

Improving the Odds of Successful and Profitable New Flame Retardant Commercialization

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Outline

- ❖ What's Different Today?
- ❖ The Need for Flame Retardants
- ❖ Phased Gate Commercialization
- ❖ What's Needed to Commercialize (a New Flame Retardant)
- ❖ Conclusions

The Need for Flame Retardants

- ❖ Our World is Made of Plastics Today, Replacing More Flame Resistant Traditional/Natural Materials
 - Replacing Wood, Metal, Glass, Ceramics, Leather
- ❖ Most Widely Used Polymers, e.g. Polyolefins, PET, Polyurethanes, etc. are NOT Inherently Flame Resistant
- ❖ Halogenated and Non-Halogenated Flame Retardant Additives are Incorporated into Otherwise Flammable Plastics to Delay Ignition Time

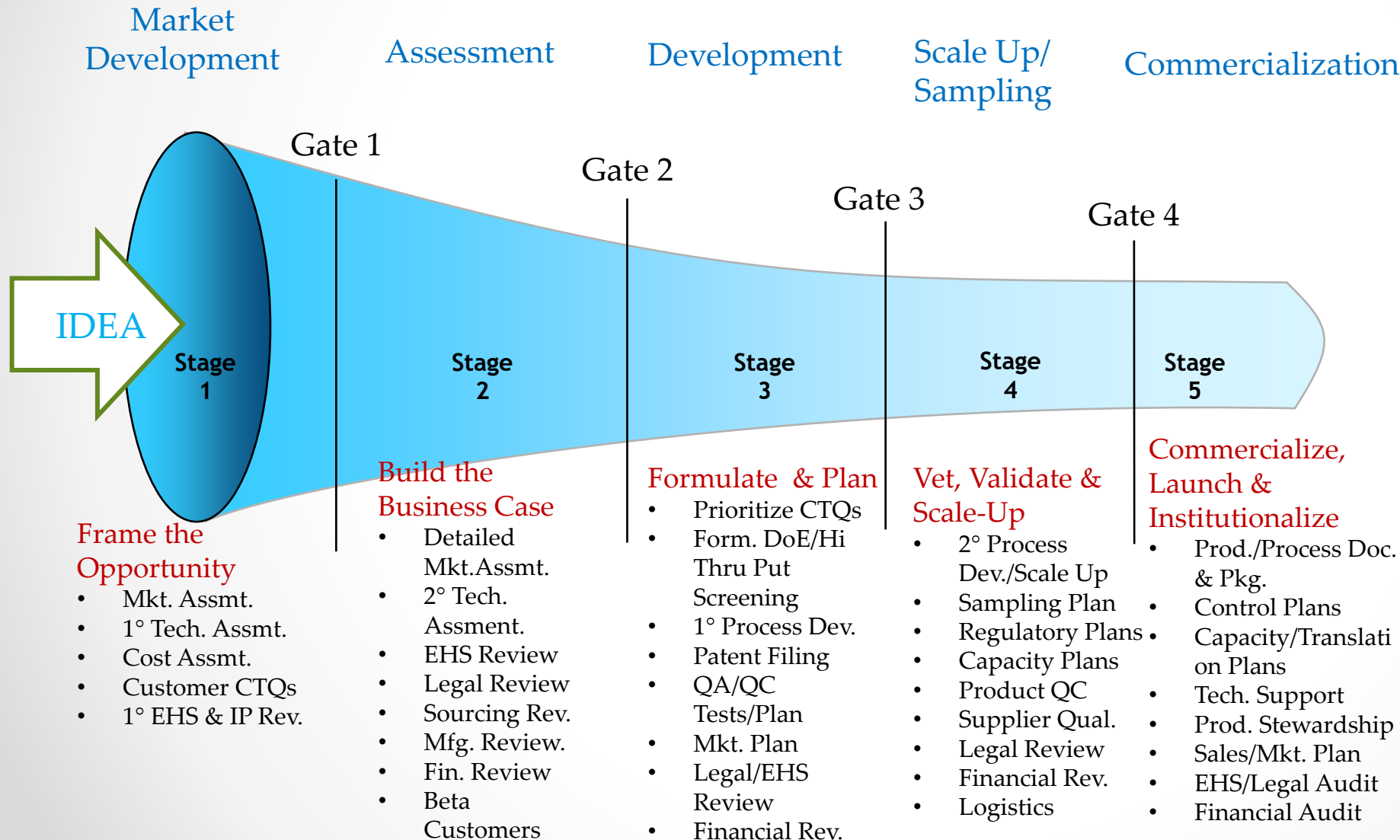
What's Different in the Marketplace Today

- ❖ Global Environment
 - Products Marketed Globally
 - Requirement for Chemicals to be Registered Globally: TSCA, REACH, China-REACH, CSCL-Japan, etc.
 - International Patent Coverage
- ❖ Need for Speed to Market With Minimal Mistakes
- ❖ What resources are needed to succeed
 - Testing Services, Equipment Suppliers, Tollers
 - Use of Enabling Technologies, Both Product and Data/Information Related
 - Consultants

A Retired Generation of Experts

- ❖ The “Baby Boom” Generation
 - Responsible for the Technologies Available Today
- ❖ Many Held Key Executive and Technical Positions in Industry and/or Academia
 - Have Extensive Personal and Professional Networks Gathered Over Decades
 - Healthier and Want to Be Involved and Contribute
- ❖ They Can Be an Enormous Advantage to Your Effort
 - Help YOU Avoid Mistakes They Have Already Made

Typical Phased Gate Process for Commercialization



- A Formal Commercialization Process for Rational Commercialization of Products/Services and Technologies
- **Requires Phase Related Expertise**

You Have An Idea...What's the Commercial Opportunity? (Market Development)

- ❖ Is There a Customer Need?
- ❖ Is The market large enough?
- ❖ Pains/Gains
- ❖ Is My Idea Unique/Differentiable/Sustainable?
- ❖ Who is Actually Making the Decision to Buy My Product?
- ❖ Who/What is the Incumbent/Competitive Product?
- ❖ What is the Current Cost in Use of the Incumbent/Competitive Product/Technology?
- ❖ Is My Idea the Basis for a Product Platform, Not Just a “One-Hit Wonder”?
- ❖ What are My Assumptions for Success?
- ❖ What Could Go Wrong? (Which Usually Does)

- ❖ Consultants Can Provide Insight to These Questions

Are There Issues to Consider?

(Assessment)

- ❖ Regulatory
 - Flame Retardants and Their Applications are Highly Regulated
 - Countries, e.g. European Union, Country, Federal, State
 - If the Flame Retardant is a New Chemical, Then
 - Chemical Registrations are Required: TSCA, REACH, China, Japan, etc.
- ❖ Legal
 - Is Your Idea Patentable or a Trade Secret?
 - What is the Patent Strategy?
- ❖ Raw Material and Production Costs
 - Commercial Prices, Availability, Number of Suppliers
 - Total Production Costs
 - Estimated Capital Expenditure and Expense Costs
 - Multiple Manufacturing Sites?

What's The Business Case to Go Forward? (Assessment)

- ❖ What/When are my Total Anticipated Costs?
 - Regulatory: Testing Costs, Document Preparation & Filing Fees
 - Legal: Patenting, Translation/Application Costs
 - Capital Expenditure Costs and Timing
 - Personnel: Temporary, Consultants, Permanent
- ❖ What/When are my Revenues
 - How Long Until My Customer's Customer Specifies/Buys My Product?
- ❖ Sufficient Cash Flow?

- ❖ Consider Best Case/Worst Case Scenarios including Monte Carlo Simulations
- ❖ Obtain Consultants' Advice On Implementing Similar Products/Technologies

How Do We Reduce It to Practice? (Development)

- ❖ Approaches to Obtain the Most Information from the Least Amount of Material
 - Modern Technique: Microscale Combustion Calorimetry (MCC): Ignition Temperature, Heat Release, Char Content, etc. with ~3 mg. of Flame Retarded Composition
 - Old, But Useful Approach: Extruded Strand Screening Test Uses Strand from Mini-extruder, Melt Indexer Instead of Molded Bars. Saves Material and Time
 - Conduct “UL 94” Test; Gives Information on Flame Spread, Smoke Generation, Charring and Dripping Behavior
 - Conduct Limiting Oxygen Index Test to Obtain Semi-Quantitative Data
 - Use Outside Labs Extensively to Leverage Their Equipment BUT Also Their Interpretation Expertise
 - Mechanical, Electrical, Rheological, Flammability, etc.

How Do We Make Enough to Get Feedback? (Development)

- ❖ How Much Flame Retardant Material Is Actually Needed For Customer Sampling/Feedback? Dependent On:
 - Flame Retardant Type
 - What is the Flammability Requirement?
 - UL 94 V0 test vs. E-84 Steiner Tunnel test
 - What Type of Polymer
 - Thermosets: Use Cast/Compression Molded Specimens
 - Thermoplastics: Extruded/Molded Specimens,
- ❖ Resources to Make the Jump from Bench to Scale-up
 - Tolling Services -Available For Physical and Chemical Processes
 - Minimizes Capital Investment and Enables Selection of Appropriate Equipment

How Do We Optimize? (Development)

- ❖ Make Sure YOU Have a Well-Organized Electronic Data Base
 - Internal and External Characterization Results
 - Customer Feedback
 - Customer Priority
 - Utilize Customer Feedback to Optimize and Improve Your Product and Its IP
- ❖ Use Available Experimental Strategies and Data Analytics Techniques
 - Six Sigma and especially DFSS (Design for Six Sigma)
 - Design of Experiments/Mixture and Factorial Designs: Mini-Tab, JMP, Stat-Ease
 - Quantisweb Technologies' Predictive Analytics and Optimization Software for Optimization and Data Mining
- ❖ Use of High Throughput Screening Technologies
 - Small Extrusions Coupled with Mini- and Micro-characterization Techniques
- ❖ Molecular Modeling to Determine Flame Retardant Compatibility, Extractability

How Do We Meet Customer Demand? (Scale-Up)

- ❖ For Flame Retardants, Oligomeric and Polymeric Moieties Are Becoming the Norm Due to More Eco-Friendly PBT (Persistence, Bio-Accumulation, Toxicity) Profiles, Improved Processing and Better Application Performance
- ❖ Reactive Extrusion (REX) is a Versatile Method Well Suited to Manufacturing Oligomeric and Polymeric Substances
- ❖ Many Industrial Consultants Have REX Experience

Where Do We Go From Here?

(Commercialization)

- ❖ Institutionalize Commercialization Process
 - Contingency Plan for Alternate Manufacturer (Toller) to Meet Unanticipated Demand, Catastrophe, Customer Requirement
- ❖ Build Out Product Platform
 - Develop “Multi-Generational Product Plan”
 - Explore Different Product Forms, e.g. powder vs. pellet, masterbatches, synergist blends
 - Test Product Variations, e.g. different molecular weights, copolymers, etc.
- ❖ Build Out Market and Customer Base
 - Different Applications for the same product, e.g. Transportation (Automotive vs. Train)
 - Broader Regions/Geographies
 - Leverage Distribution and Agents with Specific Market Experience

Conclusions

- ❖ Taking an Idea from Concept to Commercialization Can Be Risky and Expensive
- ❖ Steps Can Be Taken to Minimize Risk and Costs
 - Test your Assumptions on an Ongoing Basis
 - Utilize Others Knowledge, Equipment, Expertise and Capabilities to Minimize Costs, Maximize Knowledge and Leverage Others Experience
- ❖ Consultants Combined with Outside Services and the Use of Newer Technologies Can “Improve the Odds of Successful and Profitable New Flame Retardant Commercialization”

“A Wise Person Learns from the Errors of Others and Learns How to Be Humble and Ask Help From Others”

THANK YOU! QUESTIONS?



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