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Representing the Makers of the World's Favorite Food, Beverage and Consumer Products

Product R&D:

Innovation, Trade-offs and Avoiding Unintended Consequences

- Bill Greggs -

GREEN CHEMISTRY

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Innovation

- Innovation is:
  - Improving products
  - Improving life
- Innovation means substitution
  - Of an ingredient or a component
  - Of multiple ingredients or components
  - Of the entire product with a different product
- Classic examples in Lighting
  - Oil/gas lanterns → Incandescent light bulb
  - Carbon filament → Tungsten filament
  - Vacuum → Inert gas
  - Incandescent → Compact Fluorescent → LED

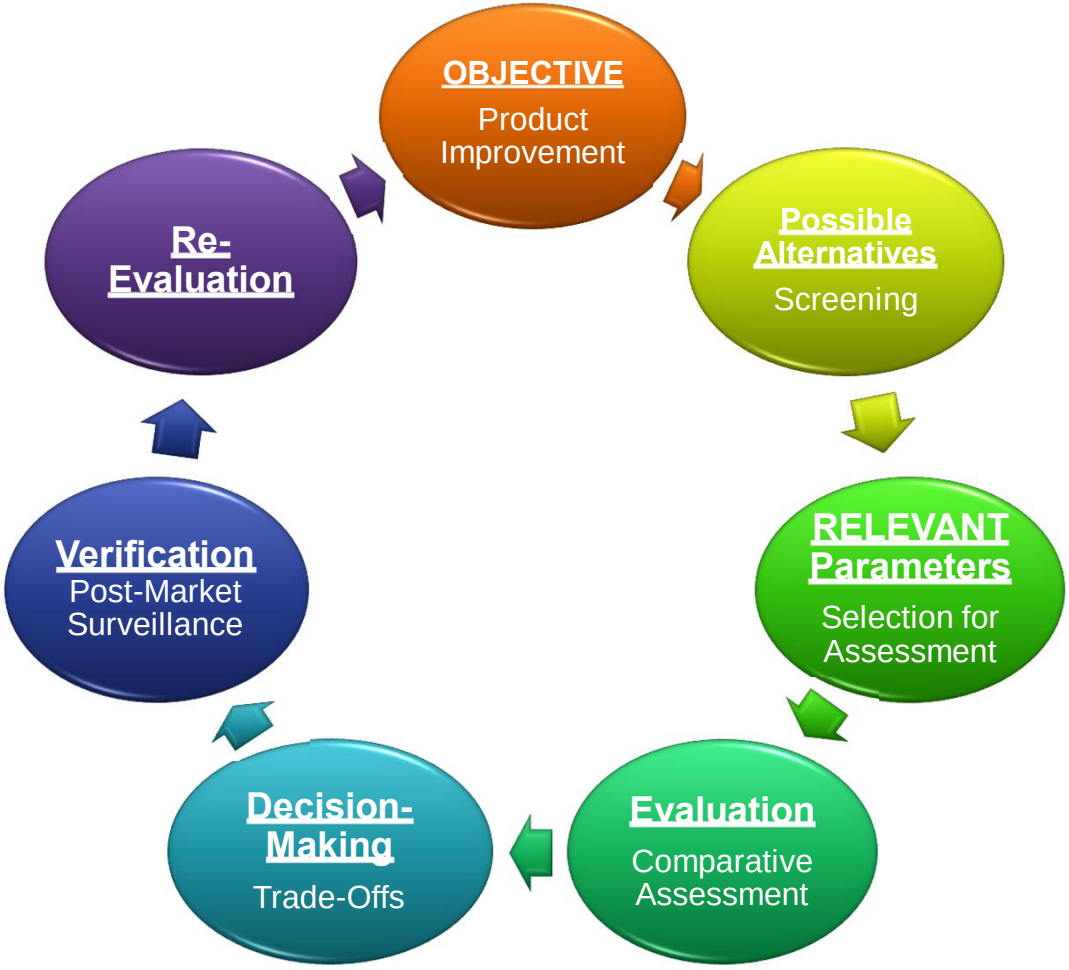
Lighting Innovation

?

What does innovation look like?

What does innovation look like?

Product R&D Process – Continuous Improvement



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What does innovation look like?

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What does innovation look like?

Genius is 1% inspiration and 99% perspiration.

- Thomas Edison, 1903

Where is the Product R&D perspiration ???

Multi-Factorial Evaluation Matrix

Companies consider ALL of these factors within the Product R&D process

(i) Safety (human and environmental)

- Public Health Impacts, incl. sensitive subpopulations
- Environmental Impacts
  - Water quality impacts
  - Air emissions
  - GHG emissions
  - Waste/End-of-Life Disposal
- Toxicological endpoints
- Physicochemical properties

(ii) Performance and Value

- Product function/performance (to include compatibility)
- Useful Life
- Economic impact
- Consumer Acceptance

(iii) Lifecycle/Resource utilization

- Material/Resource Consumption
- Water conservation
- Energy inputs (Production, In-use, and transportation)
- Energy efficiency

Without data, how can we reach any definite conclusions?

- Thomas Edison

(iv) Other

- Availability/sourcing
- Manufacturing capability
- Regulatory compliance
- Stakeholder communication
- …

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Multi-Factorial Evaluation Matrix

Evaluation Elements	
Safety	Public Health - Sensitive Subp.
	Environmental - Water - Air - GHG - Waste/End Life
Performance - Value	Product function / performance
	Useful Life
	Economic Impact
	Consumer Acceptance
Lifecycle - Resource Utilization	Material/Resource Consumption
	Water conservation
	Energy inputs (production, in-use, transportation)
	Energy Efficiency
Other	Availability/sourcing
	Manufacturing capability
	Regulatory compliance
	…

Use the Matrix in each Product R&D Process Step

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Screening Alternatives

(Narrowing to a Few Alternatives for Assessment)

Evaluation Elements		Baseline	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Safety	Public Health - Sensitive Subp.						
	Environmental - Water - Air - GHG - Waste/End Life						
Performance - Value	Product function / performance						
	Useful Life						
	Economic Impact						
	Consumer Acceptance						
Lifecycle - Resource Utilization	Material/Resource Consumption						
	Water conservation						
	Energy inputs (production, in-use, transportation)						
	Energy Efficiency						
Other	Availability/sourcing						
	Manufacturing capability						
	Regulatory compliance						
	…						

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	Energy Efficiency						
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	Manufacturing capability						
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	…						

RELEVANT Parameters
Selection for Assessment

Selection of RELEVANT Parameters for Assessment

Evaluation Elements		Baseline	Alternative 1	Alternative 4	Alternative 5
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	Water conservation				
	Energy inputs (production, in-use, transportation)				
	Energy Efficiency				
Other	Availability/sourcing				
	Manufacturing capability				
	Regulatory compliance				
	...				

Evaluation
Comparative Assessment

Evaluation Elements		Baseline	Alternative 1	Alternative 4	Alternative 5
Safety	Public Health - Sensitive Subp.				
	Environmental - Water - Air - GHG - Waste/End Life				
Performance - Value	Product function / performance				
	Economic Impact				
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Lifecycle - Resource Utilization	Material/Resource Consumption				
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Other	Manufacturing capability				
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	...				

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how can we reach any definite conclusions?

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Decision-Making
Trade-Offs

What we all hope for…

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Other	Manufacturing capability				
	Regulatory compliance				
	…				

Decision-Making
Trade-Offs

The real world …

Evaluation Elements		Baseline	Alternative 1	Alternative 4	Alternative 5
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Other	Manufacturing capability				
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	…				

This is a massive simplification…

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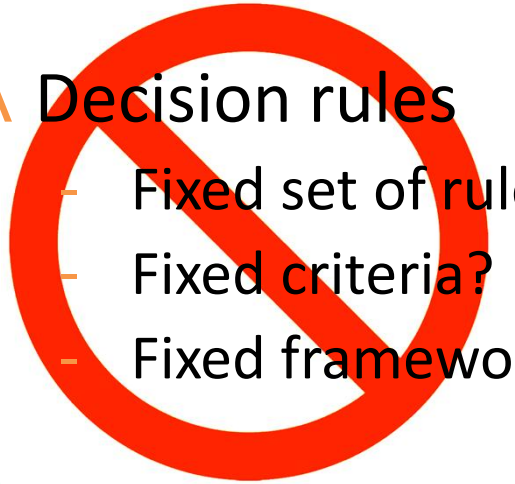
Decision-Making
Trade-Offs

Decision-Making
Trade-Offs

- Decision Principles
  - Safe for humans, environment
  - Meet consumer needs
  - Comply with all regulations
  - No significant lifecycle impacts
  - …
- Decision rules
  - Fixed set of rules?
  - Fixed criteria?
  - Fixed framework?



Unintended Consequences

Å Unexpected Trade-Offs

- Product R&D gone wrong?
- Overlooked details?
- Ill-considered political mandates?
- Newly developed criteria?

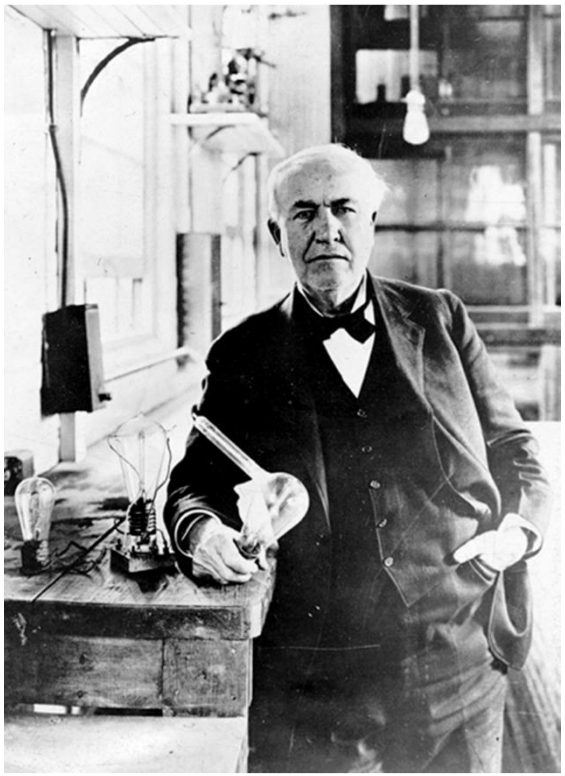
Just because something doesn't do what you planned doesn't mean it's useless.

- Thomas Edison

Å Examples of Trade-Offs

- Fuel: Tetraethyl lead → Methyl tert-butyl ether → Ethanol
- Refrigerants: Anhydrous ammonia → CFC R-12 → HCFC R-22 → R-410A
- Textiles: Flammable materials → Fire retardancy standards
- Solvents: Methylene chloride → 1-bromopropane
- Polio Vaccines: Injection → Oral
- Lighting: Incandescent bulb → Compact fluorescent → LED
- Insecticides: Arsenicals → DDT → Organophosphates

How do we minimize the potential for Unintended Consequences?



Genius is 1% inspiration and 99% perspiration.

Accordingly, a 'genius' is often merely a talented person who has done all of his or her homework.

- Thomas Edison, 1903

Do all of the Homework !

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How do we minimize the potential for Unintended Consequences?

Rigorous use of the Product R&D Process and Multi-Factorial Evaluation Matrix !

Evaluation Elements	
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Thank You!

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