



Industrial Research

*What to expect after
graduate school*

19th Annual Chemical Engineering GSO
Purdue University
August 19, 2010



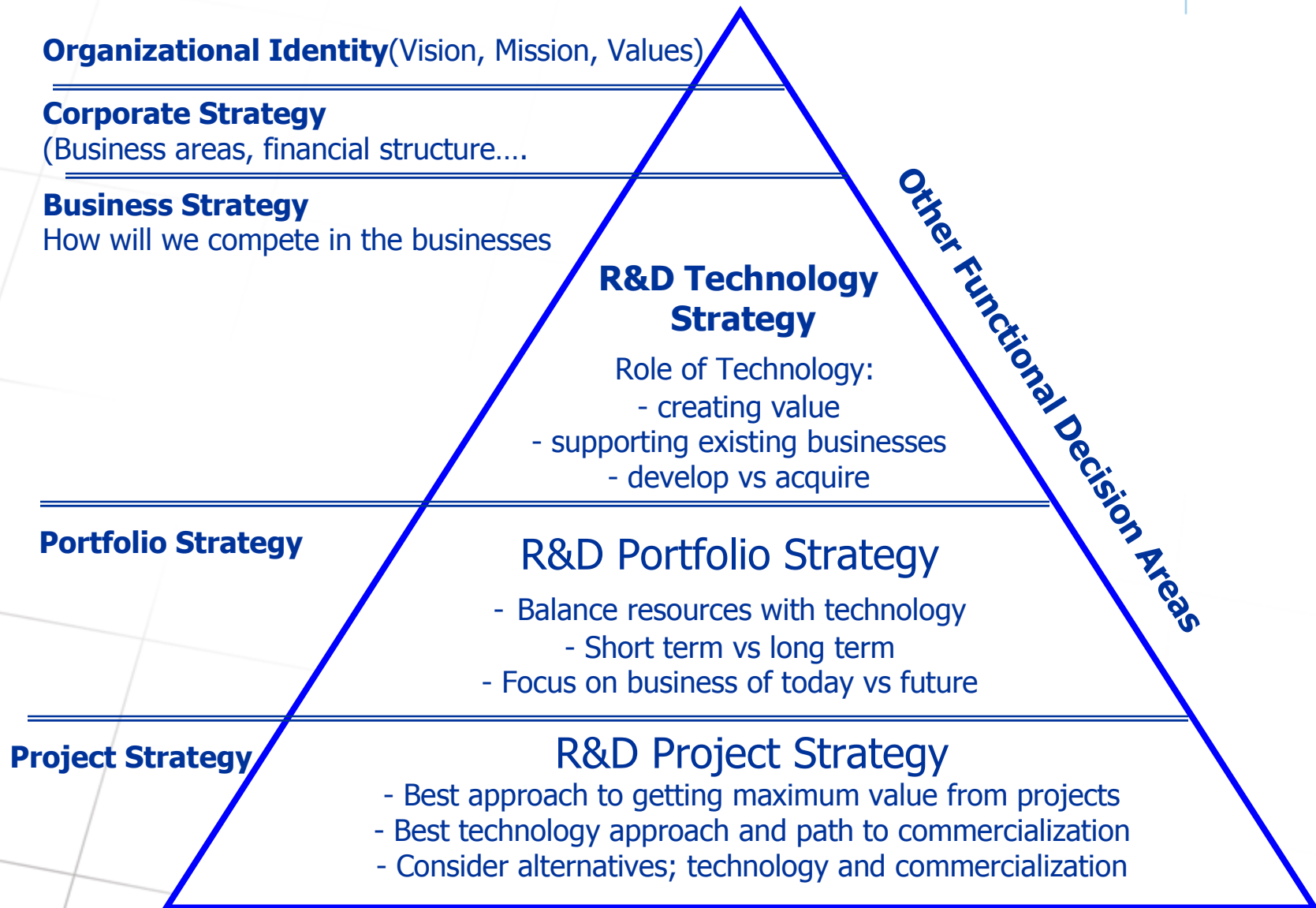
WORKING TO REDUCE OUR ENVIRONMENTAL FOOTPRINT



● Air Liquide

- R&D at Air Liquide
- How do you allocate resources to R&D?
- Challenges facing Corporate R&D labs
- The transition from Graduate School

Strategic Decision Hierarchy



World leader in gases for industry, health and the environment



- Total revenue 2009 : \$ 16 **billion**
- Over 1 million customers in **75 countries**
- **43 000 employees**
- **36% of Air Liquide's revenue** comes from gas applications which preserve **life** and the **environment**
- **60% of Air Liquide's R&D** budget devoted to developing technologies designed to preserve the **environment** (energy savings, cleaner production, future energy development) and **life**
 - **Innovation budget \$290 million**



Innovation

1902 - Georges Claude and Paul Delorme

- **New process** for oxygen production (10 times more energy efficient)
- Now **world leader** in gases for **industry, health and the environment**



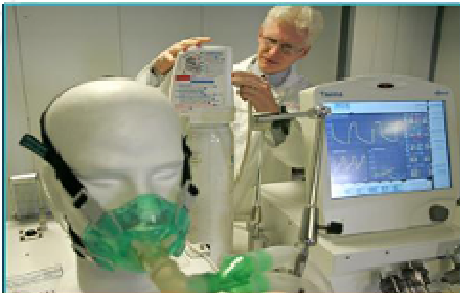
Industrial Customers (€4.2 bn)

- Bulk & cylinders deliveries
- Serving a wide variety of customers



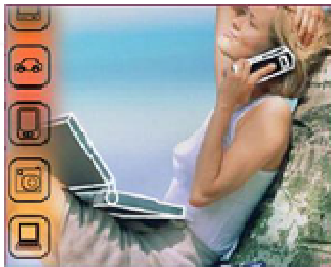
Large Industries (€3.3 bn)

- Large dedicated plants at customer sites
- Air gases and Hydrogen
- Pipeline network



Healthcare (€1.8 bn)

- Medical gases & equipment (hospitals)
- Homecare
- Hygiene applications



Electronics (€1 bn)

- Smaller dedicated plants at customer sites
- Specialty gases, equipment, services



Engineering – Welding & Cutting - others (€1.7 bn)

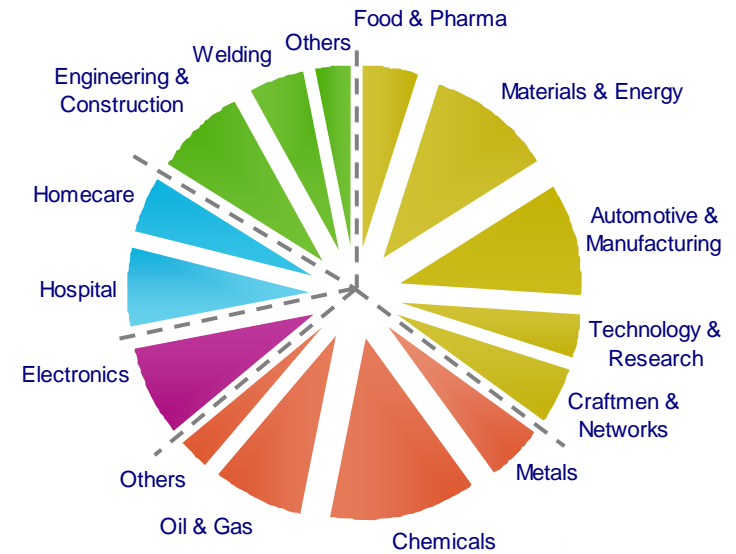
- Design & build production plants (O₂, N₂, H₂, CO)
- W&C : processes, equipment & consumables

The strength of diversity

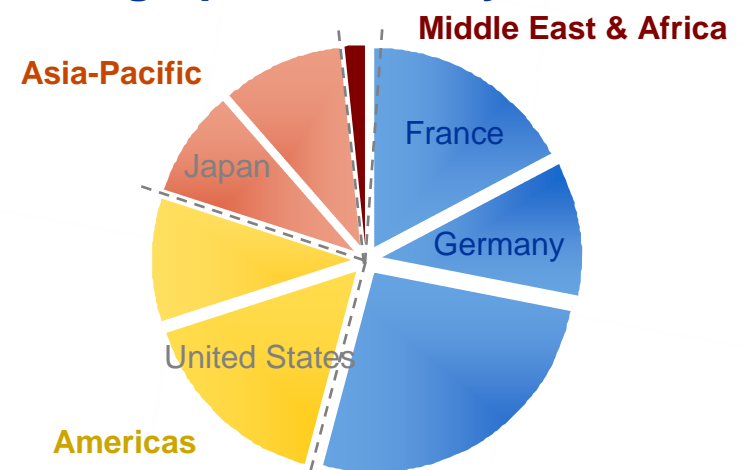
Diversity of our talents: *nationalities, education, expertise*



Diversity of our customers



Geographic diversity of revenue



At the heart of the most important challenges facing the planet



● Our ambition:

To be the recognized leader in gases for industry, health and the environment.

● Our vision:

Our activities lie at the heart of the most important challenges facing the planet. To meet these challenges, Air Liquide develops innovative technologies and sustainable solutions, optimizing the use of air and the planet's natural resources, enabling progress and preserving life.

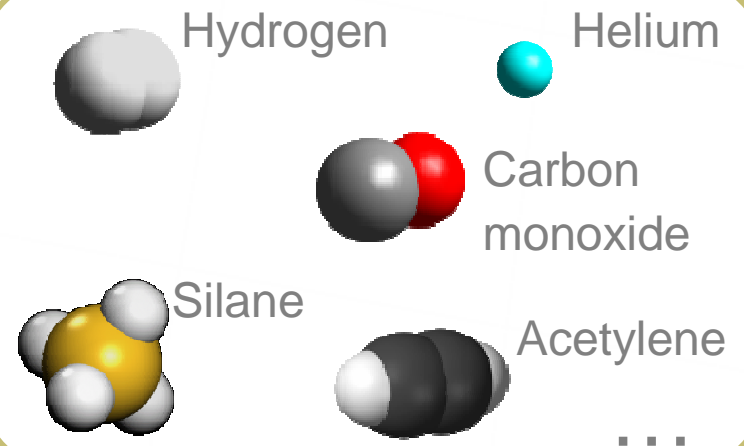
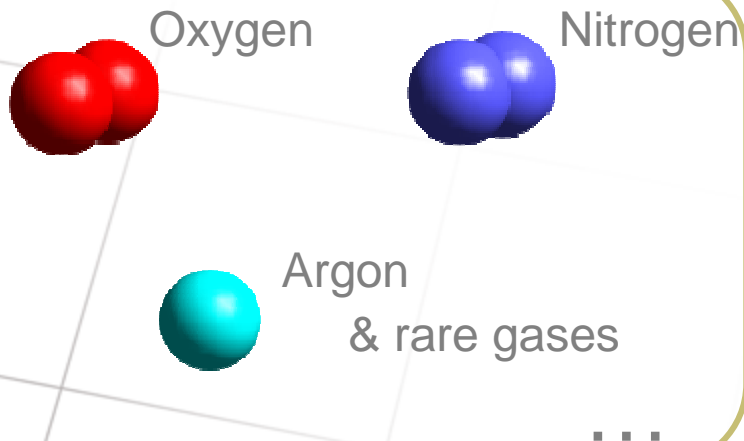
● Our mission:

Anticipate the challenges facing our current and future markets worldwide and deliver sustainable progress for our customers, employees and shareholders, thanks to innovation, know-how and performance over the long term.

Separating the components of the **air** to take advantage of their properties

Producing molecules from **natural resources** of the Planet

Air Liquide Technologies



Customer focus: drives innovation



Molecule provider



Technology provider



In depth knowledge of customer's process



Creating added-value for our customers by proactively proposing solutions



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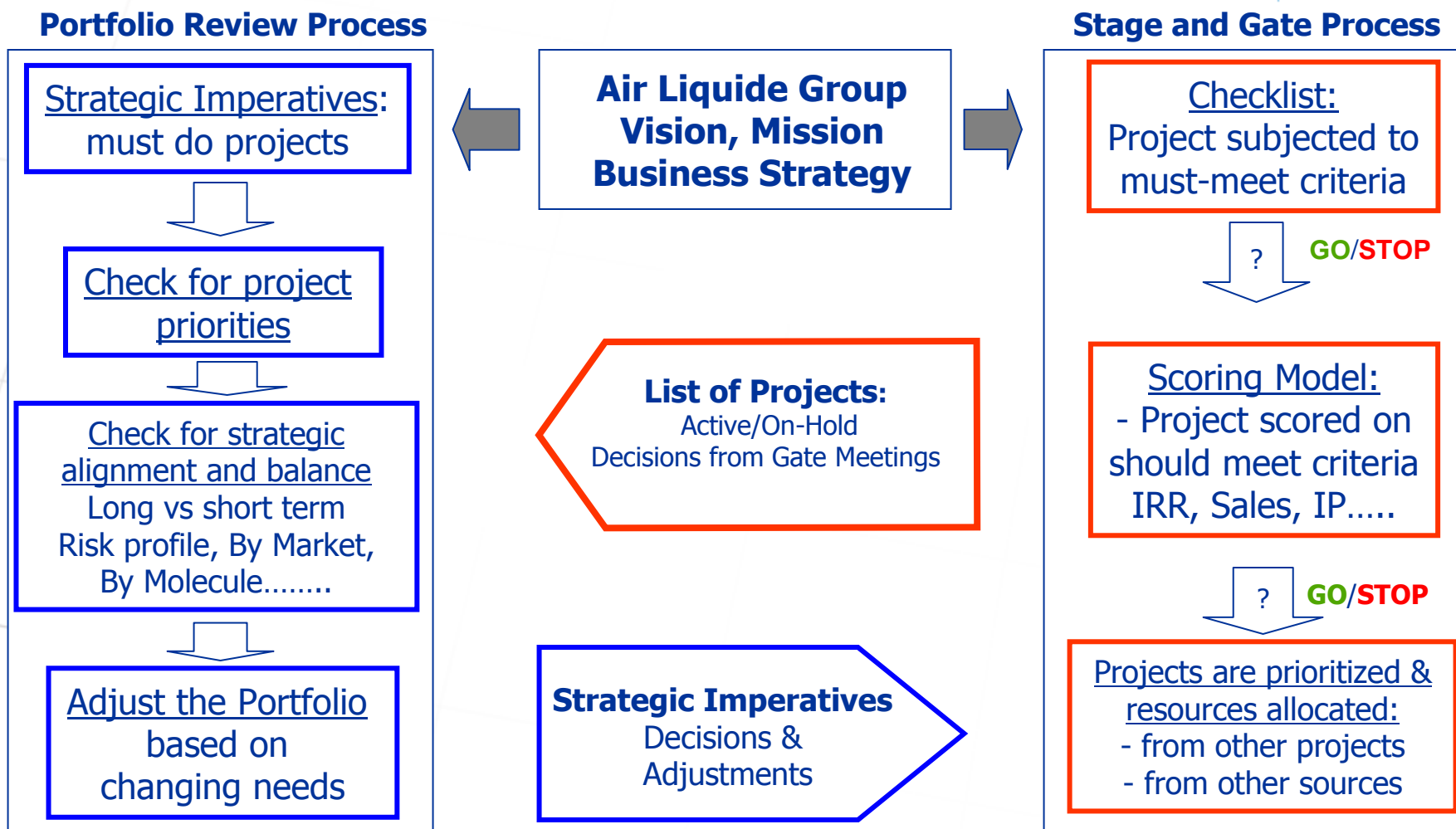


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Portfolio Management Process



A process to assures R&D alignment with Business strategy

- **By type of Project**

- Breakthrough
- New Markets
- Extension and Renewal
- Technical Consulting and Expertise
- Development of Technology Road Maps

- **By Molecule**

- N₂, O₂, H₂, CO₂, CO, He, Xe, He, Ar....

- **By World Business Line**

- Industrial Merchant
- Large Industries
- Electronics
- Healthcare
- Advanced Technologies

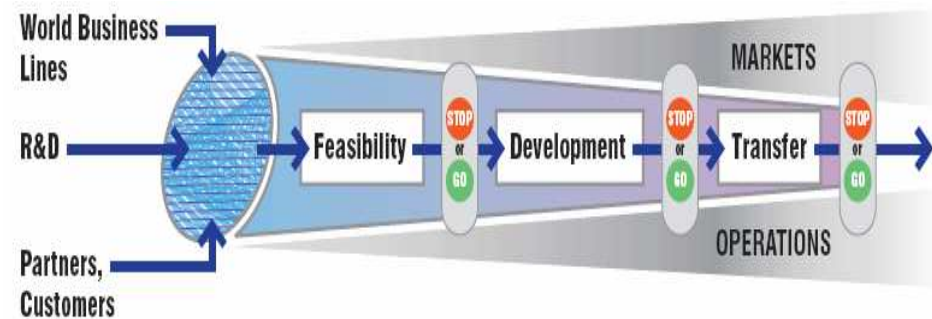
- **Building and Maintaining Competencies**

- Studies
- Academic partnerships
- Safety, Sustainability initiatives

Resource allocation is managed on a yearly cycle

Criteria for Project Selection

- Customer need
- Alignment with Business Strategy and Mid Term Objectives
 - Business model fit
- Project risk assessment
 - Financial and Safety
- Patentability
- Financial
 - Sales potential
 - Capital requirements
 - IRR
 - Profitability
 - Resources
 - Funding opportunities

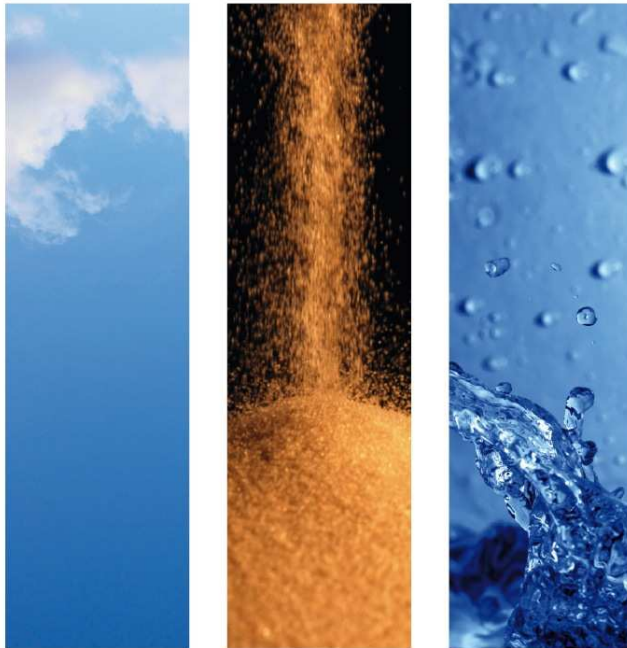


3 step stage and gate process

Over 60% of R&D resources are allocated to sustainability initiatives



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Challenges facing Corporate R&D labs



- Speed of innovation in a global, networked world
- Commercialization of technologies
 - How to create, deliver and capture value
- Increased accountability for performance and spending
- Career development and advancement
- Need for open innovation – borderless innovation
 - Small companies, Universities, Labs, Independent inventors
- Attracting and retaining talent
- Changing competitive landscape

A technology platform for anesthesia



Developing new ventilator for anesthesia

- Delivering a dual gas delivery system:
 - N₂O (Classical anesthesia)
 - Xenon
 - With minimal gas usage
 - Significantly improved recovery after surgery

CIMIT[®]

Center for Integration of Medicine
& Innovative Technology

To improve patient care by facilitating collaboration among scientists, engineers and clinicians to catalyze the discovery, development and implementation of innovative technologies, emphasizing minimally invasive approaches

Market approval

LENOXe – June 2007 in 12 European countries



Anesthesia workstation administering N₂O and Xenon

Preparing for hydrogen energy

Development and deployment of a Hydrogen energy supply chain

Technology Bricks



H₂ production



Dedicated distribution



Fuel cell



Systems in real world conditions



Storage



Risk management and safety



Early markets



Energy for remote sites



Portable generators



30 SCOOTERS



34 WHEELCHAIRS



40 TRICYCLES



44 LIGHT UTILITY VEHICLES



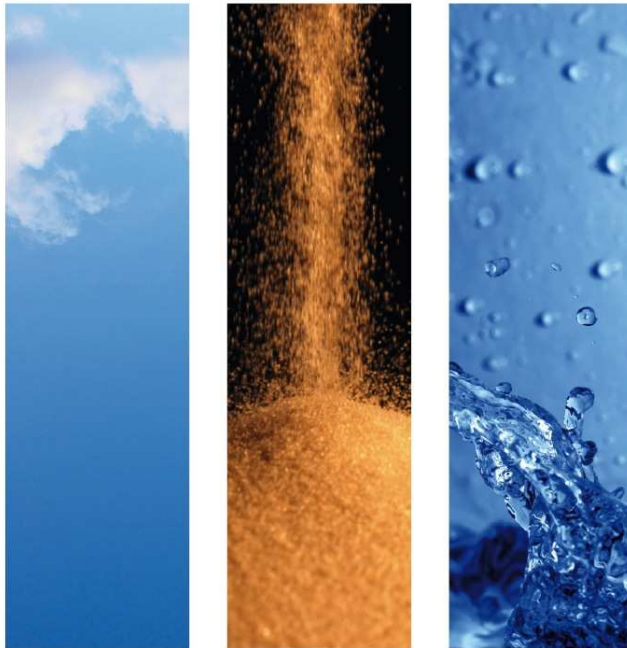
10 MINIBUSES



Collaboration with over 25 partners, in 14 countries

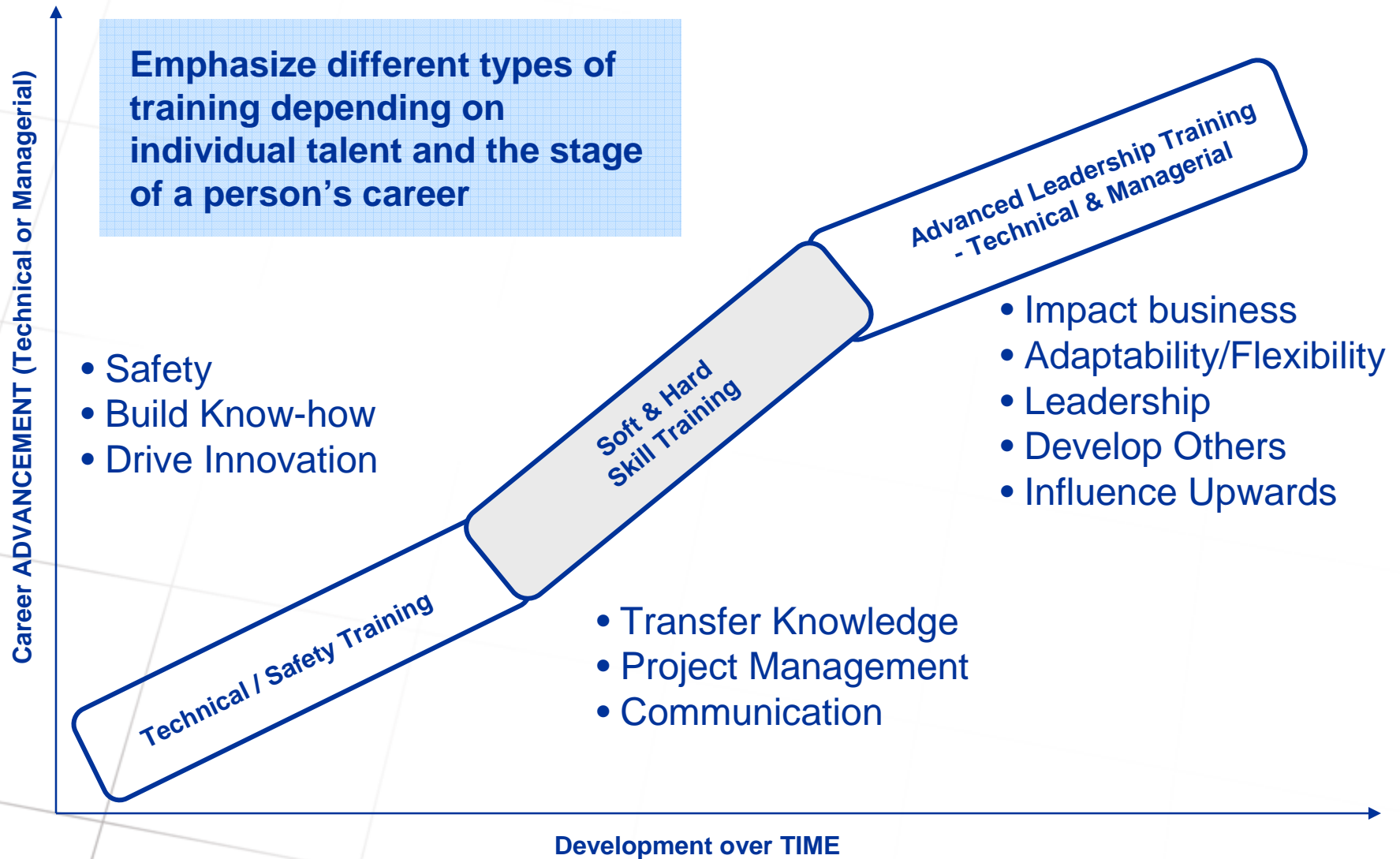


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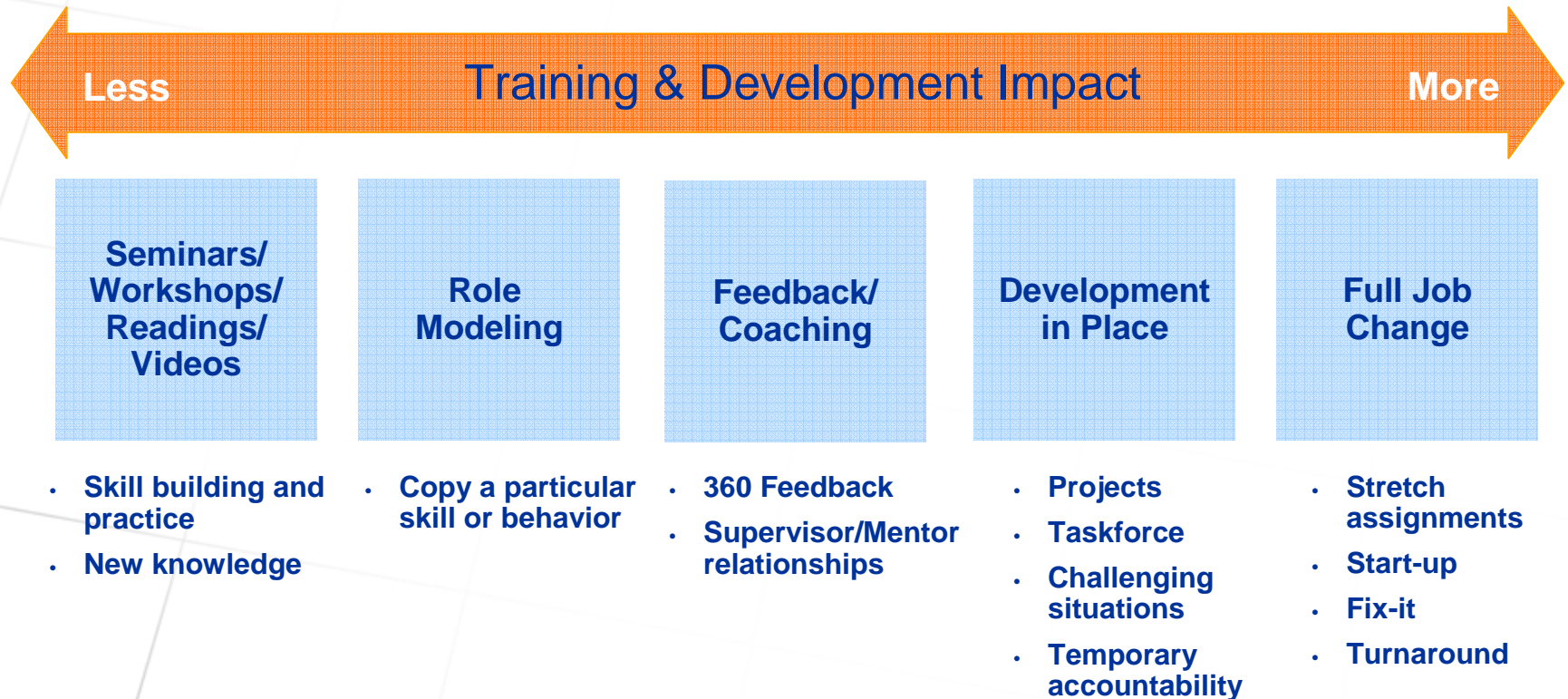
Training and Competency Development



Training and Competency Development

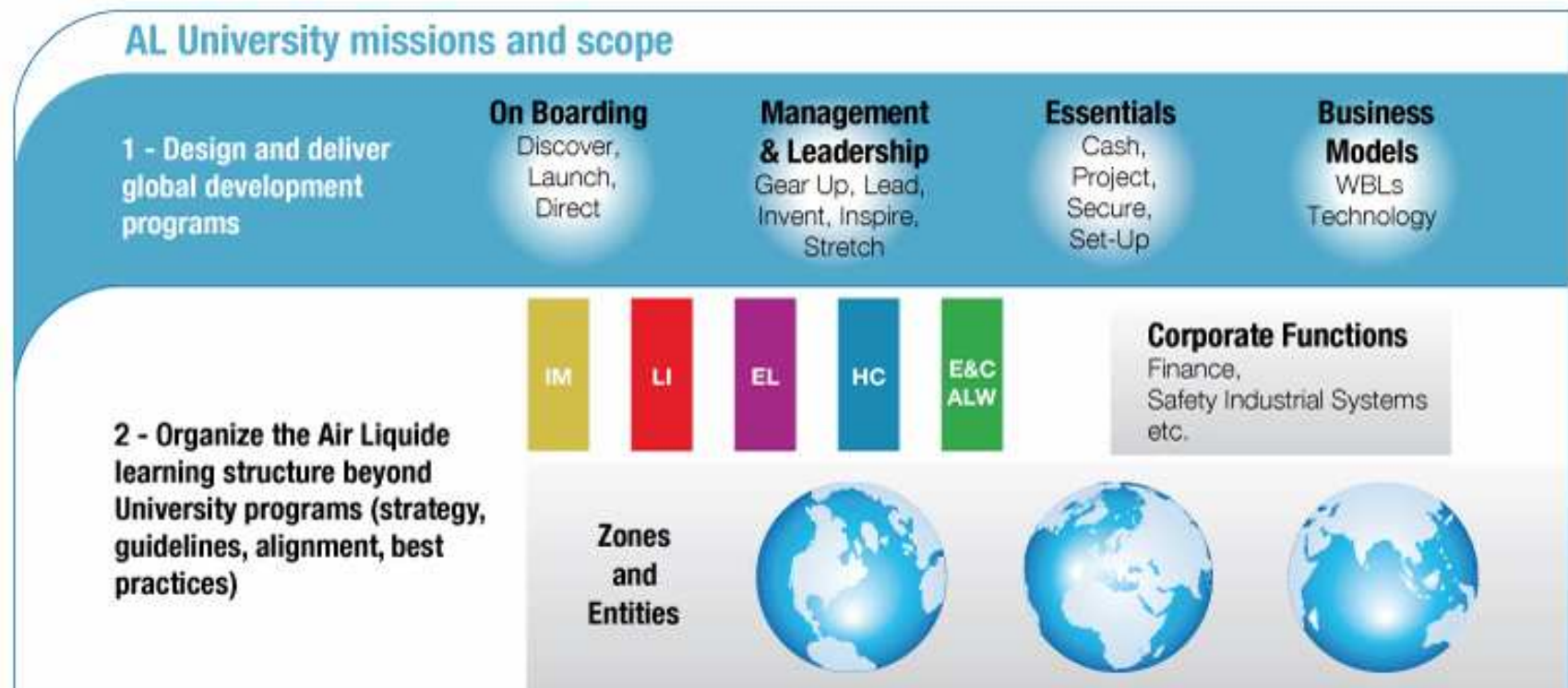


Address all aspects of the employee development continuum



Air Liquide University

Scope: The University supports the Group's strategic initiatives and promotes the Group's culture. The University helps people connect, learn and share knowledge across activities and geographies to ensure sustainable leadership for the Group.



Example: International Talent Development Programs



STRETCH

This yearly 2 week course is an intensive international development program designed and managed by Air Liquide University in partnership with the London Business School (LBS),

STRETCH is designed for 36 recognized young Air Liquide Group International High Potentials in order to enhance their skills and competencies to handle successfully current and future Air Liquide's challenges

Objectives

The objectives of this program, focused on industry dynamics, strategy, people leadership, decision making and financial management in an international context, are to:

- Build participants' skills in the areas of strategy, finance, marketing
- Enhance their leadership ability
- Provide networking and team building opportunities in a multi-national and multi-functional Group
- Give participants opportunities to meet Air Liquide Executives and discuss Air Liquide Group strategies in an open forum
- Acknowledge past performance of International High Potential employees to reinforce their sense of belonging to Air Liquide
- Stretch participant and apply the program key messages through case studies and business simulation

Example: International Talent Development Programs



INVENT

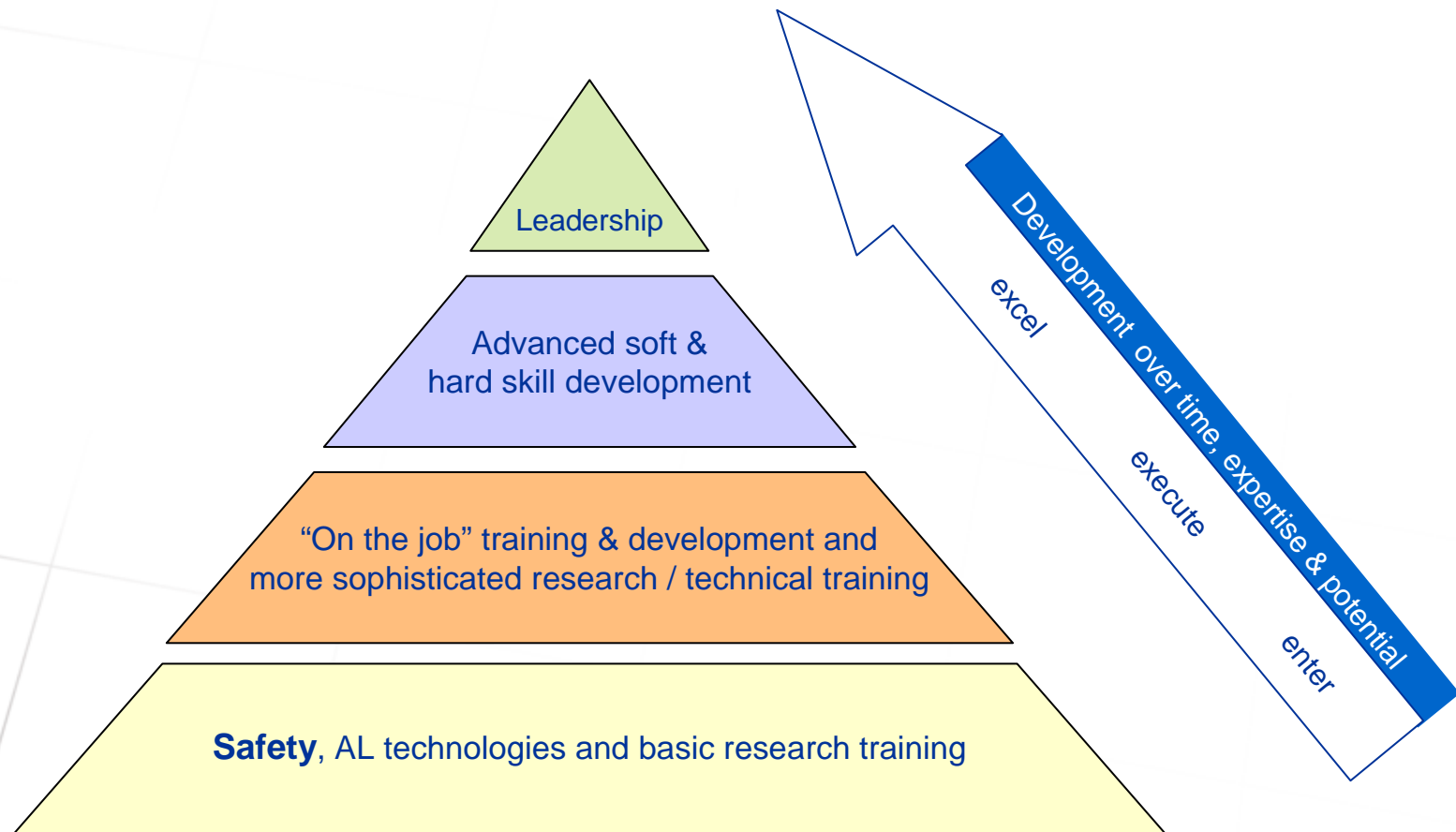
This yearly 6 day course program for Air Liquide International Experts and Air Liquide International Senior Experts has been developed and managed by Air Liquide University in partnership with the Massachusetts Institute of Technology (MIT) Engineering school and Sloan School of Management, as part of the Technical Career Ladder development program.

Objectives

The objectives of INVENT are to develop International Experts into “agents of change” for the growth of the Group, and specifically to:

- Develop critical skills in the areas of innovation management, communication, including: persuasion and influence, creating the business case, cross-cultural communication, knowledge transfer, other transversal skills that are key to their success
- Build a network among technical experts across different fields of expertise and business lines
- Provide an opportunity for technical experts to interact with senior management
- Build an on-going learning community with the faculty and university research labs
- Engage technical experts and managers to become agents of change

Facilitate development at all stages to ensure results and advancement



- The “Hygiene Factor”
 - Safety, integrity, honesty, technical competence
- Most ideas fail for non-technical reasons
- Complex problems need multi-disciplinary solutions
- Listening skills and open to learning
- Communication
 - Ability to position a technical problem as a business opportunity
 - Effective business writing
 - Ability to communicate across levels in the organization
 - Across cultures



Thank You