

- Context
  - MBDA OA group and our operating environment
- What is a vignette?
  - Key components
  - How does a vignette differ from a scenario ?
- Usage of vignettes in MBDA
  - Why do we use them ?
  - What do we use them for ?
- Case Studies
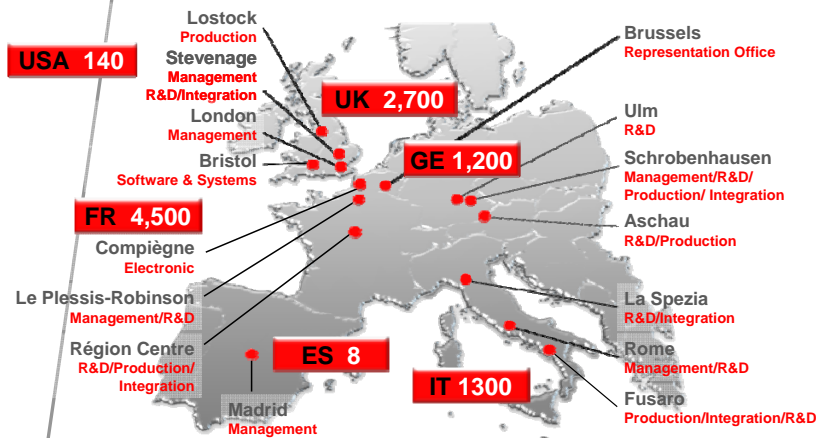- Decision Challenges & Lessons learned
- Summary

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MBDA Operational Analysis Group

- **12 Analysts based in UK**

- **Part of the Future Systems Directorate**
  - International Working
  - Focus on potential weapon system solutions for 2020+
  - Primarily concept and assessment phase activities

- **Typical Study Environment**
  - User & System Requirements are fluid
  - Different types of solution are possible
  - Solutions are immature
  - Limited data available
  - Limited time & resources

MBDA • European Centres of Excellence

10,000 people worldwide, 60% in Technical/Engineering functions

USA 140

Lostock
Production
Stevenage
Management
R&D/Integration
London
Management
Bristol
Software & Systems

UK 2,700

Brussels
Representation Office

Ulm
R&D

Schrobenhausen
Management/R&D/
Production/ Integration

GE 1,200

Aschau
R&D/Production

FR 4,500

Compiègne
Electronic

Le Plessis-Robinson
Management/R&D

Région Centre
R&D/Production/
Integration

ES 8

Madrid
Management

IT 1300

La Spezia
R&D/Integration

Rome
Management/R&D

Fusaro
Production/Integration/R&D

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Vignette*: Noun. Lit.* "little vine"

1. a small illustration placed at the beginning or end of a book or chapter
2. a short graceful literary essay or sketch
3. a photograph, drawing, etc, with edges that are shaded off
4. *architect* a carved ornamentation that has a design based upon tendrils, leaves, etc
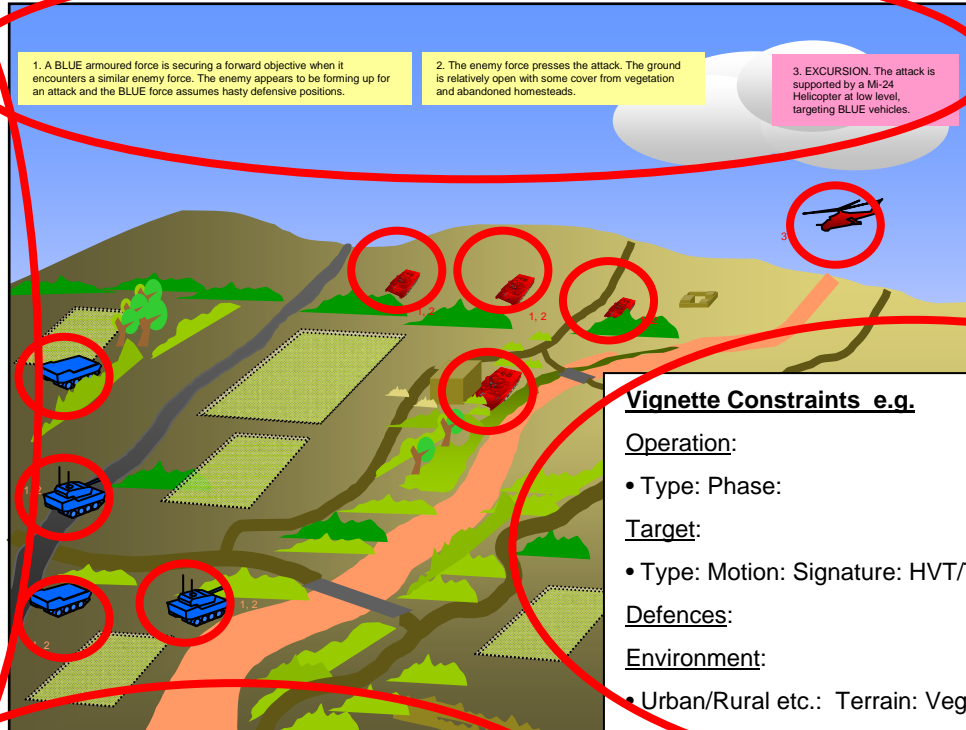5. any small endearing scene, view, picture, etc

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Vignette Key Components

1. Identity
2. Problem statement
3. Agents or Actors
4. Constraints
5. Additional Information

Vignette 4

Hasty defence against armour in rural

1. A BLUE armoured force is securing a forward objective when it encounters a similar enemy force. The enemy appears to be forming up for an attack and the BLUE force assumes hasty defensive positions.

2. The enemy force presses the attack. The ground is relatively open with some cover from vegetation and abandoned homesteads.

3. EXCURSION. The attack is supported by a Mi-24 Helicopter at low level, targeting BLUE vehicles.

Complete or Partial Solutions

Variations & Excursions

Vignette Constraints e.g.

Operation:

• Type: Phase:

Target:

• Type: Motion: Signature: HVT/TST: Effect / Kill Criteria:

Defences:

Environment:

• Urban/Rural etc.: Terrain: Vegetation: Time (Day/Night):

• Weather: Temperature: Altitude:

Op Environment:

• False Targets: CCD: Sensor Jamming: GPS Jamming: Comms Jamming: DL Jamming:

Targeting:

• Method: Accuracy: Endurance:

ROE:

Collateral Damage: Fratricide

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Vignettes vs. Scenarios (i)

- How does a vignette differ from a scenario?
- Some suggestions..
  - By taxonomic relation
    - A scenario (could) contain many vignettes
  - By detail
    - Far less information
    - De-situated context, usually lacking strategic context
    - Real-world geography less critical
  - By scale:
    - Smaller in time / duration
    - Smaller in space
    - Smaller in scale of forces involved (typically < sub-formation)
    - *But can be ranges >1,000km, timespan of days, and include dozens of platforms.*

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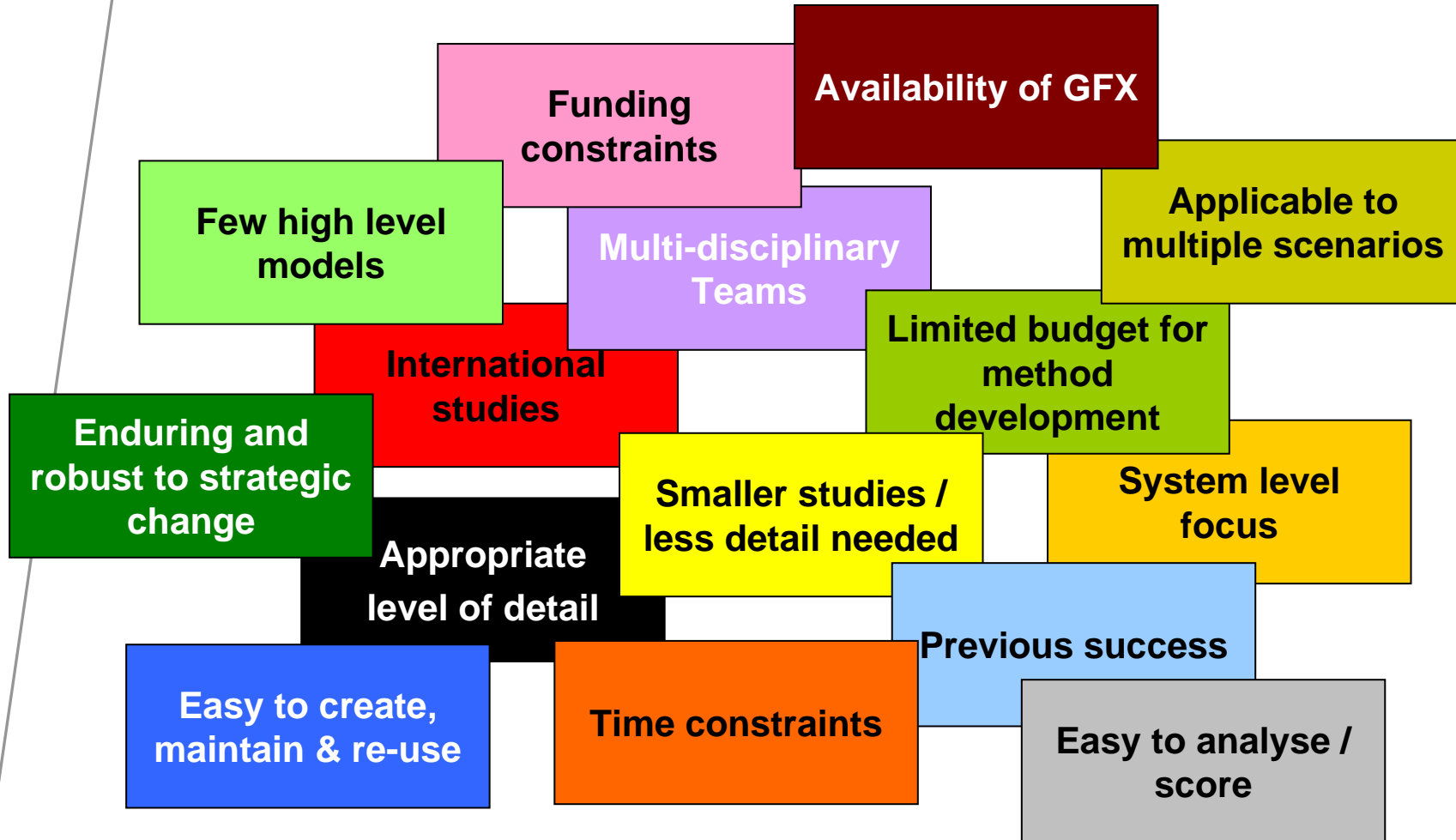
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Vignettes vs. scenarios (ii)

- How does a vignette differ from a scenario? (cont.)
  - By format
    - Typically richer in graphics and narrative, less quantitative.
  - By function
    - Often built for a specific analytical task (e.g. portfolio analysis)
    - ...and then adapted for other purposes - possibly *in addition to* scenario-like usage.
  - By user:
    - Accessible to non-specialists
    - Used outside the traditional analytical community
      - Problem of (false) familiarity!
  - By security classification:
    - Internationally shareable

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Why do we use Vignettes in MBDA ?

Funding constraints

Availability of GFX

Few high level models

Multi-disciplinary Teams

Applicable to multiple scenarios

International studies

Limited budget for method development

Enduring and robust to strategic change

Smaller studies / less detail needed

System level focus

Appropriate level of detail

Easy to create, maintain & re-use

Time constraints

Previous success

Easy to analyse / score

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What do we use Vignettes for ?

- Customer acquisition planning and Industrial portfolio planning
  - In lieu of requirements – represents the 'far' future

- Future Operational Requirements
  - Concurrency of requirements – 'real life' combinations
  - Shared awareness and understanding – International alignment of requirements
  - Context and illustration – for engineering team

- Support to weapon system concept development
  - Illustrate and develop outline CONEMP
  - System & sub-system level trade-offs and down-selection

- Force mix studies
  - Do weapon system options complement or duplicate capability ?
  - Competitor assessment & Win Themes

Emphasis: How to create a better product

- Stockpile planning

- Sales and Marketing

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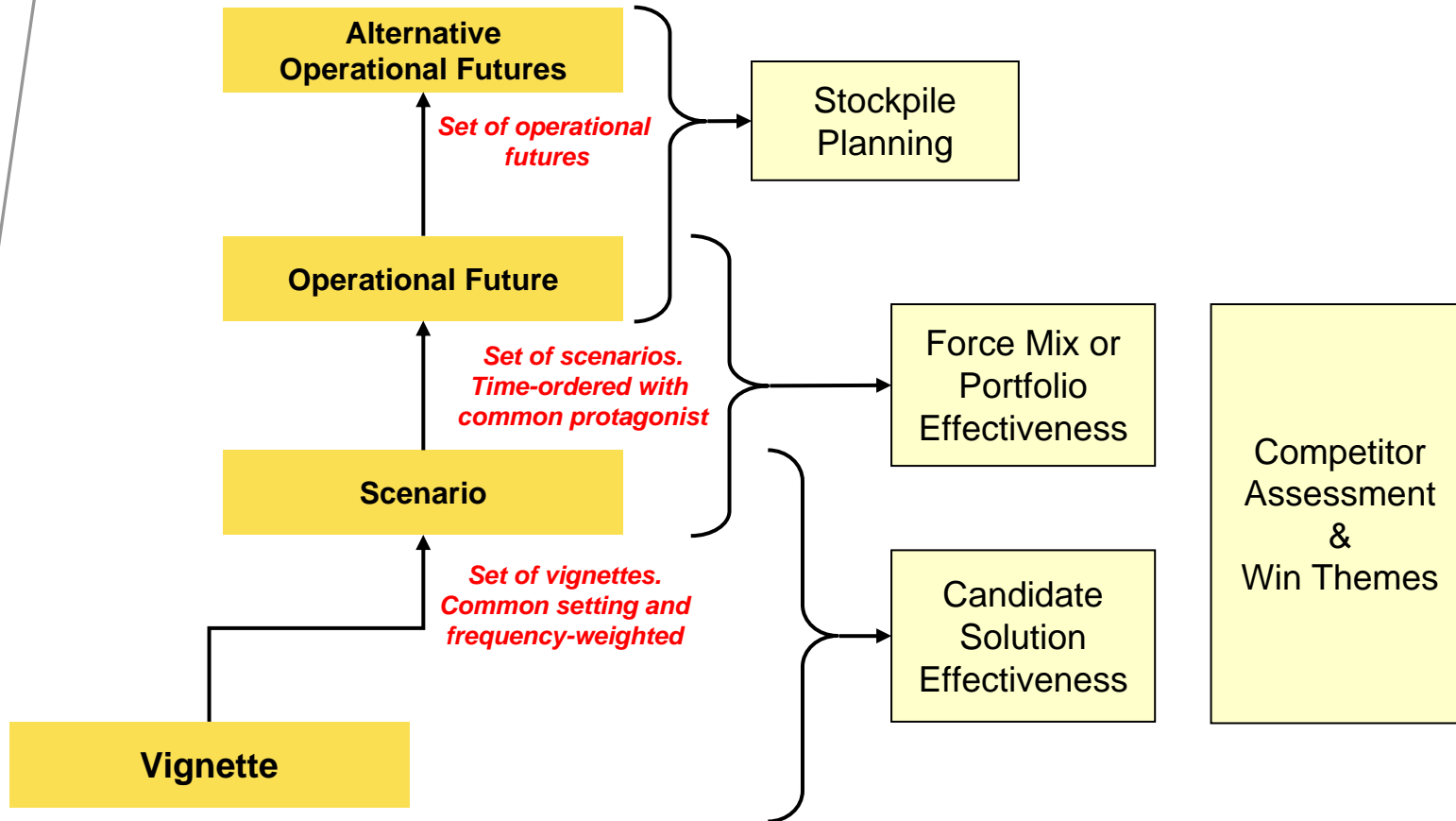# Representing the Solution

- Solution constraints will become more "specific" as studies progress through the project lifecycle.

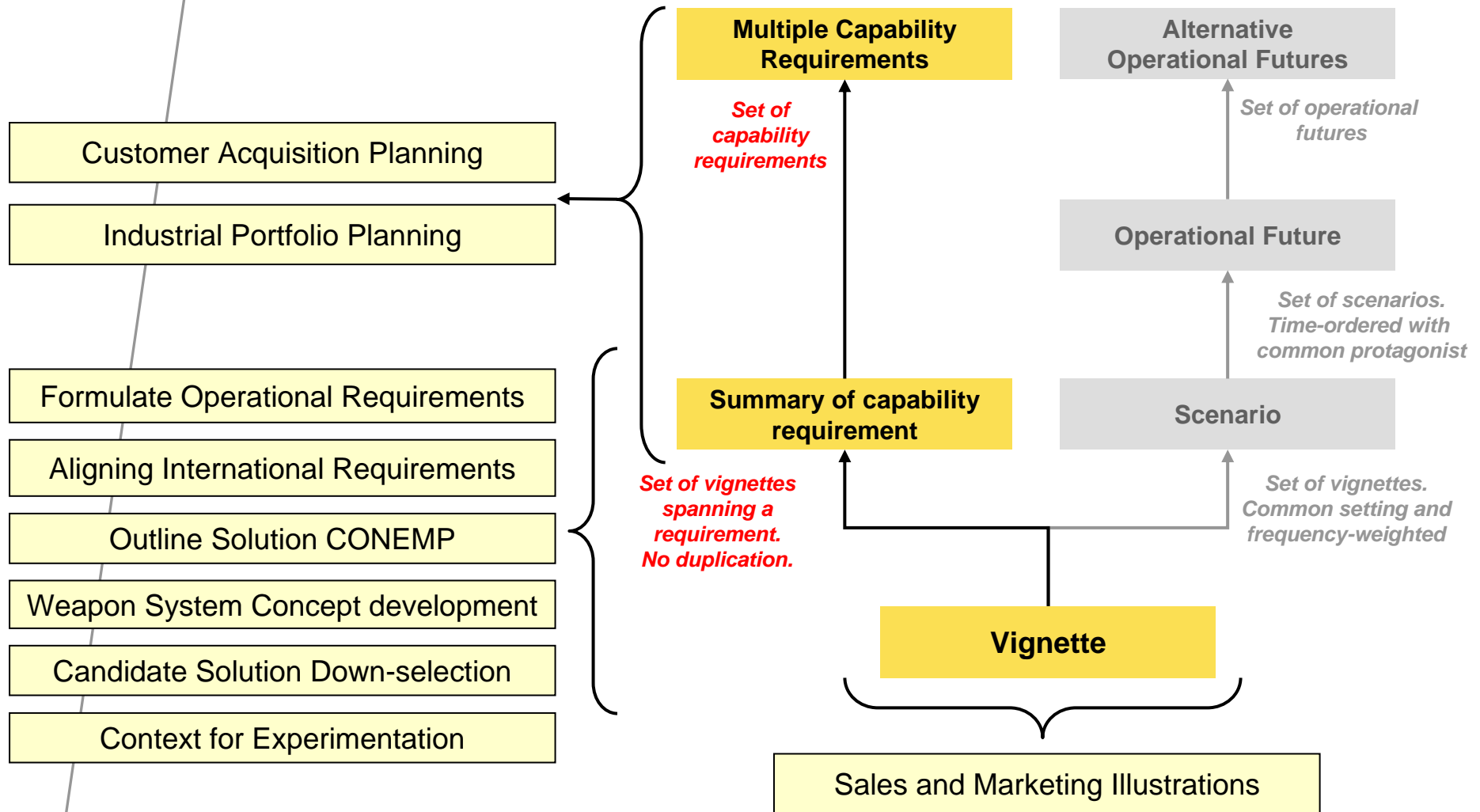Example Usage   Launch Platform

Project Lifecycle		Example Usage	Launch Platform
More solution specific		**Sales & Marketing illustration**	Specific FJ
		Candidate solution down-select	1 or 2 types of FJ
		Solution CONEMP	Any FJ
			Any Air Launched
Less solution specific		**Portfolio planning**	Any platform

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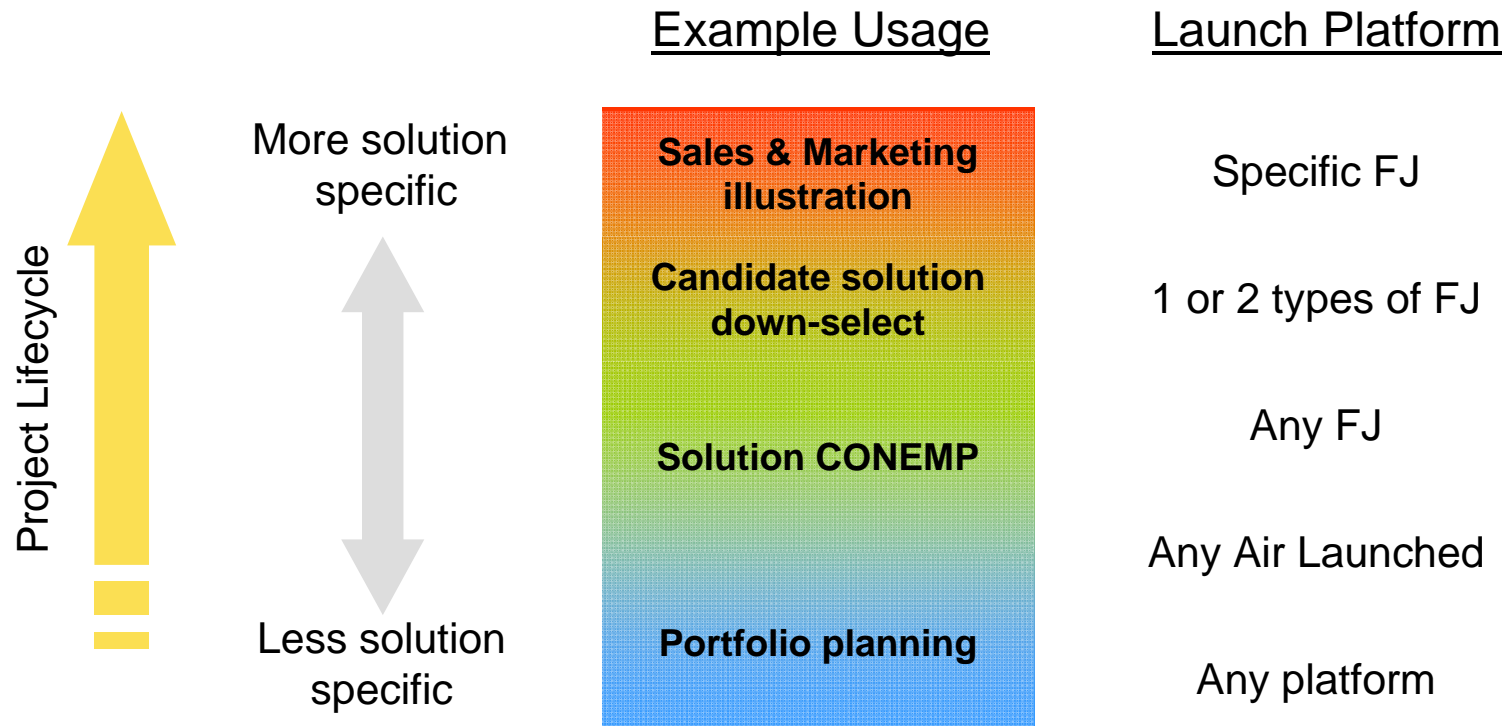
Vignettes as components of *a SCENARIO*

Alternative Operational Futures

Set of operational futures

Stockpile Planning

Operational Future

Set of scenarios. Time-ordered with common protagonist

Force Mix or Portfolio Effectiveness

Competitor Assessment & Win Themes

Scenario

Set of vignettes. Common setting and frequency-weighted

Candidate Solution Effectiveness

Vignette

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Vignettes as components of a *REQUIREMENT*

Customer Acquisition Planning	Multiple Capability Requirements	Alternative Operational Futures

Set of capability requirements

Set of operational futures

Industrial Portfolio Planning		Operational Future

Set of scenarios. Time-ordered with common protagonist

Formulate Operational Requirements	Summary of capability requirement	Scenario

Aligning International Requirements		

Set of vignettes spanning a requirement. No duplication.

Set of vignettes. Common setting and frequency-weighted

Outline Solution CONEMP

Weapon System Concept development

Candidate Solution Down-selection	Vignette

Context for Experimentation

Sales and Marketing Illustrations

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Case Studies

- **Customer acquisition planning and Industrial portfolio planning**
  - In lieu of requirements – represents the 'far' future

- Future Operational Requirements
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- Support to weapon system concept development
  - Illustrate and develop outline CONEMP
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- **Force mix studies**
  - Do weapon system options complement or duplicate capability ?
  - Competitor assessment & Win Themes

  UK Focus

  Export Focus

- Stockpile planning

- Sales and Marketing

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- Aim
  - Identify favourable concept options
  - Assess stockpile implications
- Scope
  - Surface Attack weapons
  - Air-launched and ground-launched
- Scale
  - 1 Nation
  - 30 Vignettes
  - 6 Scenarios
  - 100 Operational futures
  - 27 weapon concepts – including variants
  - 10 Force Mixes

- Approach
  - Bottom up – assessment of concepts in individual vignettes
  - Results 'multiplied up' to force mix capability over 20 years for all operational futures

- Toolset
  - Judgemental assessment
  - Spreadsheet based collation and manipulation of data
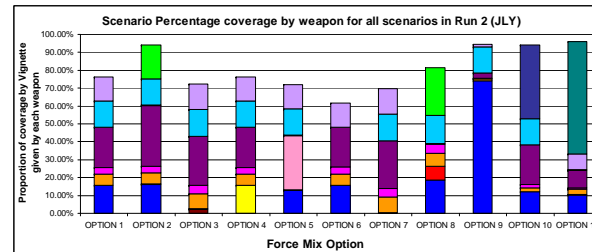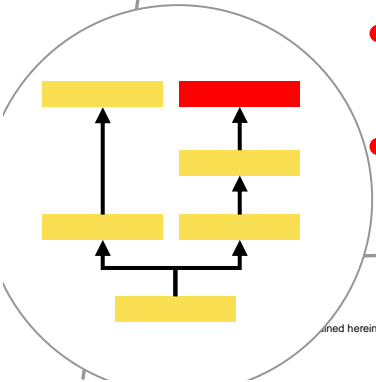
Vignette Coverage by Force mix
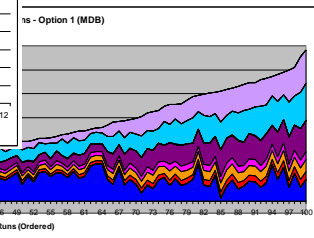
Weapon Consumption by Operational Future

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2: Export Force Mix Study

- Aim
  - Identify 'Win Themes'
  - Provide quantitative evidence

- Scope
  - Fast-Jet Surface Attack weapons

- Scale
  - 6 Nations
  - 60 Vignettes
  - 15 Scenarios
  - 3 Force Mixes per nation
    - Do nothing: Legacy weapons
    - Buy MBDA weapon
    - Buy Competitor weapon
  - 100+ Feasible Weapon load-outs

- Approach
  - Top down – Review of National Defence Policies, then development of relevant scenarios and vignettes
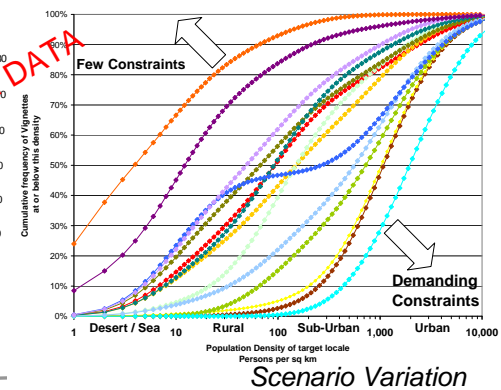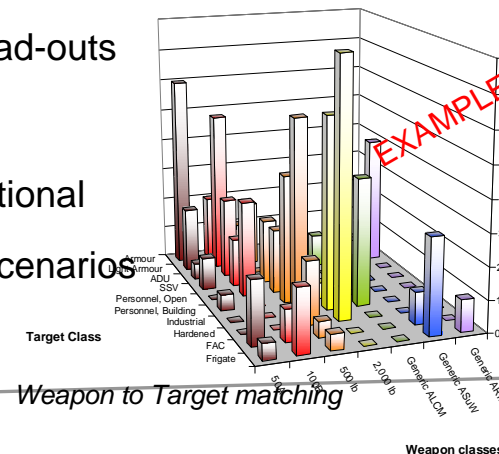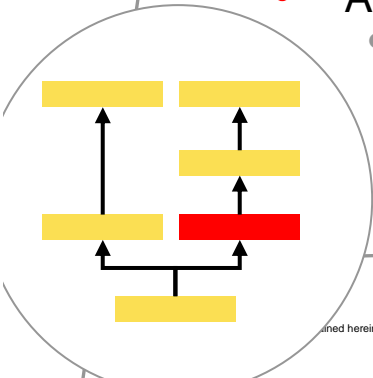
- Outputs
  - Total numbers of weapons used per scenario
  - Percentage of targets addressed per national scenario
  - Weapon strengths against types of targets per national scenario

- Toolset
  - Spreadsheet based genetic algorithm model
  - Algorithms defined for matching aircraft load-outs to vignettes, given system and operational constraints

EXAMPLE DATA

Weapon to Target matching

Few Constraints

Demanding Constraints

Desert / Sea   Rural   Sub-Urban   Urban

Scenario Variation

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- Aim
  - Support decision making for industrial product portfolio
  - Provide automated real-time assessment for use in workshops

- Scope
  - Future complex weapon concepts of all types
- Scale
  - 2 Nations
  - 23 Capabilities
  - 29 Vignettes
  - ~100 Weapon/platform combinations

- Approach
  - Concept vs vignette assessment reduced to key parameters
  - Vignettes mapped to capabilities

- Toolset
  - Part of a Portfolio planning spreadsheet providing cost and capability output

EXAMPLE DATA

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Decision Challenges

- Selecting a balanced and representative set of vignettes. Trade-off: study richness vs study complexity
  - Review by multiple stakeholders
  - Approachable with Principal Component Analysis and optimisation / Hopfield nets if required

- Combining judgement based scores from multiple assessors
  - Variations in assessor scores found to be valid interpretations of the vignette – used to represent operational variability

- Choosing between credible weapon options when more than one option can satisfy a vignette
  - Minimise number of weapons required
  - Maximise targets killed (within platform load-out constraints)
  - Minimise cost – *preferred* ... But
    - Cost data often immature or unavailable
    - Unit Production Cost favours air launched weapons
  - 'Difficult' vignettes can distort results - What is the cost of not doing the task ?

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Lessons Learned

- Documentation for vignettes is essential
  - Unique identifiers and change history
  - Record and disseminate why vignettes have been excluded from a selection that represents an operational requirement – other people will keep trying to put them back in...
- Vignettes are a good aid to communication, but its still possible for people to have different interpretations of a vignette
  - Can be useful – highlights different viewpoints
  - Also exposes biases and misunderstanding
- Having multiple target types in a vignette adds richness – but also complicates the analysis
- Tendency for everyone to think they can do OA !

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Summary

- Vignettes have been widely adopted within MBDA UK and are used for many purposes
  - OA, Systems Engineering, Portfolio planning, Sales...

- Increasingly used internationally within MBDA
  - Shareable - low classification
  - Discussion and alignment of national requirements
  - International Product portfolio planning

- A vital component in the OA toolset
  - Supports low cost, quick turn-around studies
  - The basis for complex higher level studies

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Questions ?

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