

E1

E3 .

**PRIORITISATION OF RESEARCH  
PROGRAMMES USING PORTFOLIO  
ANALYSIS**

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## Prioritisation Of Research Programmes Using Portfolio Analysis

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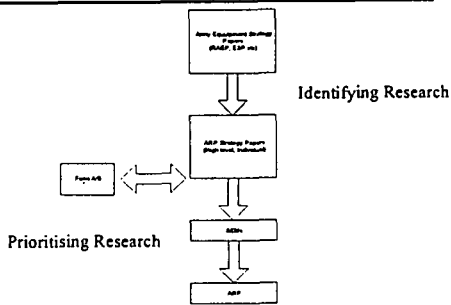
## Introduction

1. Need For Research Prioritisation
2. The Study Approach

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## The Management Process



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## Difficulties In Managing Research

- ◆ Pace of technological change
- ◆ The activity/ability of commercial sectors
- ◆ Interactions with Downey cycle
- ◆ Projects always laying claim to importance
- ◆ Inertia/momentum of research
- ◆ The savings and enhancements debate
- ◆ Interpreting strategy papers etc.
- ◆ Quantifying the value of research
- ◆ Different types of research (direct & indirect)

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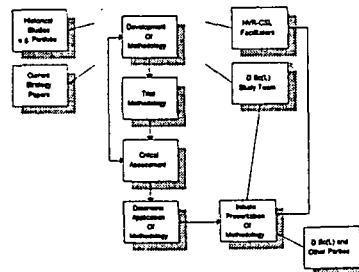
## Types Of Research

- ◆ Direct Research
  - Primarily contributing to concept definition, ST
- ◆ Indirect Research
  - Primarily supporting research
  - e.g. Design and test methodologies

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## Overview Of Study



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## The Methodology

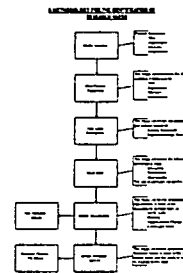
Introduce The Overall Methodology:

- a) Identifying New Research Needs
- b) Prioritising Research Needs

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## Overall Methodology (1)

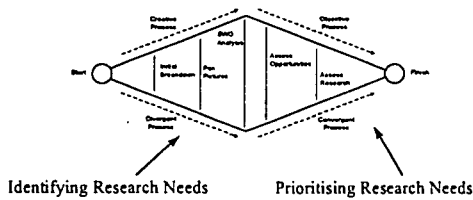


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## Overall Methodology (2)

THE STAGES OF THE METHODOLOGY



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## Identifying Research Needs

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## Identifying Research Needs

### ◆ Step 1

– Pose The Master Question:

» e.g. "What research is necessary to achieve maximum exploitation of a core BMS on a Bowman Brigade by 2002/5?"

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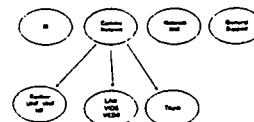


## Identifying Research Needs

### ● Step 2/3

– Initial Problem Breakdown, High Level Descriptions:

» e.g.



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## AVR Identifying Research Needs

### Step 4

#### - Apply SWO Analysis:

- » This is supported by use of a set of tables to act as a checklist, audit trail
- » Tables used are Capability Pull and Technology Push
- » A brainstorm activity

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## AVR Identifying Research Needs

Attribute	Strengths	Weakness
Situational Awareness		
Decision Support		
Time to Use Of Information		
Interoperability		
Skills		
Viability		
Cost		
Other		

Technology Availability	Strengths	Weakness
Capacity		
CCU		
Hardware		
Software		
HCI		
Other		

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## AVR Identifying Research Needs

Attribute	Strength	Weakness
Situational Awareness	Need to help to understand presence of AEWIS No major problems	Range - 0.15 to 1.5 km Long Term Personal index - based on good number of related to intelligence conditions Lower in bandwidth usage 10% for 100 person-calls
Decision Support	BT	BT
Time to Use Of Information	Higher availability of data	Management of flexibility
Interoperability	Network capability	Network capability leading to more complexity and increased costs
Skills	Skilled	Skilled to maintain systems
Viability	Combined index score	Low response times to user
Cost	40 more BAWC	Cost response times to user
Other	Skilled to UK, US, Italy	US, US, US is important of
Capacity	Combined index has interoperability demand in	Prepared to help (not, just?)
Hardware	Low specific equipment	Early required for training, system operation
Software		hardware still low?
HCI		Low response setting up what
Other	Higher than systems	Low cost to help to build new
Other	Costs, usability	Key resources

Capability Pull

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## AVR Identifying Research Needs

- Identify opportunities based on the previous stage
- Assess these to identify a research need – again a checklist will support this

Opportunities	CVES ?	Organisational Change?	Research Needs?	Priority (R.A.G.)	Area

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## AVR Identifying Research Needs

### Example Of Opportunity Identification

Research Area	Opportunities
Situational Awareness - Range, Terrain, HF	RAYCOM, UAV, "Sensing" off (atmosphere, improving track/peak etc, ability to install relays, positioning forces to avoid range limits) Predict and change freq. Use of comms to inform (warn, predict, "squirt" data while possible)
Interoperability	ensure back-to-back compatibility - Clearcom promote standards complete program ability in radio - more flexible (flexibility in US) switch between systems/emulation buy US equipment/relays etc.
Timeliness	response detection to rel procedures for use "intelligent" radio to monitor environment and detect
Capacity	ability to change operating environment (freq, modulation, trans rate, compression, prioritisation) speech recognition push-to-talk burst data bursts (importance of successful delivery)

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## AVR Identifying Research Needs

- The Benefits
  - Provision of a structured framework
    - » audit trail
    - » a forum for debate
  - Useful in assessment of strategy papers etc.
  - Looks to future research needs rather than management of today's problems alone

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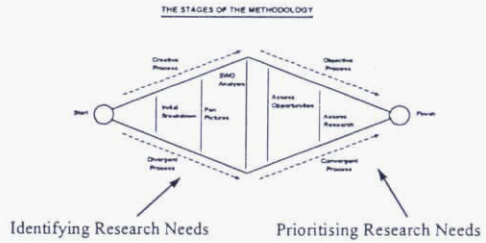


## Research Prioritisation

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## Overall Methodology (2)



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## Research Prioritisation

- Need to “score” research
- Scoring Research ?
  - Urgency
  - Cost
  - A Military Benefit
  - Advances In Technology
  - Risk
  - Retention Of Research Expertise
  - Maintaining A “Balance” Of Research

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## Portfolio Analysis

◆ *A Technique For Charting Or Categorising The Different Businesses In A Firm's Portfolio And Determining Implications For Resource Allocation*

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## Portfolio Analysis History

- Boston Consulting Group 1960s
  - BCG Matrix (Plots Market Share Against Market Growth)
- ◆ GE Matrix Mid 1970s
  - Plots Industry Attractiveness Against Competitive Position
  - Preferred Industry Approach (Used By 75 % Of Large US Firms By 1982)

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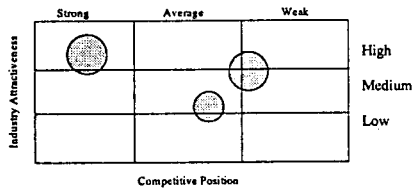
## Subordinate Factors

Attractiveness Of Industry	Competitive Position
Market Size	Market Share
Expected Rate Of Market Growth	Competitive Advantage
Industry Profitability	Knowledge Of Customers & Markets
Regulatory Structure	Production Capability
Costs Of Entry	Quality Of Management
Technical Requirements	Business Unit Size
Local & Environmental Factors	Business Unit Growth
Government Support	Production Processes
	Strength & Weakness
	Image
	Personnel
	People

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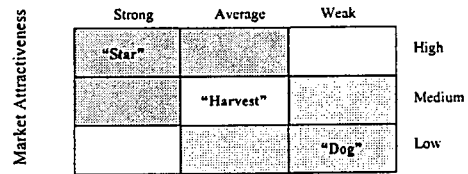
## A Worked Example



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## Implications



### Competitive Position

- Star - Target for growth and development
- Harvest - Monitor but make no radical changes
- Dog - Examine to see if it is worth continuing

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## Application To ARP

- ◆ How can this be applied to military research?
  - The "attractiveness" corresponds to the military return that research can deliver
  - The "strength" corresponds to the balance between defence and commercial research capability
- ◆ Develop a set of sub-factors and metrics to score these

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## The Chosen Factors

- ◆ Military Return
  - needs to address the benefit that the research will offer e.g. urgency, filling an identified weakness
- ◆ Technology Stream
  - needs to address the strength of commercial sectors in delivering the required research aims
- ◆ Also can consider Cost, Risk separately

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## The Sub Factors

MILITARY RETURN	TECHNOLOGY STREAM
Urgency	# Active Companies
Dependency	Barriers To Entry
Identified Military Weakness	Economies Of Scale
Interoperability	Skill Base
	Cyclicalilty

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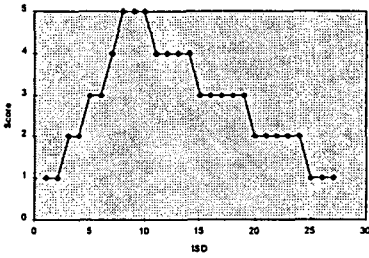
## Military Return Metrics

	Urgency	Dependency	Interoperability	Identified Military Weakness
1	>25 yrs or <2 yrs to ISD	Non-standard Not Lynchpin Stand alone system	Supports Army system	No identified military weakness
2	2-4 yrs or 20-25 yrs to ISD	Non-standard Not Lynchpin Little support of other systems	Supports Army wide	Some evidence of weakness Capability replacement
3	15-20 yrs to ISD 4-5yrs	Some implications for standards Supports some systems	Limited mil. and joint interoperability. Achievement through work round	Non-critical military weakness (ESF) or known future weakness 5-10yrs
4	10-15yrs 5-8 yrs to ISD	Lynchpin system Supports many other systems/components	Adequate mil. and joint interoperability.	Non-critical military weakness (ESF) or known future weakness < 5yrs
5	6-10yrs from ISD	Functional standard	Supports full mil. and joint operations.	Significant, critical military weakness identified in ESF area

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## The Urgency Metrics



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## Technology Stream Metrics

Pre-Authority Comparison	Business T. Entry	Precedent Market	Cyclicity	Risk Rate
1-10 years before	More than 10000 and 1 year or more	Should part of M&D (M&D)	No, substitution on one side, or the impact on the other side of the equation	Low Risk 7% of sales on M&D, Moderate risk on M&D, Moderate risk on M&D, Moderate risk on M&D, Moderate risk on M&D
2-10 years before	10-10000 and 1 year	Should part of M&D (M&D)	Some substitution possible, but not all of it	2-7% of sales on M&D, Moderate risk on M&D, Moderate risk on M&D, Moderate risk on M&D
3-10 years before	10-10000 and 1 year	Should part of M&D (M&D)	Some substitution possible, but not all of it	2-7% of sales on M&D, Moderate risk on M&D, Moderate risk on M&D, Moderate risk on M&D
4-10 years before	10-10000 and 1 year	Should part of M&D (M&D)	Some substitution possible, but not all of it	2-7% of sales on M&D, Moderate risk on M&D, Moderate risk on M&D, Moderate risk on M&D
5-10 years before	10-10000 and 1 year	Should part of M&D (M&D)	Some substitution possible, but not all of it	2-7% of sales on M&D, Moderate risk on M&D, Moderate risk on M&D, Moderate risk on M&D

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## Weighting Sub-Factors

Apply Saaty weighting to combine sub factor scores

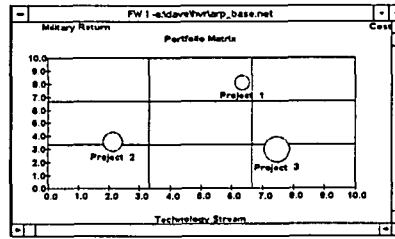
A	B	Legitimacy	Dependency	Market Entry	Market Entry	Market Entry	Market Entry
Legitimacy		1	3				
Dependency		1/3	1	7			
Market Entry			1/7	1			

The matrix is filled in as follows:  
 A is decisively more important than B Score 7  
 A is more important than B Score 3  
 A is slightly more important than B Score 2  
 A is equal to B Score 1  
 A is slightly less important than B Score 1/2  
 A is less important than B Score 1/3  
 A is decisively less important than B Score 1/7

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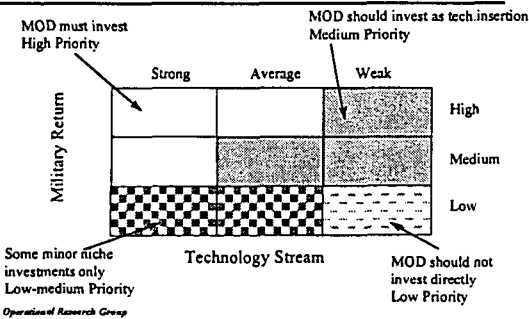
## A Portfolio Matrix



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## The Military Return/Technology Matrix



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## Summary Of Approach

- ◆ Has a proven pedigree
  - industry, DRA Malvern
- ◆ Provides a structured, auditable approach
- ◆ Offers a decision support tool to aid debate
  - sensitivity analysis
    - » weights
  - trends i.e. in which direction are research assignments moving on the portfolio matrix

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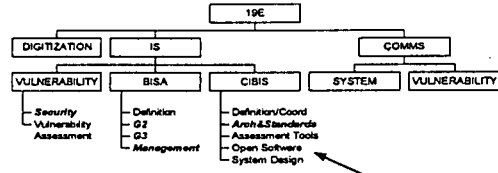
## Applying Portfolio Analysis

### Scoring An Assignment

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## 19e Package



Key:  
 Priority Process  
 Priority Product

Example Scoring

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## Scoring Military Return

	Urgency	Dependency	Interoperability	Identified Military Weakness
1	>25 yrs or <2 yrs to ISD	Non-standard Not Lyncpin Stand alone system	Supports Army wide system	No identified military weakness
2	2-4 yrs or 20-25 yrs to ISD	Non-standard Not Lyncpin Little support of other systems	Supports Army wide system	Some evidence of weakness Capability replacement
3	15-20 yrs to ISD 4-5 yrs	Some implications for standards Supports some systems	Limited mil. and joint interoperability. Achievement through work round	Non-critical notified weakness (ESP) or known future weakness <10yrs
4	10-15 yrs 5-6 yrs to ISD	Lyncpin system Supports many othe systems/components	Adequate mil. and joint interoperability.	Non-critical notified weakness (ESP) or known future weakness < 5yrs
5	< 10yrs from ISD	Fundamental stand ar	Supports full mil. and joint operations.	Significant critical military weakness identified in ESP now
Open Software	?	?	?	?

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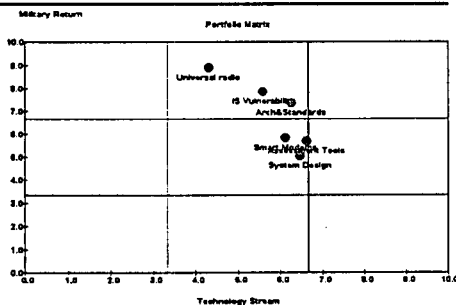
## Scoring Technology

	No Author Copyright	Months To Entry	Planned Market	Cyclability	Risk Rate
1	No known author copyright	More than 120mms and 7 years or more	World wide	10 yrs or more	Low Risk 1% of jobs on R&D, 10% of jobs on maintenance, 90% of jobs on support e.g. the equipment
2	1 or 2 authors	60-120mms 4-7 years	Regional/US only military equipment	5-10 yrs	2-7% of jobs on R&D, 10% of jobs on maintenance, 80% of jobs on support
3	3-10 authors	120-180mms 3-4 years	Wide range of military equipment and other commercial applications	3-5 yrs	5-10% of jobs on R&D, 10% of jobs on maintenance, 80% of jobs on support
4	10-20 authors	180-240mms 2-3 years start up	Limited range of military equipment	2-3 yrs	5-10% of jobs on R&D, 10% of jobs on maintenance, 80% of jobs on support
5	More than 20 authors	Less than 180mms 1 year start up time	Wide range of commercial applications	1-2 yrs	More than 10% of jobs on R&D, 10% of jobs on maintenance, 80% of jobs on support
Open Software	?	?	?	?	?

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## Will Add Example To The Portfolio



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## Interpreting The Portfolio

- Assess the balance of investment across the assignments
- ◆ Can carry out sensitivity analyses on the sub-factor weights
- May identify areas of research which deserve further scrutiny

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## Technology Weighting

Technology Stream	1	2	3	4	5	6	7	8	9	10	Weight
Companion	1	1/7	1/5	1/7	1/5	1	1	1	1	1	0.23
Barriers	7	1	7	5	5	1	1	1	1	1	0.54
Econ	5	1/7	1	5	5	1	1	1	1	1	0.23
Skill Base	7	1/5	1/5	1	1/7	1	1	1	1	1	0.26
Cyclicalty	5	1/7	1/5	3	1	1	1	1	1	1	0.12
	1	1	1	1	1	1	1	1	1	1	-
	1	1	1	1	1	1	1	1	1	1	-
	1	1	1	1	1	1	1	1	1	1	-
	1	1	1	1	1	1	1	1	1	1	-

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## Military Weighting

Military Return	1	2	3	4	5	6	7	8	9	10	Weight
Urg	1	1/7	1/7	1/7	1	1	1	1	1	1	0.04
Dep	7	1	1	1	1/7	1	1	1	1	1	0.22
Interop	7	1	1	1	1/7	1	1	1	1	1	0.22
Mill Weak	7	1	1	1	1	1	1	1	1	1	0.51
n/a	1	1	1	1	1	1	1	1	1	1	-
n/a	1	1	1	1	1	1	1	1	1	1	-
n/a	1	1	1	1	1	1	1	1	1	1	-
n/a	1	1	1	1	1	1	1	1	1	1	-

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## Assessing The Methodology

- Who should carry out the scoring?
- What are the strengths of the approach?
- Is the approach particularly useful for some packages?
- What are the current limitations to the approach?
- ◆ What is the ideal forum in which the methodology could be applied?

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## Conclusions

- ◆ Have developed a methodology which:
  - could be applied to identifying future research needs
  - provides a route to discriminate assignments as a way of prioritising research
- Potentially useful decision support tool
- Have applied this to part of the 19e package

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