

A Matrix Model for Assessment of Advanced Life Science Technologies

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Development of a matrix assessment tool for advanced life science technologies, an on-going study

- Swedish Defence Research Agency (FOI)
 - MFA + MoD: - technical support non-proliferation + EU-bioprep.
 - Civilian authorities: - risk assessments + biopreparedness (lab network)
- Project funded by MFA
 - Contribution to BWC Review Conference 2011
 - Assessment of technical development relevant to BWC
- Non-state actors, selected community/target
- Identify thresholds to success

BWC relevant focus technologies

- Synthetic biology
- Nanotechnology
- Bioregulators
- Production techniques

Key definitions I – Competence levels

1. Upper-secondary education from the natural sciences programme
2. Undergraduate studies within molecular biology
3. Higher university education and long experience within relevant area

Key definitions II – Technology levels / aims

- i) Simple genetic modification - cloning
- ii) Advanced genetic modification - mutated organism/
stable integration
- iii) Synthetic virus
- iv) Synthetic bacteria

Key definitions III – Essential capabilities

- A) Obtain the technical equipment and reagents required to achieve the aim
- B) Construct and propagate the "new" organism x2
- C) Ensure proper expression and function
- D) Produce the biological agent in appropriate quantities x2
- E) Obtain relevant protection required

Detailed requirement list for each essential capability

- A) Technical equipment + reagents => physical items
- B) Construct + propagate => biological material, primers, vectors, DNA
- C) Proper expression + function => protein expression, virulence, toxicity, tissue culture, animal testing, stability
- D) Appropriate quantities => pilot scale production
- E) Protection => physical, BSL-3/4, medical, decontamination agents

Key definitions IV – Probability scores

Presently impossible		<1
Very difficult		1
Moderately difficult	2	
Easy		3

Key definitions V – Total probability scores

I	Presently impossible	<6
L	Low probability	6-12
M	Moderate probability	13-17
H	High probability	18-21



Matrix scores – Upper secondary education

Aim \ Ess. Capabil.	Equipment Reagents	Construct Propagate	Expression Function	Production in required quantities	Protection	Σ
Simple GM	1	4	1	2	1	9 L
Advanced GM	1	2	1	2	1	7 L
Synthetic virus	1	2	1	2	1	7 L
Synthetic bacteria	1	<1	Irrelevant	Irrelevant	Irrelevant	1 I

Matrix scores – Undergraduate studies

Aim \ Ess. Capabil.	Equipment Reagents	Construct Propagate	Expression Function	Production in required quantities	Protection	Σ
Simple GM	2	4	2	4	2	14 M
Advanced GM	2	2	2	4	2	12 L
Synthetic virus	2	2	1	2	2	9 L
Synthetic bacteria	2	<1	Irrelevant	Irrelevant	Irrelevant	2 I

Matrix scores – expert knowledge

Aim \ Ess. Capabil.	Equipment Reagents	Construct Propagate	Expression Function	Production in required quantities	Protection	Σ
Simple GM	3	6	3	6	2	20 H
Advanced GM	3	6	3	6	2	20 H
Synthetic virus	3	4	3	4	2	16 M
Synthetic bacteria	3	<1	Irrelevant	Irrelevant	Irrelevant	3 I

Summary - competence level thresholds

Aim \ Comp. level	1 Upper-sec	2 Undergrad.	3 Expert	Competence level threshold
Simple GM	9 L	14 M	20 H	Equipment, reagents
Advanced GM	7 L	12 L	20 H	Construct, propagate
Synthetic virus	7 L	9 L	16 M	Ensure expression, function
Synthetic bacteria	1 I	2 I	3 I	Know-how

Matrix assessment for advanced life science technologies

- Assesses probability for actors of different competence levels to succeed in using advanced life science technologies with malicious intent
- Matrix can be modified for other technologies
- Matrix can be used together with further actor assessments
- Matrix variants can be used across sectors
 - Spread of natural diseases within: - the food-chain (previous study)
- in agriculture (future study)