GUEST LECTURE

Senin, 29 Juni 2026

Curtin University Malaysia

UNIVERSITAS PEMBANGUNAN NASIONAL "VETERAN" JAWA TIMUR

Know Your Real TRL:

Building Credible Innovation Through Accurate Technology Readiness Assessment and Feasibility Study

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PREVIOUS ATTENDED WORKSHOPS

Research and Development of a

Validation Instrument for Technology Readiness Levels (TRL)

in Higher Education Research Proposals

Professor Dr Mohd Shahir Shamsir, RTTP
Universiti Teknologi Malaysia

Professor Dr Samsilah Roslan, RTTP
Director, PUTRA Science Park, Universiti Putra Malaysia

Assoc. Prof. Ts. Dr. Mohd Faizal Omar
Director, Innovation & Commercialization Centre UUM, Universiti Utara Malaysia

22 OCT
Wednesday
9.30AM - 4.00PM
SK3 - 205 Collaborative Room 1, Skylark 3

DAY 1
TOPIC 1
9.30AM - 11.30AM (*break 10.30AM-11.00AM*)
Business Negotiation: Techniques for Securing Deals, Partnerships & Commercialisation

TOPIC 2
2.00PM - 4.00PM (*break 3.00PM-3.30PM*)
Technology Readiness Levels (TRL) Assessment and Validation Instrument

23 OCT
Thursday
9.30AM - 12.00PM
SK3 - 205 Collaborative Room 1, Skylark 3

DAY 2
TOPIC 1
9.30AM - 12.00PM (*break 11.00AM-11.30AM*)
Crafting Competitive Proposals and Managing Research Impact: A National Grant Writing Workshop

Those interested in attending are kindly requested to register their interest **via the Google Form** provided.

JOIN NOW

ORD@curtin.edu.my
085-630100 (Ext 2547/2548)

OUTLINE

1.	**Pembukaan & framing**	Mengapa TRL penting untuk hibah, hilirisasi, dan kemitraan.
2.	**Sesi A — Memahami TRL**	Konsep TRL, level 1–9, bukti, checklist, studi kasus.
3.	**Sesi B — Menghindari overclaim**	Penyebab, red flags, verifikasi, scoring, audit trail.
4.	**Sesi C — Feasibility study**	Teknis, pasar, ekonomi, operasional, risiko, keberlanjutan.
5.	**Brief Coaching Session**	Struktur dokumen, executive summary, feasibility canvas.

Tujuan pembelajaran

Setelah sesi ini, peserta diharapkan mampu menilai posisi teknologi yang telah dikembangkan dari hasil penelitian dan menyiapkan dokumen pendukung hilirisasi secara lebih akuntabel.

1. **Memahami indikator TRL**

   Membedakan TRL level 1–9 berdasarkan bukti, bukan intuisi.

2. **Menilai TRL secara objektif**

   Menggunakan checklist, bukti uji, dan batasan klaim.

3. **Menghindari overclaim**

   Mengenali red flags dan memperbaiki narasi proposal.

4. **Menyusun feasibility study**

   Menghubungkan aspek teknis, pasar, ekonomi, operasional, risiko, dan keberlanjutan.

5. **Memperkuat proposal hilirisasi**

   Menunjukkan readiness, pathway, dan keputusan lanjut secara kredibel.

6. **Membangun budaya inovasi**

   Berorientasi implementasi, kebermanfaatan, dan pembelajaran berbasis data.

Mengapa TRL dan feasibility study penting sekarang?

Publikasi penting, tetapi hilirisasi menuntut bukti kesiapan, risiko, dan kelayakan implementasi.

1 **Riset**
Pengetahuan baru publikasi

2 **Prototipe**
Fungsi terbukti di lab

3 **Validasi**
Uji lingkungan relevan

4 **Adopsi**
Pengguna nyata model bisnis

5 **Dampak**
Implementasi berkelanjutan

Masalah umum

TRL ditulis untuk proposal, bukan diverifikasi sebagai posisi teknologi. Klaim sering bergerak lebih cepat daripada bukti.

Risiko nyata

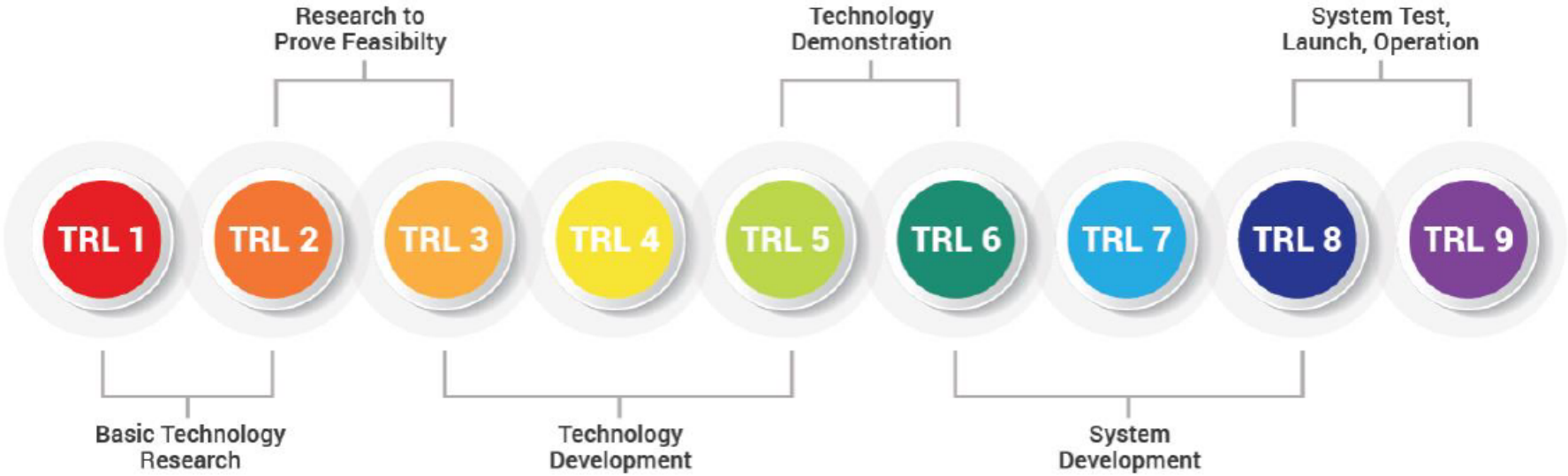
Proposal tidak meyakinkan reviewer. Mitra industri ragu karena bukti belum operasional.

Solusi sesi ini

Penilaian TRL defensible.
Feasibility study yang sistematis.

Introduction

LITERATURE REVIEW



Technology Readiness Levels (TRLs) were **originally developed by NASA** in the 1970s as a method to assess the maturity of space technologies

TRLs provide a **common language** for discussing technology maturity across different stakeholders, facilitating clearer communication and collaboration among researchers, industry partners, and policymakers Xavier *et al*. (2020).

The **interpretation and application of TRLs can vary significantly** across different sectors and organisations, as noted by Zhang *et al*. (2010).

The variability underscores **the need for standardisation** in the use of TRLs to ensure that they are applied consistently fields like **healthcare or environmental science** may lack clarity and rigour (Bogacheva & Smorodinov, 2022)..

This inconsistency can lead to **misunderstandings about technology maturity and readiness**, potentially **hindering collaboration** and **innovation**

Introduction

01

Why TRL — and Why Now?

The national rationale for adopting TRL across Malaysian HEIs

02

The MOHE TRL Framework

Scale, domains, 77 sub-bidang, and how 'readiness' is defined

03

The Assessment Process

Self-assessment, evidence standards, and panel evaluation

04

Roles & Responsibilities

What MOHE, Pusat PI, researchers and panel members each do

05

TRL in the Grant Lifecycle

Application gates, mid-term review, final evaluation and commercialisation

06

Pitfalls, FAQs & Next Steps

Common misapplications, administrator guidance and rollout timeline

30 MENIT

Sesi A1
Memahami TRL

Tujuan: peserta mampu mengidentifikasi kematangan teknologi secara akurat berdasarkan indikator dan bukti.

Sesi A1 — Understanding TRL

Konsep dasar TRL

TRL membantu peneliti menjelaskan jarak teknologi dari riset awal menuju penerapan nyata.

Apa itu TRL?

Skala 1–9 untuk menilai kematangan teknologi berdasarkan bukti kemajuan pengembangan dan validasi.

Mengapa digunakan?

Benchmark kematangan teknologi.
Mengurangi risiko pengembangan.
Memandu keputusan pendanaan.
Membantu komunikasi dengan industri.

Akar rujukan

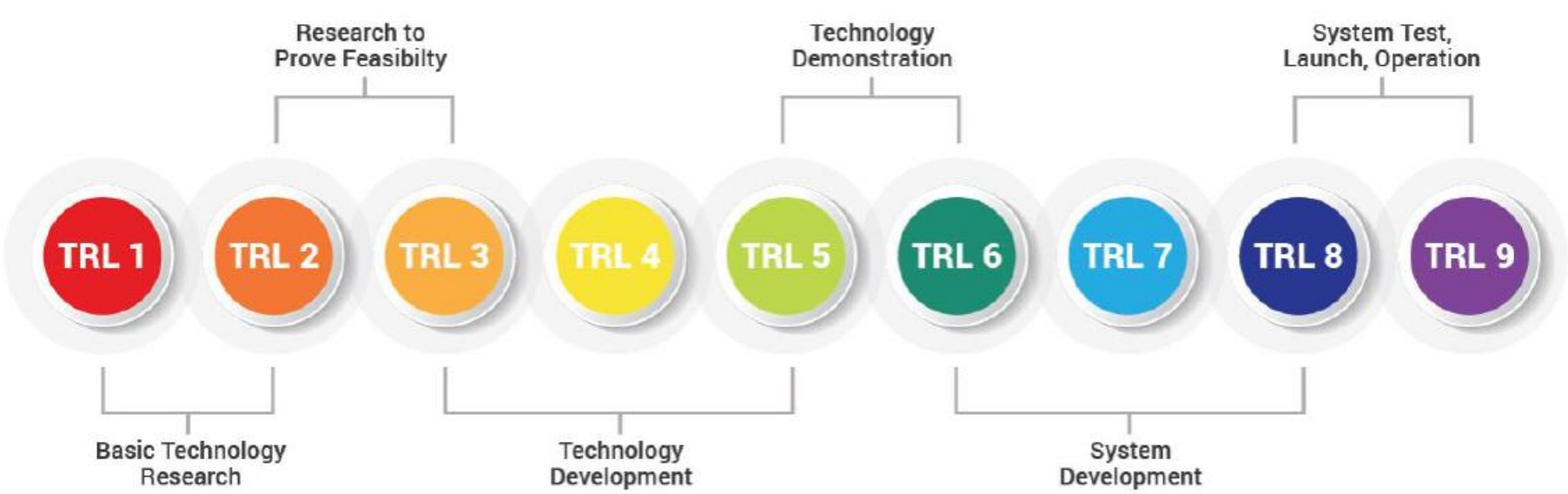
MOHE Technology Readiness Level
NASA Technology Readiness Levels.
ISO 16290:2013.
EU Horizon / Horizon Europe.
TKT di Indonesia.

Prinsip utama:
Level TRL hanya sah apabila bukti pada level tersebut sudah terpenuhi secara konsisten.

Rujukan: NASA Technology Readiness Levels; ISO 16290:2013; European Commission TRL guidance; Permenristekdikti No. 42/2016.

Sesi A1 — Understanding TRL

PROBLEM STATEMENT



In pursuit of impact, the Ministry of Higher Education (MOHE) is facing increasing challenges in efficiently allocating research funding due to the growing volume and complexity of research proposals.

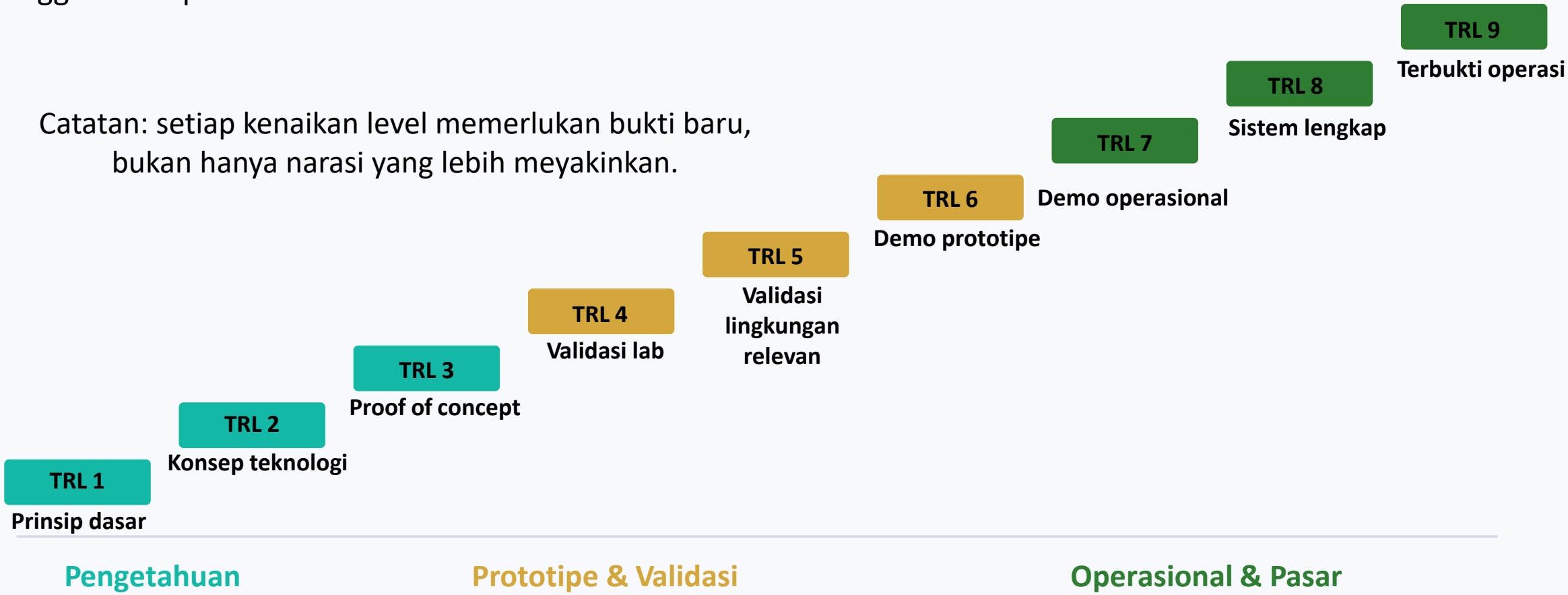
The previous evaluation process lacks a standardised method for assessing the maturity of proposed technologies.

The introduction of Technology Readiness Levels (TRLs) as a metric in proposal submissions aims to address this issue, but it **brings its set of challenges.**

Tangga TRL 1–9

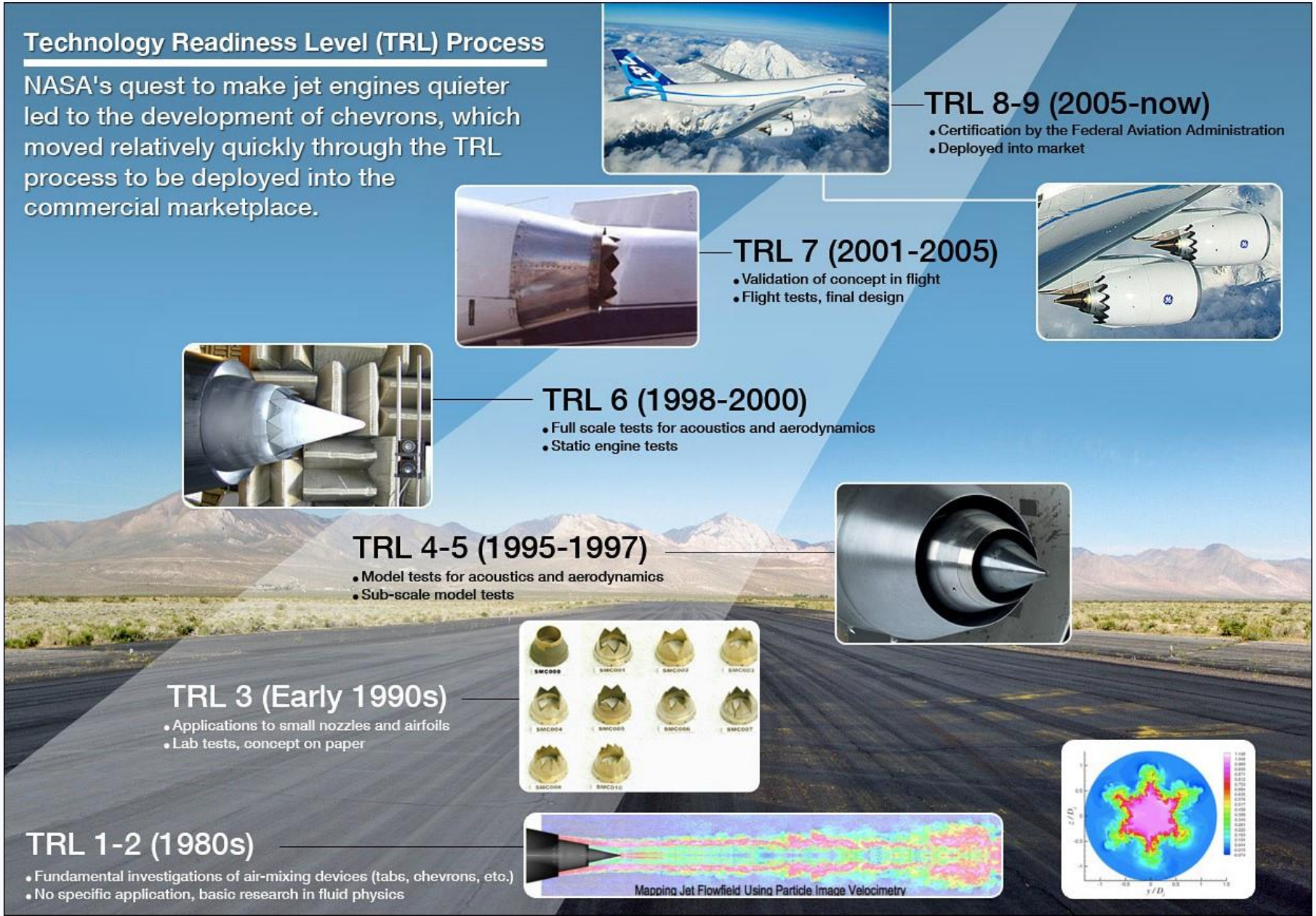
Dari prinsip ilmiah, pembuktian konsep, validasi prototipe, demonstrasi lapangan, hingga penggunaan operasional.

Catatan: setiap kenaikan level memerlukan bukti baru, bukan hanya narasi yang lebih meyakinkan.



Sesi A1 — Understanding TRL

"In truth, we **transfer knowledge at all technology readiness levels**," he said. "This especially occurs when we work with industry and academia on collaborative projects. In those cases, NASA works with others as equal partners and information flows organically throughout the technology development life cycle."



Sesi A1 — Understanding TRL

Sesi A1 — Understanding TRL

WITHOUT TRL · TANPA TRL

- No common language between researchers, evaluators, and industry partners
- Grant panels unable to objectively compare outputs across disciplines
- Inflated or misleading claims of technology maturity in applications
- No systematic link between research stage and funding instrument
- Commercialisation handoffs with no readiness baseline established

WITH TRL · DENGAN TRL

- Single objective scale understood by all stakeholders in the grant system
- Evaluators can assess and compare evidence regardless of research domain
- Claims must be backed by specific, dated, verifiable documents
- Funding instrument is matched to the appropriate TRL entry point
- Clear readiness gate before commercialisation referral is made

Cara cepat membaca kelompok TRL

Untuk riset kampus, klasifikasi awal dapat dimulai dari tiga zona utama.

TRL 1–3

Zona riset awal

Prinsip ilmiah, konsep aplikasi, proof of concept awal. Bukti utama: literatur, model, simulasi, eksperimen awal.

Bertanya: "apakah prinsipnya masuk akal?"

TRL 4–6

Zona prototipe tervalidasi

Komponen/prototipe diuji di laboratorium atau lingkungan relevan. Bukti utama: data uji, spesifikasi, repeatability, validasi terbatas.

Bertanya: "apakah prototipe bekerja konsisten?"

TRL 7–9

Zona operasional

Sistem didemonstrasikan, lengkap, dan digunakan dalam lingkungan operasional. Bukti utama: uji lapangan, SOP, pengguna nyata, performa stabil.

Bertanya: "apakah sistem siap dipakai pengguna?"

Sesi A1 — Understanding TRL

RESEARCH · Penyelidikan	**TRL 1** Basic Principles Observed	**TRL 2** Technology Concept Formulated	**TRL 3** Experimental Proof of Concept
DEVELOPMENT · Pembangunan	**TRL 4** Technology Validated in Laboratory	**TRL 5** Technology Validated in Relevant Environment	**TRL 6** Technology Demonstrated in Relevant Env.
DEPLOYMENT · Penggunaan	**TRL 7** System Prototype in Operational Environment	**TRL 8** System Complete and Qualified	**TRL 9** Actual System Proven in Operations

Key Rule: TRL is CUMULATIVE — all questions at TRL N must be answered 'Yes' before TRL N can be claimed · Peraturan Utama: TRL adalah kumulatif — semua soalan pada TRL N mesti dijawab 'Ya' sebelum TRL N boleh dituntut

Sesi A1 — Understanding TRL

TRL bukan “nilai gengsi”

Kesalahan umum muncul ketika TRL diperlakukan sebagai angka promosi, bukan diagnosis kesiapan.

TRL bukan jumlah publikasi

Artikel Q1 menunjukkan kontribusi ilmiah, tetapi belum otomatis menunjukkan prototipe tervalidasi atau sistem siap digunakan.

TRL bukan intensi hilirisasi

Niat membangun start-up atau kerja sama industri tidak menaikkan level tanpa bukti uji dan validasi.

TRL bukan ukuran potensi pasar

Pasar yang besar dapat mendukung feasibility, tetapi TRL tetap menilai kesiapan teknologi.

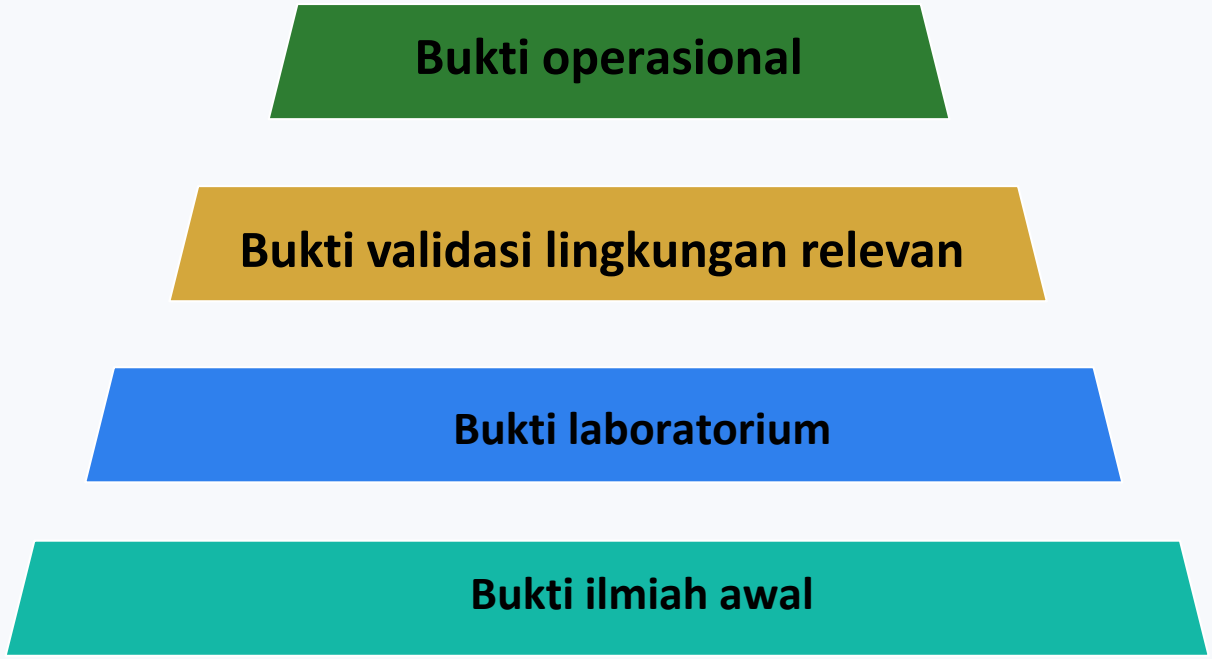
Kalimat yang lebih aman:

“Berdasarkan bukti saat ini, teknologi berada pada TRL 4–5; kegiatan berikutnya diarahkan untuk validasi di lingkungan relevan sebelum klaim TRL 6.”

Sesi A1 — Understanding TRL

Bukti yang dibutuhkan untuk verifikasi TRL

TRL yang kredibel selalu dapat dilacak ke bukti tertulis, data uji, dan validasi yang relevan.



Audit sederhana

Apa bukti terkuat?
Di mana diuji?
Berapa kali diuji?
Siapa memverifikasi?
Apa batasannya?

Sesi A1 — Understanding TRL

Checklist verifikasi TRL

Gunakan pertanyaan ini sebelum menuliskan angka TRL pada proposal atau laporan luaran.

- ✓ **Definisi teknologi jelas**
  Komponen, fungsi, batas sistem, dan target pengguna sudah didefinisikan.
- ✓ **Lingkungan uji sesuai**
  Laboratorium, simulasi, lingkungan relevan, atau operasional disebutkan dengan jelas.
- ✓ **Data dapat ditelusuri**
  Ada protokol, tanggal uji, replikasi, data mentah/olah, dan hasil kegagalan.
- ✓ **Kinerja dibandingkan target**
  Ada indikator performa dan ambang keberhasilan yang objektif.
- ✓ **Keterbatasan tidak disembunyikan**
  Batas validasi, risiko, dan asumsi teknis ditulis eksplisit.
- ✓ **Pihak verifikator jelas**
  Penilaian internal, peer review, lab independen, atau pengguna dicatat.

Aturan praktis:
Jika dua pertanyaan kunci belum dapat dijawab, turunkan klaim TRL satu level dan tulis rencana validasinya.

Sesi A1 — Understanding TRL

Studi kasus kampus: menentukan TRL

Contoh penilaian cepat untuk menghindari klaim yang terlalu tinggi.

Kasus 1	Metode baru sudah dipublikasikan dan divalidasi melalui simulasi, belum ada prototipe fisik.	**Kemungkinan: TRL 2–3**
Kasus 2	Prototipe alat sudah bekerja di laboratorium dengan tiga kali uji fungsi, belum diuji di lingkungan pengguna.	**Kemungkinan: TRL 4**
Kasus 3	Sistem diuji bersama pengguna di lokasi operasional terbatas, SOP awal tersedia, data performa tercatat.	**Kemungkinan: TRL 6–7**

Pertanyaan diskusi:
Bukti apa yang perlu ditambahkan agar level berikutnya dapat diklaim secara defensible?

Sesi A1 — Understanding TRL

Latihan singkat: “TRL saya sebenarnya berapa?”

Gunakan satu hasil penelitian peserta sebagai bahan diagnosis cepat.

Output 5 menit

Satu kalimat TRL defensible: “Teknologi X saat ini berada pada TRL __ karena bukti utama adalah __; validasi berikutnya yang dibutuhkan adalah __.”

Sesi A1 — Understanding TRL

Domain 1 1

Technology & Engineering

Mekanikal, Kimia, Elektrik, Aeroangkasa, Material, Awam, Tenaga, Pembinaan, Infrastruktur, Keselamatan

Domain 2 2

Information & Communication Technology

AI & Kuantum, Teori Pengkomputeran, Algoritma, IoT & Rangkaian, Sains Data, Sistem Perisian, Keselamatan Siber, Multimedia

Domain 3 3

Clinical & Health Sciences

Sains Perubatan Asas, Klinikal, Perubatan, Pembedahan, Komuniti, Sains Kesihatan, Pergigian, Mikrobio, Jururawat, Parasit, Patologi, Farmasi, Farmako, Veterinar, Psik. Klinikal, Perubatan Alternatif

Domain 4 4

Pure & Applied Sciences

Biokimia, Bioteknologi, Biologi, Kimia, Sains Bahan, Matematik & Statistik, Fizik

Domain 5 5

Arts & Applied Arts

Bahasa, Kesusasteraan, Agama, Falsafah, Ketamadunan, Sejarah, Seni, Budaya, Pendidikan, Pend. Orang Asli, Polisi & Undang-Undang, Alam Bina

Domain 6 6

Social Sciences

Antropologi, Psikologi, Sosiologi, Sains Politik, Ekonomi, Perniagaan, Pengurusan, Geografi, Komunikasi, Kajian Etnik

Domain 7 7

Environment & Heritage

Pelancongan, Alam Sekitar, Kesihatan Bumi, Perhutanan, Pertanian, Marin, Arkeologi, Geologi, Warisan, Budaya, Biodiversiti, Kulinari, Geomatik, Sains Angkasa

30 MENIT

Sesi A2
Proses Penilaian TRL

Tujuan: peserta mampu mengidentifikasi kematangan teknologi secara akurat berdasarkan indikator dan bukti.

Sesi A2 — The TRL Assessment Process

1

Select Sub-Bidang

PI identifies the single primary sub-bidang from the 77 available. Use the disciplinary anchor of the core innovation, not the application area.

2

Download Form

Obtain the correct TRL Determination Form from the MOHE grant portal. There are 77 unique forms — one per sub-bidang.

3

Self-Assessment

Answer all 5 yes/no questions per TRL level. The claimed TRL is the highest level where ALL questions are 'Yes' with evidence.

4

Compile Evidence Index

List every cited document with title, type, date, authors, and storage location. Evidence must pre-date the submission date.

5

Submit to Pusat PI

Submit completed form + evidence package to the Pusat PI administrator within the grant cycle deadline. Incomplete submissions are returned.

6

Panel Review

Panel reviews evidence (within 21 working days), may request clarification, deliberates and issues the official TRL Panel Rating Report.

Sesi A2 — How the final TRL Rating is Determined

THE GOLDEN RULE

All 5 questions at TRL N must be answered 'Yes' before TRL N can be claimed.

Semua 5 soalan pada TRL N mesti dijawab 'Ya' sebelum TRL N boleh dituntut.

A single 'No' at any level CAPS the TRL at N-1.
Partial credit is NOT awarded.

WORKED EXAMPLE

TRL	Q1	Q2	Q3	Q4	Q5	Result
TRL 1	Y	Y	Y	Y	Y	✓ CLAIMED
TRL 2	Y	Y	Y	Y	Y	✓ CLAIMED
TRL 3	Y	Y	Y	Y	Y	✓ CLAIMED
TRL 4	Y	Y	Y	N	Y	✗ CAPPED
TRL 5	—	—	—	—	—	NOT ASSESSED

Final Rating: TRL 3 (highest level where ALL questions = Yes)

Penilaian Akhir: TRL 3 (tahap tertinggi di mana SEMUA soalan = Ya)

Discrepancy Rule: ±1 TRL — panel rating stands. ±2 or more TRL — formal moderation process is triggered. See Section 06 of the Guideline.

Sesi A2 — How the final TRL Rating is Determined

TRL 1 – Basic Principles Observed
- **Scientific principles identified**: Has the fundamental science behind the technology been observed?
- **Concept relevance established**: Is there evidence that the principle is relevant to a potential application?
- **Initial literature reviewed**: Has prior research been surveyed to confirm novelty?
- **Feasibility recognized**: Is there a plausible path toward application?
- **Knowledge gap defined**: Have the unknowns been clearly identified?

TRL 2 – Technology Concept Formulated
- **Application identified**: Has a potential use case been articulated?
- **Concept model created**: Is there a theoretical model or hypothesis?
- **Critical parameters outlined**: Are the key variables and performance metrics defined?
- **Research plan established**: Is there a plan to validate the concept?
- **Risks acknowledged**: Have the main scientific/technical risks been identified?

TRL 3 – Experimental Proof of Concept
- **Lab experiments conducted**: Has initial testing been performed in a controlled environment?
- **Proof of principle demonstrated**: Do results confirm the concept works at a small scale?
- **Critical functions tested**: Have the essential elements been validated?
- **Data supports feasibility**: Is there quantitative evidence backing the concept?
- **Iteration possible**: Can the design be refined based on test results?

Sesi A2 — How the final TRL Rating is Determined

TRL 4 – Technology Validated in Lab
Prototype built: Has a lab-scale prototype been developed?
Subsystems integrated: Are different components working together?
Performance validated: Do lab tests confirm expected performance?
Safety assessed: Have potential hazards been evaluated?
Repeatability confirmed: Are results consistent across multiple trials?

TRL 5 – Technology Validated in Relevant Environment
Prototype tested in relevant setting: Has testing moved beyond the lab?
Environmental factors considered: Are real-world conditions accounted for?
Subsystems reliable: Do integrated components function reliably outside the lab?
Performance metrics achieved: Are target outcomes met in relevant conditions?
Scalability assessed: Is there evidence the technology can scale?

TRL 6 – Technology Demonstrated in Relevant Environment
System prototype demonstrated: Has a near-final prototype been tested in a relevant environment?
Operational performance verified: Does it meet operational requirements?
Reliability proven: Is the system consistently reliable?
Integration successful: Does it integrate with existing systems?
Stakeholder validation: Have external stakeholders confirmed its viability?

Sesi A2 — How the final TRL Rating is Determined

TRL 7 – System Prototype Demonstrated in Operational Environment
Full-scale prototype tested: Has the system been tested in an operational environment?
Operational conditions met: Does it function under real-world stresses?
User feedback collected: Have end-users validated usability?
Performance benchmarks achieved: Are benchmarks consistently met?
Risk mitigation effective: Have operational risks been addressed?

TRL 8 – System Completed and Qualified
Final system built: Is the system complete and ready for deployment?
Certification obtained: Has it passed regulatory or certification processes?
Operational readiness confirmed: Is it fully operational in its intended environment?
Maintenance plan established: Is there a plan for upkeep and support?
Stakeholder acceptance: Have stakeholders formally accepted the system?

TRL 9 – Actual System Proven in Operational Environment
System deployed: Is the technology in active use?
Operational performance proven: Does it consistently meet mission requirements?
Long-term reliability demonstrated: Has it proven reliable over time?
User adoption achieved: Are users successfully employing it?
Continuous improvement enabled: Is there a feedback loop for upgrades?

Sesi A2 — Evidence Standards

Every 'Yes' must be backed by a specific, dated, verifiable document. Setiap 'Ya' mesti disokong oleh dokumen yang spesifik, bertarikh dan boleh disahkan.

Verifiable

The evaluator must be able to independently confirm the existence and content of the document from an external source.

Contemporaneous

Evidence must pre-date the assessment submission. Post-hoc documents are inadmissible — regardless of content.

Specific

Must specifically relate to the technology being assessed. Related prior work or tangential activities do not qualify.

Adequate

Sufficient in quality AND quantity to satisfy the intent of the question — not merely technically responsive.

EVIDENCE TYPES BY PHASE ·	JENIS BUKTI MENGIKUT FASA
TRL 1–2 Research	Publications, theoretical frameworks, literature reviews, documented hypotheses, conceptual models
TRL 3–5 Development	Lab data, prototypes, ethics approvals, test reports, pilot study results, regulatory pre-submissions, validated instruments
TRL 6–8 Deployment	Qualification certificates, regulatory approvals (MDA/BPfK/CAAM/JAKIM), production records, V&V reports, user acceptance sign-off
TRL 9 Operational	Commercial deployment records, sales/adoption data, post-market surveillance, IP licensing agreements, multi-organisation adoption

Sesi A2 — Self TRL Rating Assessment

TRL Stage	Criteria	Weight (%)	Score (0–5)	Notes
TRL 1 – Basic Principles	Concept documented in literature	5		
TRL 2 – Technology Concept	Clear application identified	5		
TRL 3 – Proof of Concept	Prototype/model tested in lab	10		
TRL 4 – Lab Validation	Subsystems integrated in lab	10		
TRL 5 – Relevant Environment	Prototype tested in simulated conditions	15		
TRL 6 – Prototype Demonstration	Functional prototype tested with stakeholders	15		
TRL 7 – System Prototype	System tested in operational environment	15		
TRL 8 – Actual System Completed	System completed and qualified	15		
TRL 9 – Operational Use	Technology fully commercialized/adopted	10		

Sesi A2 — Self TRL Rating Assessment

TRL Stage	Criteria	Weight (%)	Score (0–5)	Weighted Score	Notes
TRL 1 – Basic Principles	Concept documented in literature	5	5	25	Solar energy + purification principles well established
TRL 2 – Technology Concept	Clear application identified	5	5	25	Application: rural clean water supply
TRL 3 – Proof of Concept	Prototype/model tested in lab	10	4	40	Lab tests show purification efficiency
TRL 4 – Lab Validation	Subsystems integrated in lab	10	4	40	Solar panel + filter integration tested
TRL 5 – Relevant Environment	Prototype tested in simulated conditions	15	3	45	Tested under simulated sunlight and water conditions
TRL 6 – Prototype Demonstration	Functional prototype tested with stakeholders	15	3	45	Demonstrated to community leaders, feedback collected
TRL 7 – System Prototype	System tested in operational environment	15	2	30	Limited field trials in one village
TRL 8 – Actual System Completed	System completed and qualified	15	1	15	Not yet fully qualified for mass deployment
TRL 9 – Operational Use	Technology fully commercialized/adopted	10	0	0	No commercialization yet

Sesi A2 — Assessment Panel Composition

Minimum 3, Maximum 5 panel members per assessment · Minimum 3, Maksimum 5 ahli panel setiap penilaian

Panel Chair

Senior academic or industry expert with TRL assessment experience. Appointed by Pusat PI. Resolves disagreements and signs the final TRL Rating Report.

Required for ALL assessments

Domain Expert

At least one assessor with specific expertise in the sub-bidang being assessed. Must hold PhD or equivalent professional qualification in the relevant field.

Required for ALL assessments

Industry Representative

Required for TRL 5 and above to assess commercial and operational readiness. Must have active industry R&D or deployment experience.

Required: TRL 5 and above

Regulatory Expert

Required for health, aerospace, biotechnology, nuclear and heritage domains. Must have direct experience with the relevant Malaysian regulatory authority.

Required: Health, Aerospace, Biotech, Nuclear, Heritage

Conflict of Interest: Co-authorship, financial interest, familial relationship or PhD supervisor/student relationship within 3 years requires mandatory recusal.

Sesi A2 — Who Does What?

Principal Investigator (PI)

- Identifies the correct primary sub-bidang
- Completes the TRL self-assessment form honestly
- Compiles dated, verifiable evidence for each 'Yes' claim
- Submits complete package to Pusat PI before deadline
- Presents findings to panel if requested
- Responds to moderation within 10 working days

Pusat PI / Research Management Centre

- Validates completeness of submission package
- Appoints and coordinates the evaluation panel
- Manages conflict-of-interest declarations
- Transmits materials to panel within 5 working days
- Maintains TRL records in the MOHE grant system
- Manages moderation process when ±2 discrepancy arises

Assessment Panel

- Reviews all evidence documents against each 'Yes' claim
- May request clarification session (max 30 min) from PI
- Reaches consensus rating by deliberation
- Documents disagreements and the specific rationale
- Issues official TRL Panel Rating Report ≤21 working days
- Participates in moderation if triggered

MOHE Grant Division

- Sets TRL gate requirements per grant scheme
- Provides TRL guideline training and resources
- Audits panel assessment quality across institutions
- Resolves escalated moderation disputes
- Updates sub-bidang forms based on field feedback
- Reports national TRL distribution to policy makers

Sesi B
Menghindari Overclaim

Tujuan: peserta mampu menilai kesiapan teknologi secara objektif, transparan, dan akuntabel.

Sesi B — Avoiding Technology Overclaim

Mengapa overclaim sering terjadi?

Overclaim biasanya bukan sekadar masalah etika, tetapi juga masalah sistem penilaian dan dokumentasi.

Tekanan hibah

Proposal dianggap lebih menarik jika TRL tampak tinggi.

Tekanan publikasi

Artikel disalahartikan sebagai bukti kesiapan implementasi.

Bahasa luaran tidak presisi

“Siap pakai”, “tervalidasi”, dan “komersial” digunakan tanpa indikator.

Tidak ada audit bukti

Data, protokol, dan lingkungan uji tidak dipetakan ke level TRL.

Kurang verifikasi eksternal

Penilaian terlalu bergantung pada klaim internal tim.

Klaim yang terlalu tinggi hari ini akan menjadi beban pembuktian yang berat pada tahap hilirisasi berikutnya.

Sesi B — Avoiding Technology Overclaim

Anatomi overclaim teknologi

Overclaim terjadi ketika narasi, bukti, dan lingkungan validasi tidak sejajar.

1

Klaim

“Teknologi siap diterapkan secara luas.”

2

Bukti

Uji laboratorium terbatas dan belum ada validasi pengguna.

3

Konteks

Lingkungan nyata berbeda dari kondisi uji.

4

Risiko

Kinerja turun, biaya membengkak, adopsi gagal.

Diagnosis: overclaim bukan hanya “angka TRL terlalu tinggi”; overclaim adalah ketidaksesuaian antara klaim dan bukti.

Sesi B — Avoiding Technology Overclaim

Red flags dalam klaim TRL

Reviewer sering menangkap sinyal overclaim dari istilah yang terdengar kuat tetapi tidak diikuti bukti.

“Siap komersialisasi”
Tanpa data biaya, pasar, produksi, dan pengguna.

“Tervalidasi”
Tanpa menyebut lingkungan uji dan protokol.

“Sudah terbukti efektif”
Tanpa ukuran keberhasilan dan pembanding.

“Dapat langsung diterapkan”
Tanpa SOP, pelatihan, infrastruktur, dan risiko operasional.

“Skalabel”
Tanpa bukti kapasitas, supply chain, kualitas, dan regulasi.

“TRL 8/9”
Tanpa penggunaan operasional atau produk final.

Sesi B — Avoiding Technology Overclaim

Teknik verifikasi klaim TRL

Verifikasi bertujuan memastikan angka TRL dapat dipertanggungjawabkan bila ditanya reviewer, auditor, atau mitra.

Peer review internal

Panel kecil lintas bidang menilai kesesuaian bukti dan level.

Validasi laboratorium

Uji fungsi, stabilitas, reproduksibilitas, dan batas performa.

Audit stakeholder

Calon pengguna menilai kebutuhan, konteks operasional, dan acceptance.

Traceability dokumen

Setiap klaim memiliki sumber bukti: laporan, data, SOP, foto uji, atau logbook.

Independent check

Lab/mitra eksternal memberi validasi untuk klaim level tinggi.

Prinsip:
Semakin tinggi TRL, semakin perlu validasi eksternal dan lingkungan uji yang mendekati kondisi nyata.

Sesi B — Avoiding Technology Overclaim

Matriks kesesuaian data dan klaim

Gunakan matriks ini untuk melihat apakah data yang dimiliki sudah cukup untuk level TRL yang diklaim.

	TRL 1–3	TRL 4–6	TRL 7–9
Data literatur/model	Kuat	Lemah	Tidak cukup
Data lab	Pendukung	Kuat	Lemah
Data lingkungan relevan	Tidak cukup	Kuat	Pendukung
Data pengguna operasional	Tidak cukup	Pendukung	Kuat

Interpretasi:
Data lab yang kuat dapat mendukung TRL 4–6, tetapi belum cukup untuk klaim TRL 8–9 tanpa bukti operasional.

Sesi B — Avoiding Technology Overclaim

Rubrik scoring objektif

Berikan skor pada dimensi utama sebelum menetapkan level TRL akhir.

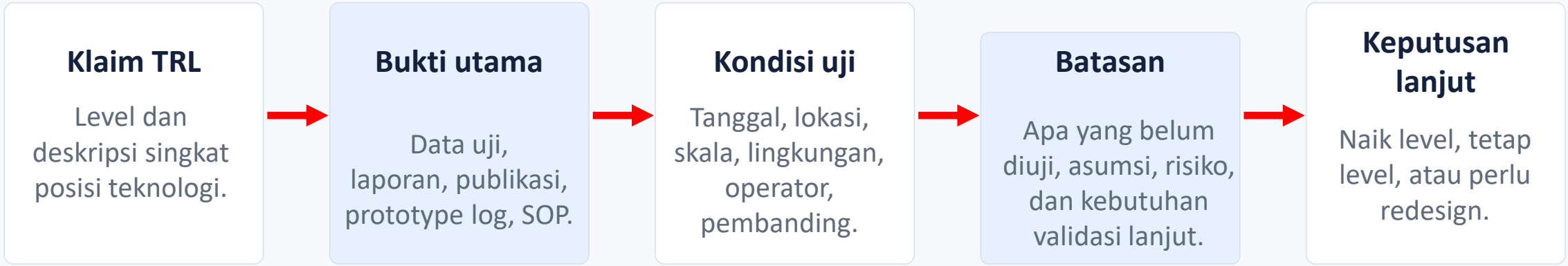
Kejelasan teknologi Batas sistem, fungsi, target pengguna	1	2	3	4	5
Kematangan bukti Jenis data, protokol, konsistensi hasil	1	2	3	4	5
Lingkungan validasi Lab, relevan, atau operasional	1	2	3	4	5
Kesiapan integrasi Komponen, sistem, SOP, kualitas	1	2	3	4	5
Kesiapan adopsi Kebutuhan pengguna, regulasi, operasional	1	2	3	4	5

1 = Belum jelas
3 = Cukup untuk tahap berikutnya
5 = Kuat dan tervalidasi

Sesi B — Avoiding Technology Overclaim

Audit trail: membuat klaim dapat dilacak

Setiap klaim readiness perlu memiliki jejak dokumen yang jelas.



Dokumentasi yang baik mengubah TRL dari “klaim angka” menjadi “argumen berbasis bukti”.

Sesi B — Avoiding Technology Overclaim

Diagnostic drill: memperbaiki klaim overclaim

Latihan mengubah klaim tinggi menjadi klaim yang akurat dan tetap persuasif.

Klaim awal: **“Teknologi ini sudah siap dikomersialisasikan karena hasil laboratorium menunjukkan performa yang baik.”**

Revisi: **“Berdasarkan uji laboratorium berulang, teknologi berada pada TRL 4. Tahap berikutnya adalah validasi prototipe di lingkungan relevan untuk menilai stabilitas performa, kebutuhan operasi, dan batasan implementasi.”**

Pola revisi:
Turunkan klaim → sebutkan bukti → nyatakan batasan → jelaskan rencana naik level.

Sesi B — Avoiding Technology Overclaim

TRL Level	Information and Communication Technology (ICT)	Technology and Engineering (TK)	Pure and Applied Science (STG)	Clinical and Health Sciences (SKK)	Social Science (SS)	Arts and Applied Arts (SSI)	Environment and Heritage (WAS)
TRL 1: Basic Principles Observed	• Literature review documents • Theoretical computations • Concept papers • Algorithm descriptions • Initial simulations	• Basic scientific reports • Material properties documentation • Physical principles documentation • Concept sketches • Initial calculations	• Research publications • Laboratory notebooks • Theoretical models • Mathematical formulations • Preliminary data	• Literature reviews • In vitro experimental data • Basic mechanism documentation • Research publications • Receptor/target identification	• Conceptual frameworks • Literature reviews • Theoretical models • Initial survey instruments • Research hypotheses	• Conceptual sketches • Artistic briefs • Design principles documentation • Media exploration notes • Aesthetic research reports	• Ecological principles documentation • Environmental samples • Initial field observations • Baseline data collection • Conceptual conservation models
TRL 2: Technology Concept Formulated	• Software architecture diagrams • Use case specifications • Data flow models • Pseudocode or flowcharts • Technology comparison analysis	• Engineering concept drawings • Design specifications • Material selection matrices • Process flow diagrams • Feasibility analyses	• Experimental design documents • Methodology formulations • Research proposals • Laboratory protocols • Instrumentation plans	• Proposed mechanism of action • Target validation data • Formulation strategies • Diagrams of molecular interactions • Preliminary safety assessments	• Research design documents • Sampling strategies • Intervention frameworks • Policy concept papers • Stakeholder analysis	• Design briefs • Visual/audio storyboards • Concept renderings • Artistic technique proposals • Audience engagement plans	• Habitat assessment protocols • Conservation strategy outlines • Environmental impact frameworks • Resource management plans • Monitoring designs
TRL 3: Experimental Proof of Concept	• Prototype code or application • Test case results • Benchmark performance data • Functionality demonstrations • Alpha testing reports	• Laboratory test results • Proof-of-concept prototypes • Experimental data logs • Material sample testing • Component performance data	• Laboratory experiment results • Initial data analysis • Proof-of-concept validation • Reaction/process demonstrations • Analytical method validation	• Cell/tissue experimental data • In vitro efficacy studies • Proof-of-mechanism data • Initial dosing studies • Analytical method validation	• Pilot study results • Focus group transcripts • Initial survey data • Preliminary statistical analysis • Qualitative coding schemes	• Prototype artifacts/media • Initial audience response data • Technical demonstrations • Creative process documentation • Material/technique experiments	• Field study results • Species/ecosystem response data • Pilot intervention outcomes • Environmental parameter measurements • Conservation technique demonstrations
TRL 4: Technology Validated in Lab	• Integrated system demonstration • Test environment logs • Performance metrics data • Interoperability testing • Configuration testing reports	• Sub-system integration tests • Laboratory validation reports • Technical specifications • Performance validation data • Failure mode analysis	• Replicated study results • Controlled variable testing • Measurement calibration data • Statistical analysis reports • Equipment validation logs	• Reproducible laboratory data • Multiple model validation • Dose-response curves • Method validation documents • Laboratory system integration	• Validated instruments • Measurement reliability data • Controlled experiment results • Intervention fidelity measures • Complete pilot study reports	• Validated production techniques • Technical quality assessments • Material integration tests • Performance reliability data • Complete creative prototype	• Validated measurement protocols • Reproducible intervention results • Controlled environmental testing • Statistical analysis of field data • System modeling validation

Sesi B — Avoiding Technology Overclaim

TRL 5: Technology Validated in Relevant Environment	**• Beta testing reports • User environment testing • Integration with external systems • Performance under constraints • Relevant data set testing**	**• Simulated environment testing • Prototype field testing • Environmental condition testing • Scaled model validation • Integration testing reports**	**• Representative environment testing • Scale-up validation • Relevant condition testing • Field sample validation • Method transfer protocols**	**• Ex vivo testing data • Animal model results • Formulation stability testing • Preliminary safety data • Production scale-up data**	**• Field testing documentation • Real-world context validation • Diverse population sampling • Contextual variable analysis • Stakeholder reports**	**• Contextual testing documentation • Venue/environment testing • User interaction analysis • Cultural context validation • Performance under constraints**	**• Relevant ecosystem testing • Seasonal variation data • Field testing across conditions • Community implementation data • Multi-factor environmental testing**
TRL 6: Technology Demonstrated in Relevant Environment	• System demonstration in intended environment • User acceptance testing • Load/stress test results • Compatibility testing across platforms • Security and performance audits	• Full prototype testing • Operational environment testing • Performance validation reports • Durability testing data • Standards compliance testing	• Demonstration in operational conditions • Field testing documentation • Process scale-up validation • Operational parameter testing • Validation across conditions	• GLP toxicology studies • GMP material production • Phase I clinical trial protocols • Regulatory submission drafts • Patient/subject screening criteria	• Demonstration with end users • Multiple site implementation • Process evaluation reports • Contextual adaptations documentation • Stakeholder engagement evidence	• Public/audience demonstrations • Professional venue presentations • Distribution channel testing • Audience engagement analytics • Critical reception documentation	• Real ecosystem demonstration • Multiple site implementation • Seasonal/annual cycle testing • Stakeholder participation evidence • Implementation under varied conditions
TRL 7: System Prototype Demonstration in Operational Environment	• Full system implementation • Real user environment testing • Integration with production systems • Performance monitoring data • Operational scenario testing	• System prototype field testing • Operational trials documentation • Integration testing with existing systems • Certification test data • User operation documentation	• Full-scale demonstration • Operational testing reports • Integration with existing systems • User validation documentation • Operational parameter verification	• Phase I/II clinical trial results • Safety and efficacy data • Method validation packages • Regulatory interactions • Clinical protocol approvals	• Multi-site implementation data • Process evaluation results • Adaptation documentation • Implementation protocols • Training materials/manuals	• Public installation/performance • Audience/market testing data • Professional venue implementation • Technical infrastructure integration • Distribution system testing	• Full ecosystem implementation • Multiple stakeholder integration • Governance system testing • Community adoption evidence • Cross-seasonal performance data
TRL 8: System Complete and Qualified	• Completed software/system documentation • Final quality assurance reports • User acceptance signoff • Performance verification reports • Compliance certification	• Manufacturing documentation • Quality control procedures • Certification/compliance documents • Final performance verification • Operational manuals	• Final validation reports • Standard operating procedures • Quality control documentation • User manuals/training • Production specifications	• Phase III clinical trial results • Regulatory submission packages • Manufacturing validation • Final product specifications • Commercial launch plans	• Complete implementation packages • Policy/practice guidelines • Training curriculum materials • Assessment/evaluation tools • Dissemination materials	• Final production/installation documents • Distribution agreements • Professional reviews/critiques • Complete audience analytics • Technical production manuals	• Complete management protocols • Implementation guidelines • Training/education packages • Multi-stakeholder agreements • Final impact assessment
TRL 9: Actual System Proven in Operational Environment	• Market deployment evidence • User adoption metrics • Operational performance data • Post-deployment audits • Maintenance records	• Commercial implementation evidence • Post-market surveillance • Customer feedback data • Performance tracking records • Industry adoption metrics	• Commercial adoption evidence • Industry standard integration • Performance tracking over time • Wide-scale implementation data • Post-market analysis	• Approved product in market • Post-marketing surveillance • Health outcomes data • Reimbursement approvals • Clinical practice integration	• Wide-scale adoption evidence • Policy/practice integration • Long-term outcome data • Knowledge transfer materials • Sustainability documentation	• Market success metrics • Cultural impact assessments • Audience/consumer adoption data • Industry recognition • Sustained distribution/exhibition	• Widespread implementation • Long-term monitoring data • Policy/regulation adoption • Ecosystem response metrics • Community ownership evidence

Sesi B — Avoiding Technology Overclaim

TRL Level	Technical Evidence	IP and Publications	Stakeholder Engagement	Regulatory Compliance	Scalability/Deployment	Collaborations
TRL 1-3	Simulation results (ICT: 80% algorithm accuracy); lab data (STG: 90% yield); pilot study (SS: survey data).	Journal article (TK: material properties); preprint (SKK: biomarker study); policy brief (SS).	Initial consultations (WAS: community input); user needs analysis (SSI: artist feedback).	Ethical approvals (SKK: IRB); cultural review (SSI: heritage sensitivity).	Theoretical scalability plan (ICT: software model); policy replication plan (SS).	Letter of intent (TK: industry MoU); NGO consultation (SS).
TRL 4-6	Prototype test data (TK: 85% efficiency); clinical trial results (SKK: 90% accuracy); community adoption (SS: 80% uptake).	Patent application (ICT: software design); conference paper (SKK: diagnostic device); policy report (SS).	User testing feedback (SKK: clinician reports); public response (SSI: art installation feedback).	Pre-submission regulatory plan (TK: safety standards); data privacy compliance (ICT).	Pilot deployment (WAS: waste system in one site); pilot policy implementation (SS).	Active partnership agreement (ICT: industry co-testing); community collaboration (WAS).
TRL 7-9	Operational system metrics (ICT: 99% uptime); long-term drug efficacy (SKK); cultural impact data (SSI).	Granted patent (TK: device design); industry journal (SKK: drug approval); cultural manual (SSI).	Stakeholder endorsements (TK: industry contracts); government adoption (SS: policy).	Full regulatory approval (SKK: FDA clearance); LEED certification (WAS).	Full-scale deployment (ICT: city-wide system); national policy adoption (SS).	Long-term partnership (SKK: commercial partner); cultural institution contract (SSI).

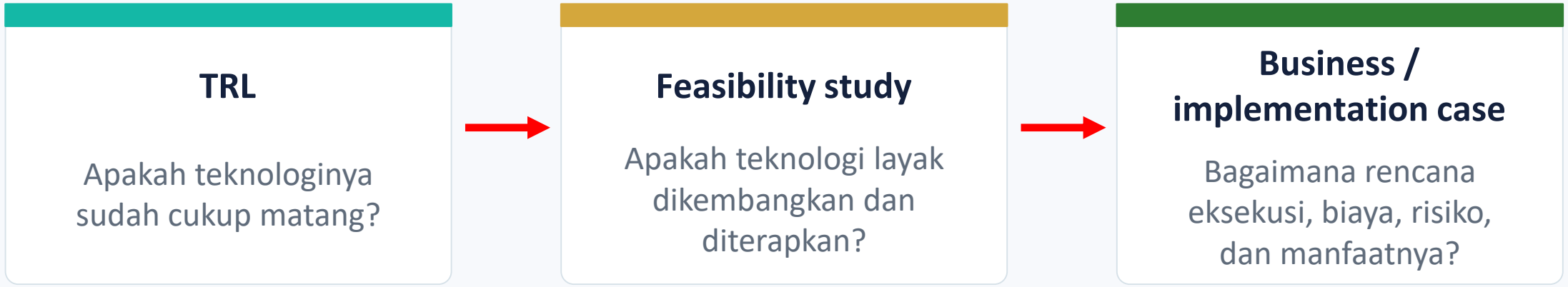
Sesi C
Feasibility Study

Tujuan: peserta memahami struktur studi kelayakan untuk mendukung komersialisasi dan implementasi riset.

Sesi C — Feasibility Study

Feasibility study sebagai jembatan hilirisasi

TRL yang baik belum cukup; keputusan hilirisasi juga membutuhkan analisis kelayakan.



Kelayakan bukan hanya “bisa dibuat”, tetapi “masuk akal untuk dijalankan, dibiayai, digunakan, dan dipertahankan”.

Sesi C — Feasibility Study

Feasibility study sebagai jembatan hilirisasi

- **TRL Assessment**
  - Focuses on the *technical maturity* of a technology.
  - Helps determine whether the innovation is at lab stage, prototype stage, or ready for commercialization.
  - Example: TRL 3 = proof of concept in lab; TRL 7 = prototype tested in operational environment.
- **Feasibility Study**
  - Broader evaluation of *technical, financial, market, operational, and regulatory viability*.
  - Determines whether the project should move forward, attract investment, or scale.
  - Includes cost-benefit analysis, risk assessment, and stakeholder readiness.

Sesi C — Feasibility Study

Feasibility study sebagai jembatan hilirisasi

1. **TRL First**:
   - You typically conduct a TRL assessment **before** a full feasibility study.
   - Reason: If the technology is still at TRL 2–3 (concept stage), a feasibility study would be premature because the technical foundation isn't validated yet.

2. **Feasibility Study Next**:
   - Once TRL reaches **5–7** (validated prototype, tested in relevant/operational environments), a feasibility study becomes meaningful.
   - At this stage, you can realistically evaluate costs, market demand, regulatory compliance, and commercialization pathways.

3. **Integration**:
   - In Malaysia, Prof. Dr. Mohd Shahir Shamsir Bin Omar's framework emphasizes using TRL as a **pre-validation tool**.
   - The feasibility study then builds on TRL results to justify funding, industry collaboration, and policy support.

Sesi C — Feasibility Study

Komponen utama feasibility study

Dokumen yang kuat menggabungkan aspek teknis, pasar, finansial, operasional, risiko, dan keberlanjutan.

Sesi C — Feasibility Study

Kelayakan teknis

Menilai apakah teknologi dapat berfungsi, direplikasi, diskalakan, dan dipelihara dalam konteks penggunaan.

Readiness

TRL saat ini
gap menuju level berikutnya
bukti validasi

Resources

material
peralatan
SDM teknis

Infrastructure

lab/pilot facility
energi/utilitas
quality control

Performance

target kinerja
toleransi kegagalan
standardisasi

Scalability

kapasitas supply chain
replikasi proses

Pertanyaan kunci: apakah teknologi bisa berjalan stabil di luar kondisi ideal laboratorium?

Sesi C — Feasibility Study

Kelayakan pasar dan pengguna

Hilirisasi gagal ketika teknologi memecahkan masalah yang tidak cukup penting bagi pengguna.

Output analisis pasar minimal

Pernyataan segmen pengguna, masalah prioritas, alternatif yang tersedia, alasan adopsi, dan hambatan utama.

Sesi C — Feasibility Study

Kelayakan ekonomi dan model bisnis

Analisis ekonomi tidak harus rumit, tetapi harus menjelaskan biaya, manfaat, dan asumsi secara transparan.

CAPEX

Alat, fasilitas, instalasi, izin awal

OPEX

Bahan, energi, SDM, maintenance, quality control

Revenue / benefit

Penjualan, penghematan, nilai sosial/lingkungan

Unit economics

Biaya per unit, margin, break-even, skenario volume

Business model

B2B, B2G, licensing, service model, spin-off

Kata kunci:
Tampilkan asumsi. Reviewer tidak menuntut kepastian penuh, tetapi menuntut logika ekonomi yang dapat diuji.

Sesi C — Feasibility Study

Risiko dan keberlanjutan inovasi

Feasibility study harus mengidentifikasi risiko sejak awal, bukan hanya setelah teknologi gagal.

Teknis

Performa tidak stabil, komponen gagal, kualitas sulit dijaga

Operasional

Operator tidak siap, SOP belum matang, supply chain lemah

Ekonomi

Biaya lebih tinggi, demand rendah, cashflow negatif

Regulasi

Izin, standar, sertifikasi, keamanan produk

Sosial

Acceptance rendah, perubahan perilaku, persepsi risiko

Lingkungan

Limbah, emisi, resource footprint, end-of-life

Risk statement yang baik = risiko + dampak + probabilitas + mitigasi + pemilik risiko.

Sesi C — Feasibility Study

Matriks TRL × feasibility

Keputusan lanjut perlu mempertimbangkan kesiapan teknologi dan kelayakan implementasi secara bersamaan.

TRL / kesiapan teknologi

TRL rendah **Feasibility tinggi** Kebutuhan kuat, R&D perlu dipercepat	**TRL tinggi** **Feasibility tinggi** Siap pilot, scale-up, atau komersialisasi
TRL rendah **Feasibility rendah** Perlu eksplorasi ulang atau stop sementara	**TRL tinggi** **Feasibility rendah** Teknologi siap, model implementasi lemah

Kelayakan implementasi →

Sesi C — Feasibility Study

Feasibility Study Report – Solar Microgrid for Rural Sarawak Communities




1. Executive Summary

- **Objective**: Assess the viability of deploying solar microgrids in off-grid villages in Sarawak.
- **Key Findings**: Technically feasible, high social impact, moderate financial risk.
- **Recommendation**: Proceed with pilot implementation in two villages under government–private partnership.

2. Background & Objectives

- **Context**: Over 20% of Sarawak's rural population lacks reliable electricity.
- **Goal**: Provide sustainable, low-cost energy using solar microgrid systems.
- **Alignment**: Supports Malaysia's *Renewable Energy Transition Roadmap 2035* and *UN SDG 7 (Affordable Clean Energy)*.

Sesi C — Feasibility Study

Feasibility Study Report – Solar Microgrid for Rural Sarawak Communities

3. Technical Feasibility

- **System Design**: 50 kW solar array, battery storage, smart inverter, and local distribution.
- **Technology Readiness Level (TRL)**: Rated **6–7**, validated prototype ready for field deployment.
- **Risks**: Weather variability, battery degradation, maintenance logistics.
- **Mitigation**: Hybrid solar–diesel backup and local technician training.

4. Market Feasibility

- **Target Users**: 200 households, small businesses, and schools.
- **Demand Analysis**: 85% of surveyed residents willing to pay RM 30–50/month for reliable power.
- **Competitors**: Diesel generators (high cost, low reliability).
- **Opportunity**: Government subsidies and carbon credit incentives.

Feasibility Study Report – Solar Microgrid for Rural Sarawak Communities Communities

5. Financial Feasibility

Metric	Value
Initial Investment	RM 1.2 million
Annual O&M Cost	RM 120 000
Payback Period	6.5 years
IRR	14.2%
NPV (10 years)	RM 480 000

6. Operational Feasibility

- **Local Workforce**: Technicians trained via UTM–Sarawak Polytechnic collaboration.
- **Maintenance Plan**: Quarterly inspections and remote monitoring.
- **Supply Chain**: Solar panels sourced locally; batteries imported from Thailand.

Sesi C — Feasibility Study

Feasibility Study Report – Solar Microgrid for Rural Sarawak Communities Communities

7. Legal & Regulatory Feasibility

- **Compliance:**
  - *Renewable Energy Act 2011 (Act 725)*
  - *Electricity Supply Act 1990 (Act 447)*
  - *Environmental Quality Act 1974*

8. Risk Assessment

Risk	Impact	Mitigation
Weather fluctuations	Medium	Hybrid backup system
Funding delays	High	Multi-source financing
Technical failure	Low	Preventive maintenance
Community resistance	Medium	Awareness campaigns

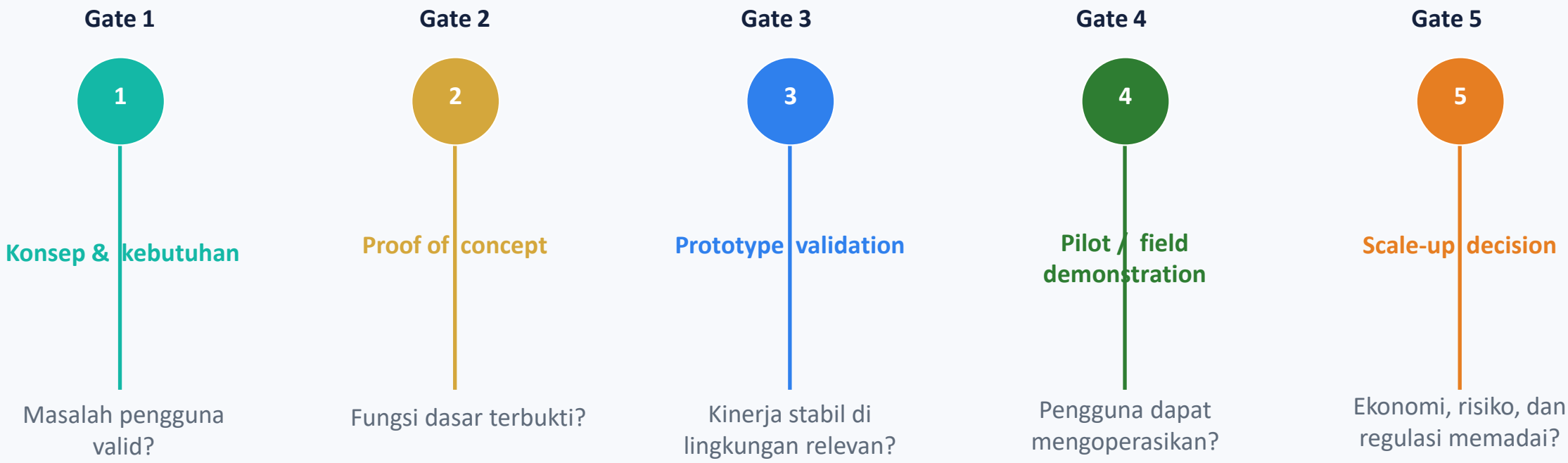
9. Recommendations & Conclusion

- **Proceed with pilot phase** in two villages.
- **Monitor performance** for 12 months before scaling.
- **Engage MOHE and UTM** for TRL validation and commercialization support.

Sesi C — Feasibility Study

Decision gate untuk hilirisasi

Setiap tahap harus memiliki keputusan: lanjut, revisi, pivot, atau hentikan sementara.



Decision gate membuat hilirisasi menjadi proses bertahap, bukan loncatan langsung dari publikasi ke produk.

10 MENIT

Brief Coaching Session of Dokumen Feasibility Study

Tujuan: peserta memahami struktur dokumen, cara menulis executive summary, dan format canvas satu halaman.

Brief Coaching Session

Struktur dokumen feasibility study

Gunakan struktur ini sebagai kerangka kerja ringkas untuk proposal hilirisasi dan diskusi dengan mitra.

1. Executive summary	Ringkasan keputusan, teknologi, nilai, dan rekomendasi
2. Deskripsi teknologi	Fungsi, status TRL, bukti, batas sistem
3. Analisis teknis	Kinerja, infrastruktur, SOP, supply chain, scalability
4. Analisis pasar/pengguna	Segmen, kebutuhan, alternatif, adoption pathway
5. Analisis finansial	CAPEX, OPEX, revenue/benefit, skenario
6. Risiko & keberlanjutan	Risk register, mitigasi, lingkungan, sosial, regulasi
7. Roadmap & rekomendasi	Milestone, keputusan lanjut, kebutuhan pendanaan

Brief Coaching Session

Contoh Executive Summary

The executive summary was extracted from the successful FRGS proposal below;

Brief Coaching Session

Contoh Executive Summary

300 words Executive Summary

Industries are becoming more reliant on the cognitive-capacity of workers who are well-grounded in critical thinking skills. There is a pressing need for educational institutions to emphasize the teaching of critical thinking skills to their TVET students because of its significant contribution towards employability especially in the advent of Industrial Revolution 4.0. However, in Malaysia, there is **no guideline** in integrating critical thinking within TVET programs even within the MTUN network. Any mention of critical thinking in the curricula are only restricted to general courses offered in early semesters and are taught by lecturers who are not well trained in adopting critical thinking in engineering/technology disciplines. Even the education regulator's MQA does not explicitly outline the practice needed to implement critical thinking in the governing documents. The **complex involvement** of many ministries with myriad TVET offerings e.g KBS, KSM, KPT, KPM under the TVET education umbrella has made the need for the creation of a best practice model a **critical need** that has to be

Brief Coaching Session

Contoh Executive Summary

Part 2

addressed quickly to **ensure our TVET Malaysia Plan and 21st Century Curriculum for MyHE 4.0 succeed.** The purpose of this study is to investigate the existing practices and competencies within the TVET Higher Education ecosystem involving MTUN and TVET IHEs. e.g. JPPKK and UniKL. Using Exploratory Sequential Mixed Methods embedding Modified Delphi techniques and Quantitative approach, this study will **produce a best practice guideline** that can be utilised by MTUN and TVET IHEs in implementing critical thinking in curriculum and instruction. This novel addition will enhance Malaysian TVET education quality and potentially **increase the graduate employability of future students**. Successful adoption can be mirrored and cascaded to other TVET education levels e.g ILP, KK and IKBN. The impact of this research is in line with the KEGA3 and SDG4.

Brief Coaching Session

Cara menulis executive summary yang kuat

Ringkasan eksekutif harus menjawab “apa keputusan yang diminta dan mengapa masuk akal”.

Masalah

Masalah pengguna/industri yang jelas dan bernilai

→

Solusi

Teknologi dan value proposition

→

Evidence

TRL, bukti validasi, dan batasan

→

Feasibility

kelayakan teknis, pasar, ekonomi, risiko

→

Ask

dukungan, keputusan, pendanaan, pilot, atau kemitraan

Formula 5 kalimat:
masalah → solusi → bukti → kelayakan → keputusan yang diminta.

Brief Coaching Session

Menulis bagian teknis: dari deskripsi ke evidence

Bagian teknis harus menunjukkan fungsi, bukti, dan gap teknologi secara presisi.

Kurang kuat “Alat ini efektif dan siap diterapkan di lapangan.”

Lebih kuat “Prototipe skala laboratorium menunjukkan stabilitas fungsi selama tiga siklus uji. Validasi berikutnya diperlukan pada lingkungan relevan untuk menguji durabilitas, kebutuhan operator, dan konsistensi performa.”

Checklist teknis:
target performa • metode uji • hasil kunci • lingkungan validasi • keterbatasan • rencana naik TRL.

Brief Coaching Session

Menulis bagian pasar dan ekonomi

Bagian ini harus menunjukkan siapa pengguna, apa nilai yang ditawarkan, dan apakah skenario ekonominya masuk akal.

Pasar/Pengguna

Siapa pengguna utama?
Apa masalah prioritas mereka?
Apa alternatif saat ini?
Mengapa solusi ini lebih baik?
Hambatan adopsi apa yang paling besar?

Ekonomi/Finansial

Apa biaya awal?
Apa biaya operasi per unit?
Apa manfaat finansial/non-finansial?
Apa skenario konservatif dan optimistis?
Kapan keputusan pilot/scale-up layak dibuat?

Jangan hanya menulis “potensi pasar besar”;
tunjukkan demand signal, segmen, dan asumsi yang dapat diuji.

Brief Coaching Session

Template risk register sederhana

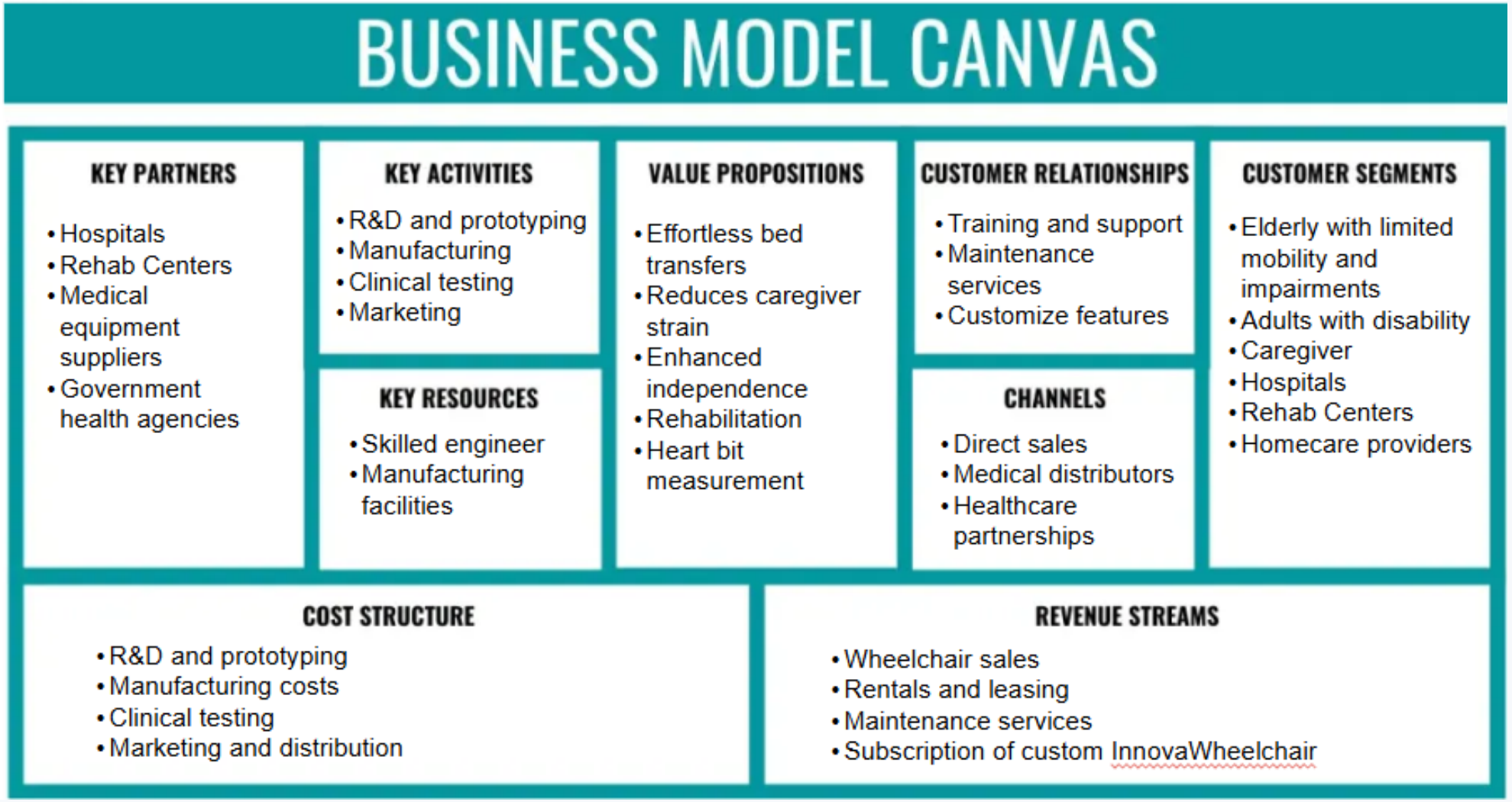
Risk register membantu feasibility study terlihat matang, bukan sekadar optimistis.

Risiko	Dampak	Probabilitas	Mitigasi	Pemilik
Performa turun saat scale-up	Produk tidak memenuhi target	Sedang	Uji pilot bertahap; parameter QC	Tim teknis
Biaya operasi tinggi	Harga tidak kompetitif	Sedang	Skenario biaya; optimasi bahan/energi	Tim bisnis
Regulasi belum jelas	Implementasi tertunda	Rendah–Sedang	Early consultation; mapping standar	Tim legal/mitra

Gunakan kategori sederhana: rendah / sedang / tinggi; yang penting adalah mitigasi dan pemilik risiko jelas.

Brief Coaching Session

Contoh Business Model Canvas



SDEC launches TechFrontier Incubator to drive innovation, job creation and high-value growth in Sarawak

By Digital News Asia February 5, 2026

- ***Programme enables researchers to scale lab innovations with economic potential***
- ***The incubator aims to turn validated research into scalable, market-ready solutions***

The Sarawak Digital Economy Corporation (SDEC) has launched the TechFrontier Incubator Cohort 1, a strategic initiative designed to accelerate research commercialisation, stimulate deep-tech innovation-led enterprise creation, and support the growth of high-value industries in Sarawak.

Brief Coaching Session

Feasibility canvas satu halaman

Canvas ini dapat digunakan sebagai latihan setelah sesi atau sebagai lampiran awal proposal.

Teknologi & TRL

Apa teknologi, fungsi, dan level saat ini?

Bukti utama

Data apa yang paling kuat?

Pengguna & masalah

Siapa pengguna dan masalah apa yang diselesaikan?

Nilai/manfaat

Apa manfaat yang terukur?

Kelayakan teknis

Sumber daya, infrastruktur, SOP?

Kelayakan ekonomi

CAPEX, OPEX, manfaat, skenario?

Risiko utama

Apa risiko terbesar dan mitigasinya?

Roadmap

Langkah 6–12 bulan berikutnya?

Prinsip canvas: satu halaman, berbasis bukti, cukup jelas untuk didiskusikan dengan reviewer/mitra.

Brief Coaching Session

Contoh walkthrough: dari riset ke feasibility plan

Gunakan pola ini untuk mengubah hasil penelitian menjadi rencana hilirisasi yang realistis.

1	**Hasil riset**	Prototipe/produk/proses menunjukkan fungsi awal.
2	**TRL saat ini**	
3	**Gap bukti**	Apa yang belum diuji untuk level berikutnya?
4	**Feasibility scan**	Teknis, pasar, ekonomi, operasional, risiko.
5	**Roadmap**	

Kuncinya bukan membuat semua teknologi terlihat siap, tetapi membuat jalan menuju kesiapan terlihat jelas.

Brief Coaching Session

Latihan kelompok: quick feasibility diagnosis

Format latihan 10–15 menit bila waktu memungkinkan.

1. Pilih satu teknologi

Gunakan hasil riset yang benar-benar ada, bukan ide yang masih umum.

2. Tentukan TRL defensible

Tuliskan angka, bukti utama, lingkungan validasi, dan batasan.

3. Isi feasibility canvas

Fokus pada pengguna, kelayakan teknis, ekonomi, risiko, dan roadmap.

4. Presentasi 2 menit

Sampaikan keputusan: lanjut, validasi ulang, pivot, atau stop sementara.

Output yang diharapkan:
Satu kalimat TRL + satu keputusan feasibility + satu langkah validasi berikutnya.

Brief Coaching Session

Kesalahan umum dalam feasibility study

Dokumen feasibility yang lemah biasanya terlalu naratif dan kurang menunjukkan keputusan.

Tidak ada keputusan

Dokumen hanya mendeskripsikan teknologi tanpa rekomendasi.

Tidak ada asumsi biaya

Angka ekonomi muncul tanpa dasar atau skenario.

Pengguna terlalu umum

“Masyarakat/industri” tidak didefinisikan sebagai segmen spesifik.

Risiko disembunyikan

Dokumen hanya menonjolkan manfaat dan mengabaikan kegagalan.

TRL tidak sinkron

Bagian teknis mengklaim siap, tetapi bukti masih level laboratorium.

Uji akhir:
Setelah membaca dokumen, pembaca harus tahu apakah proyek layak dilanjutkan dan apa syaratnya.

Conclusions

Credible innovation starts with honest readiness.

TRL yang akurat membangun kepercayaan.
Feasibility study mengubah hasil riset menjadi keputusan hilirisasi.
Hilirisasi yang kuat dimulai dari bukti, bukan overclaim.

Terima kasih

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Republik Indonesia	Permenristekdikti No. 42 Tahun 2016 tentang Pengukuran dan Penetapan Tingkat Kesiapterapan Teknologi.

Catatan:
Definisi dan contoh telah disesuaikan untuk konteks riset perguruan tinggi dan hilirisasi teknologi di Indonesia.