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applied to Nanomaterial Development.

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Nanomaterials and the Safer-By-Design approach for the next generation: Economic and regulation issues with the case of AMIPAINT

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Keywords: Innovation, Nanotechnology, sustainable development, competitiveness, Business Cases

LabEx SERENADE and the NEIS chair at Novancia



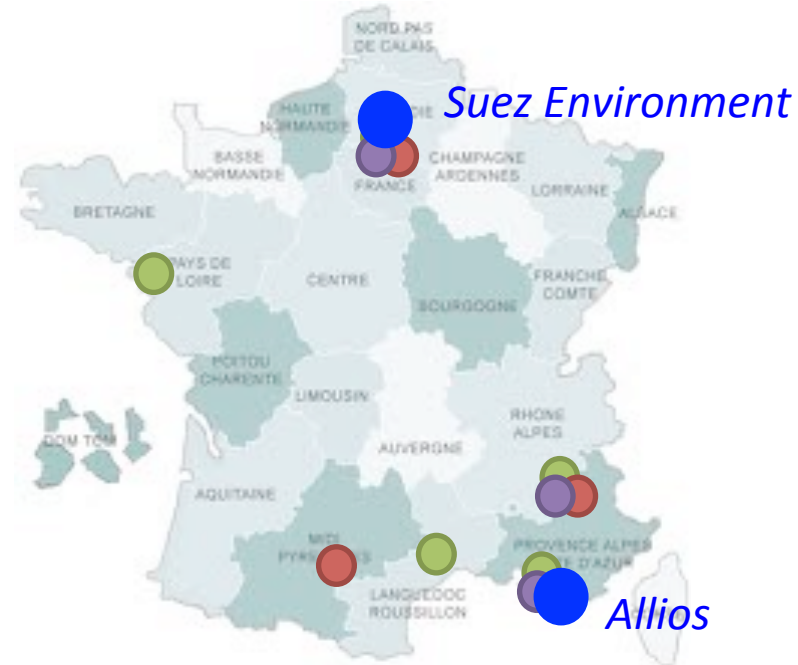
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11 Academic partners :



2 Industrial partners :

- Suez Environment
- Allios group

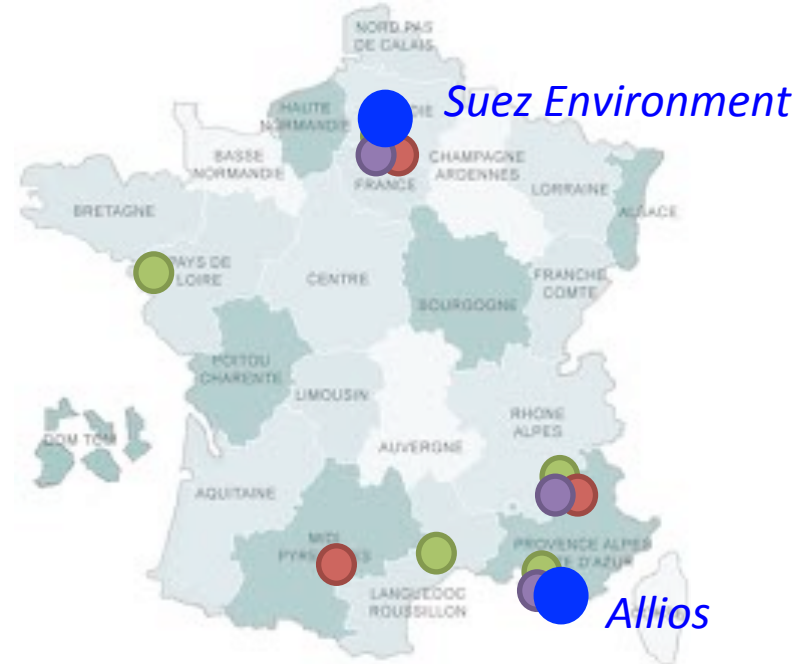


LabEx SERENADE and the NEIS chair at Novancia



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Nanotechnology Business Cases

- NEIS Chair = Nanotechnologies, Ecodesign, Innovation and Strategy
- **Axis 1** : Research into Business Development strategies for nano-based products in the context of sustainable development

Nanotechnology Education



RESEARCH – EDUCATION

- MBA or executive MBA students
- Ms students
- Summer school (doctorates and post-doctorates)- various scientific background



Economic and Business development

- Workforce development and industry training
- Managers of companies in relation with nanotechnology (producers or users)

Painting the future : AMIPAINT



Painting the future : AMIPAIN



What should AMIPAIN – a manufacturer of decorative paints- do to develop a new line of products based on nanostructured materials?

Painting the future : AMIPAINT



What should AMIPAINT – a manufacturer of decorative paints- do to develop a new line of products based on nanostructured materials?

Please note that this case is not intended to provide a single answer, but to stimulate discussions about several possible solutions. AMIPAINT is a fictitious company but is representative of a French SME

Innovation and nanotechnologies



Innovation and nanotechnologies

Innovation : key element for sustainable competitive advantage.

Nanotechnologies



New properties

New uncertainties

Nanotechnologies : too innovative, expensive (technical adaptation, compliance)?
Uncertainty about health and environmental impacts.

Innovation and nanotechnologies



What does it mean for the development of new business activities?

Developing a new product is difficult

100 ideas are developed

Developing a new product is difficult

100 ideas are developed

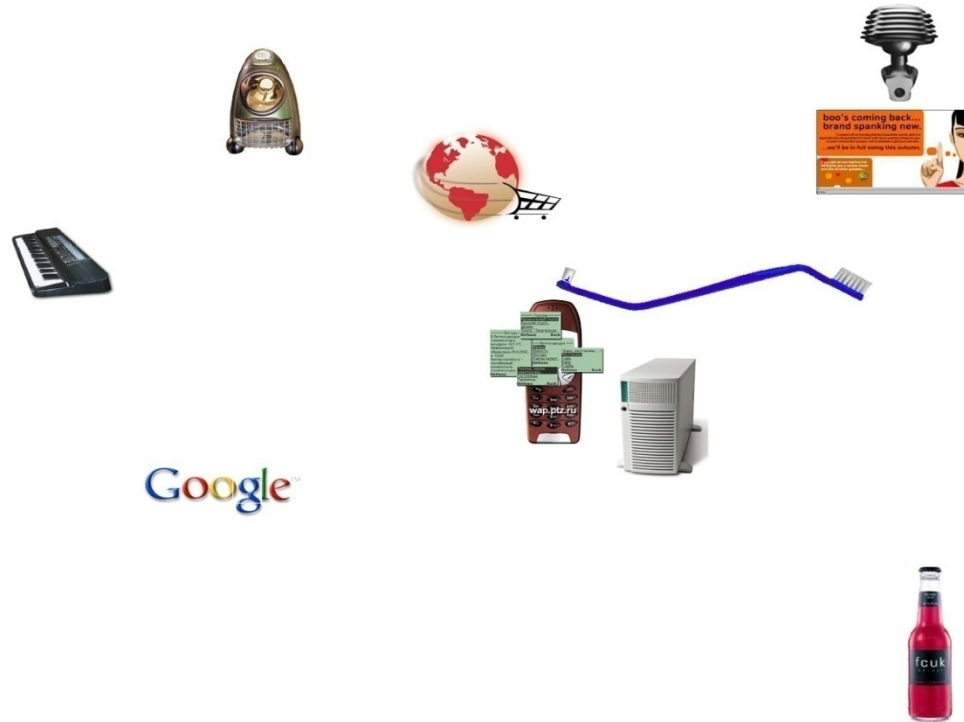


Developing a new product is difficult

100 ideas developed... 10 go to market

Developing a new product is difficult

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Google

Developing a new product is difficult

100 ideas developed... 10 go to market...
1 is a success.

Developing a new product is difficult

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Painting the future : AMIPAINT



This business case addresses elements to take into account to develop nano-based products (industry of paints and coatings) : investment, compliance, policy, internationalization strategy, assessment of costs and benefits.

It follows the Safer-By-Design approach, which integrates sustainability into corporate strategy.

Case study – Elements to consider

A. Paint is a complex market. Challenges and promises of the industry are deduced from a *PORTER analysis*

B. What new nano-based products could AMIPAINTE develop? For what competitive advantages?

C. Checklist of all the steps needed to go from idea to market with a SBD approach.

D. Evaluate the cost over 5 years of developing a nano-based paint.



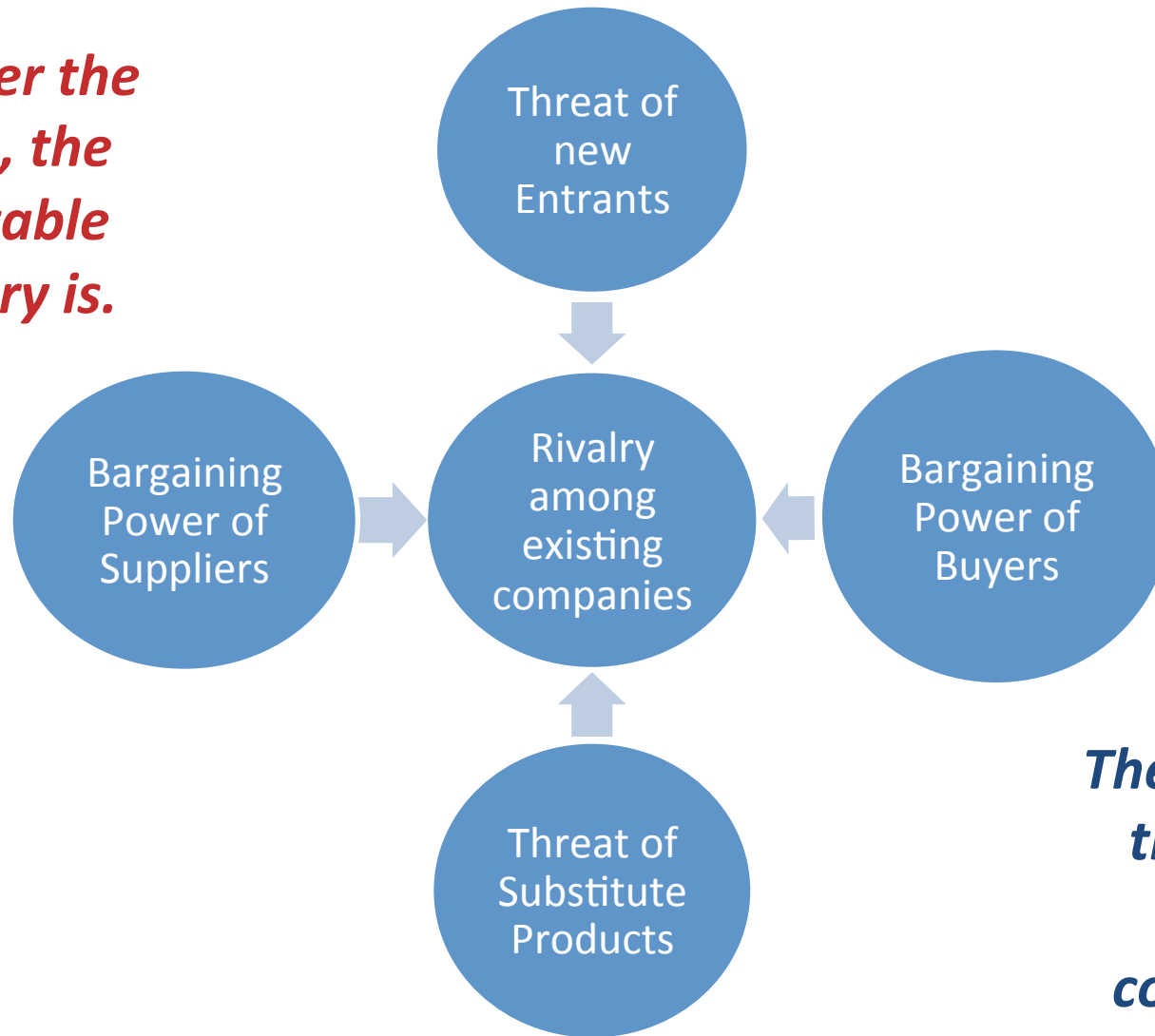
A. Porter analysis of the Paint Industry



*The five forces
that shape
industry
competition*

A. Porter analysis of the Paint Industry

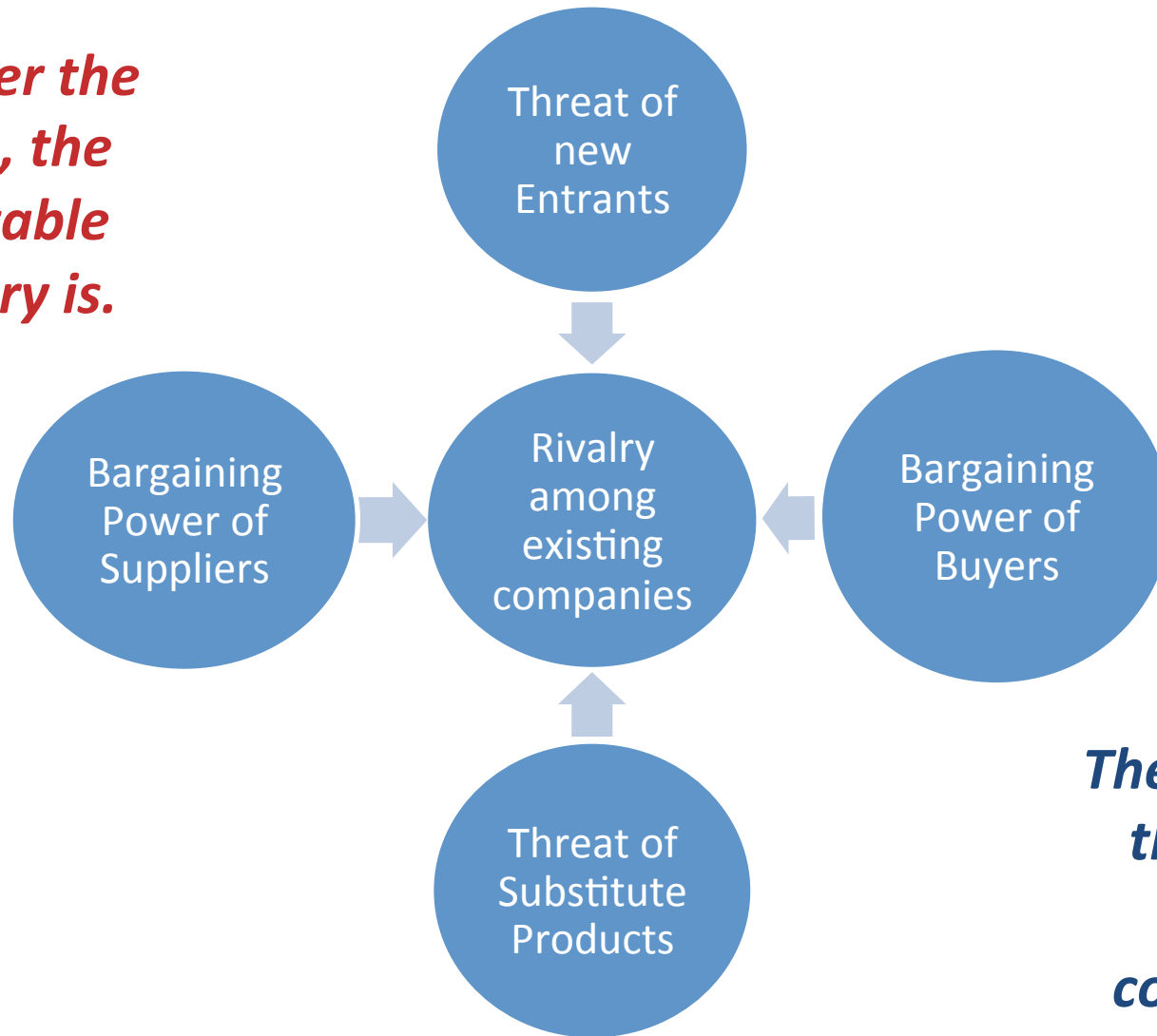
The stronger the forces are, the less profitable the industry is.



The five forces that shape industry competition

A. Porter analysis of the Paint Industry

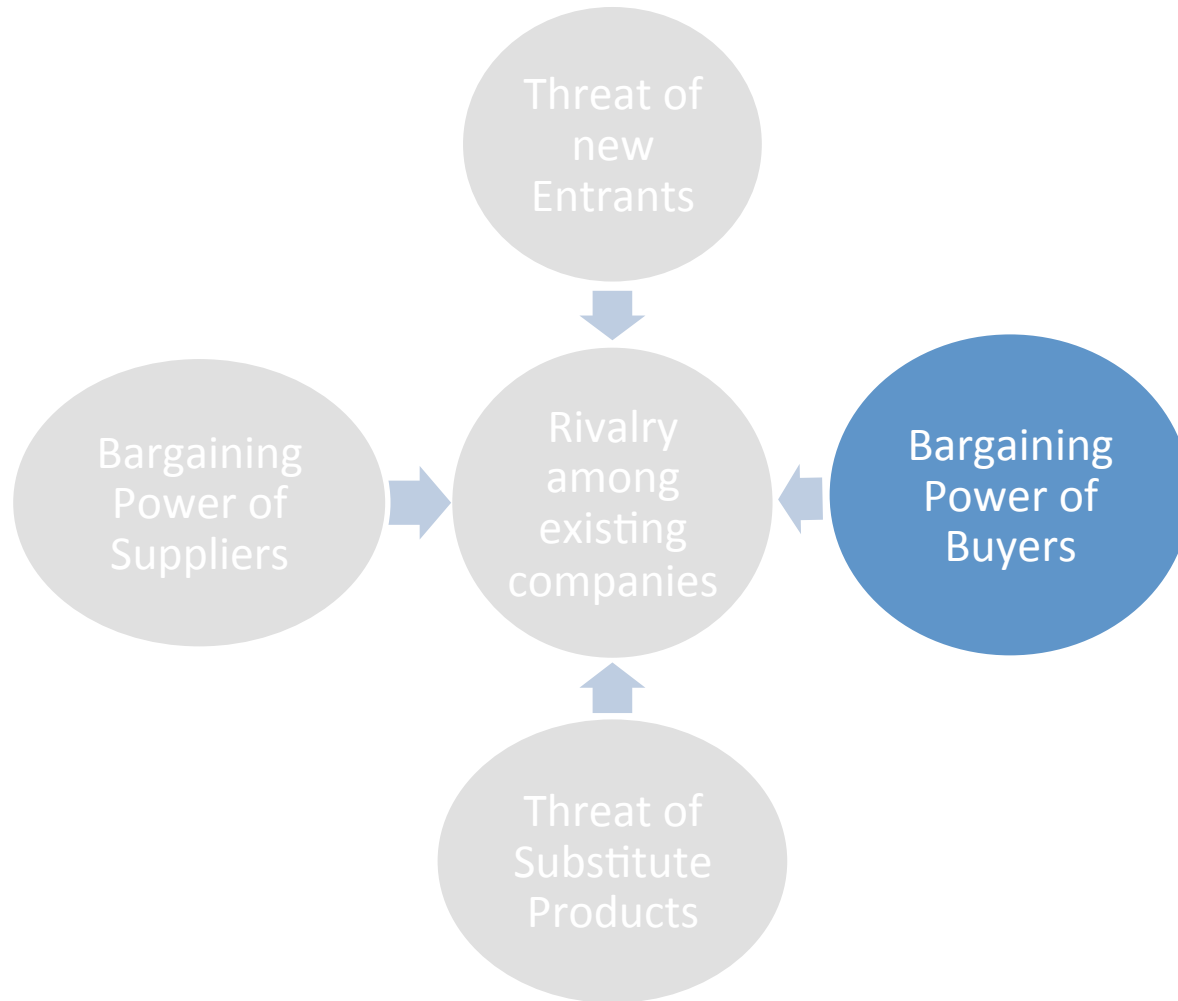
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The five forces that shape industry competition

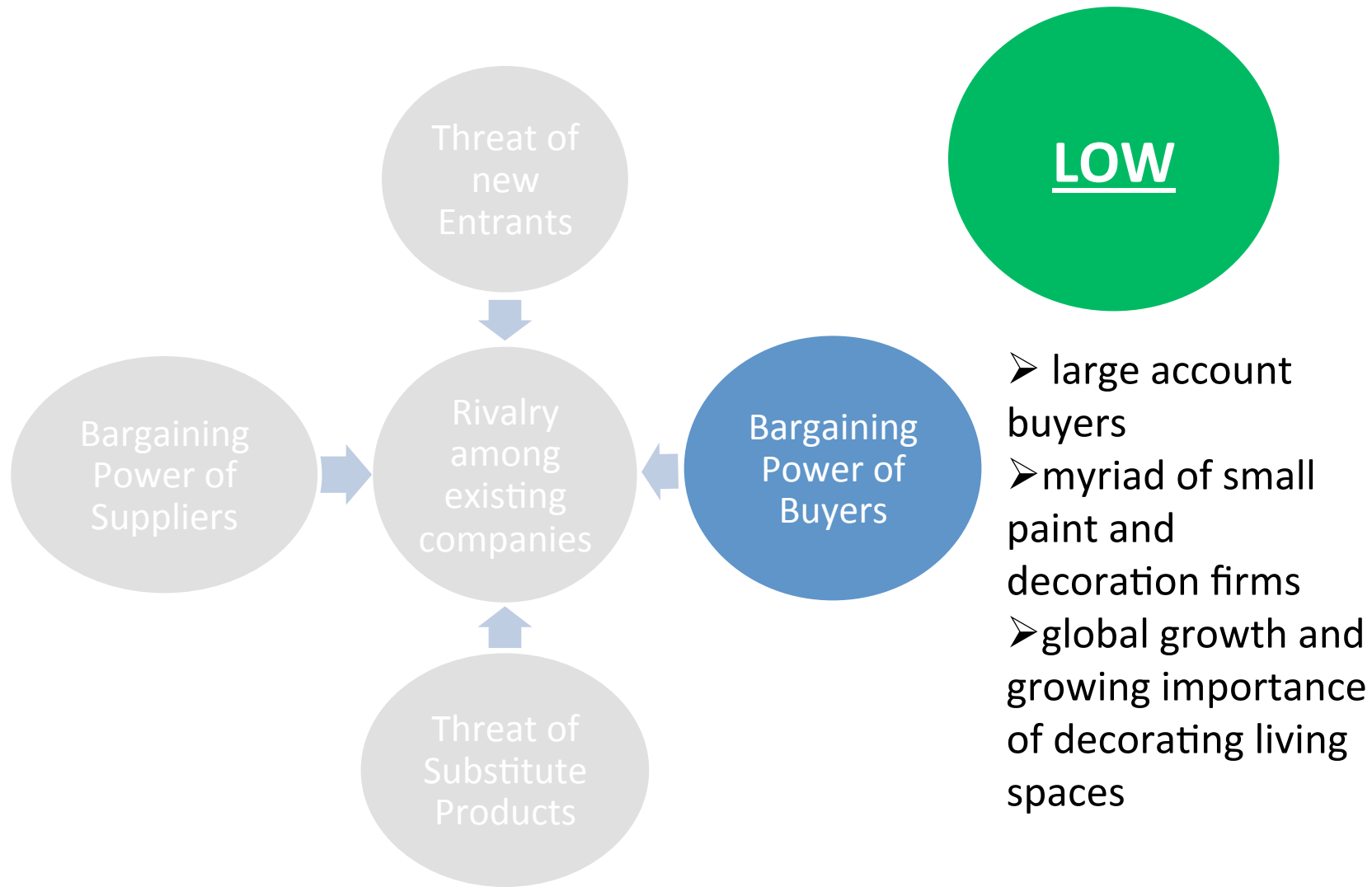
For each force, it is important to discuss the changes resulting from a switch to nano-based paints.

A. Porter analysis of the Paint Industry



- large account buyers
- myriad of small paint and decoration firms
- global growth and growing importance of decorating living spaces

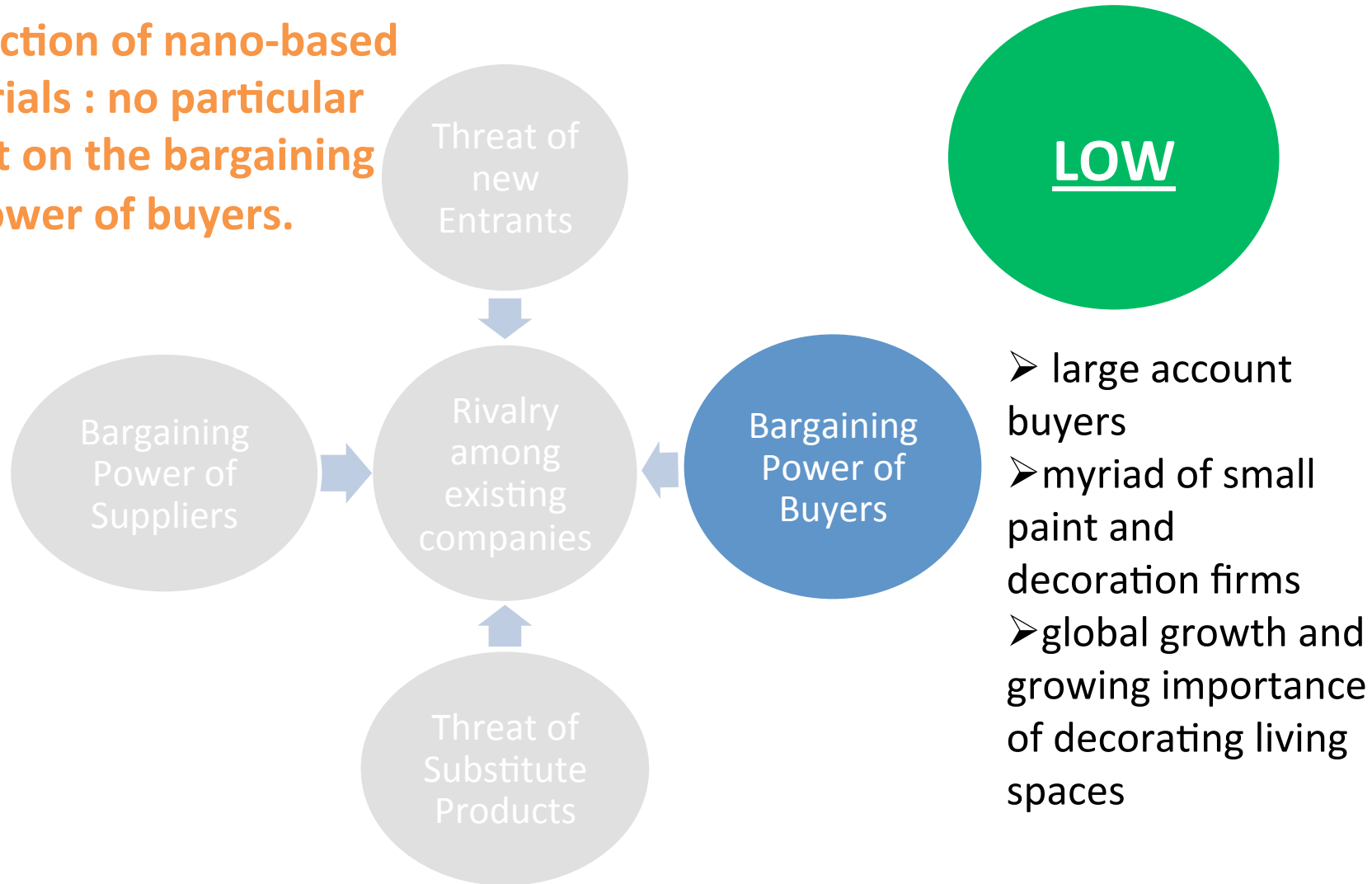
A. Porter analysis of the Paint Industry



***ALTOGETHER RATHER WEAK BARGAINING POWER FROM BUYERS
BECAUSE OF GROWING DEMAND***

A. Porter analysis of the Paint Industry

Introduction of nano-based materials : no particular impact on the bargaining power of buyers.



ALTOGETHER RATHER WEAK BARGAINING POWER FROM BUYERS BECAUSE OF GROWING DEMAND

A. Porter analysis of the Paint Industry

➤ Raw materials account for about 50% of total costs and can fluctuate a lot.

➤ Main suppliers of paint industry are chemical manufacturers



A. Porter analysis of the Paint Industry

STRONG

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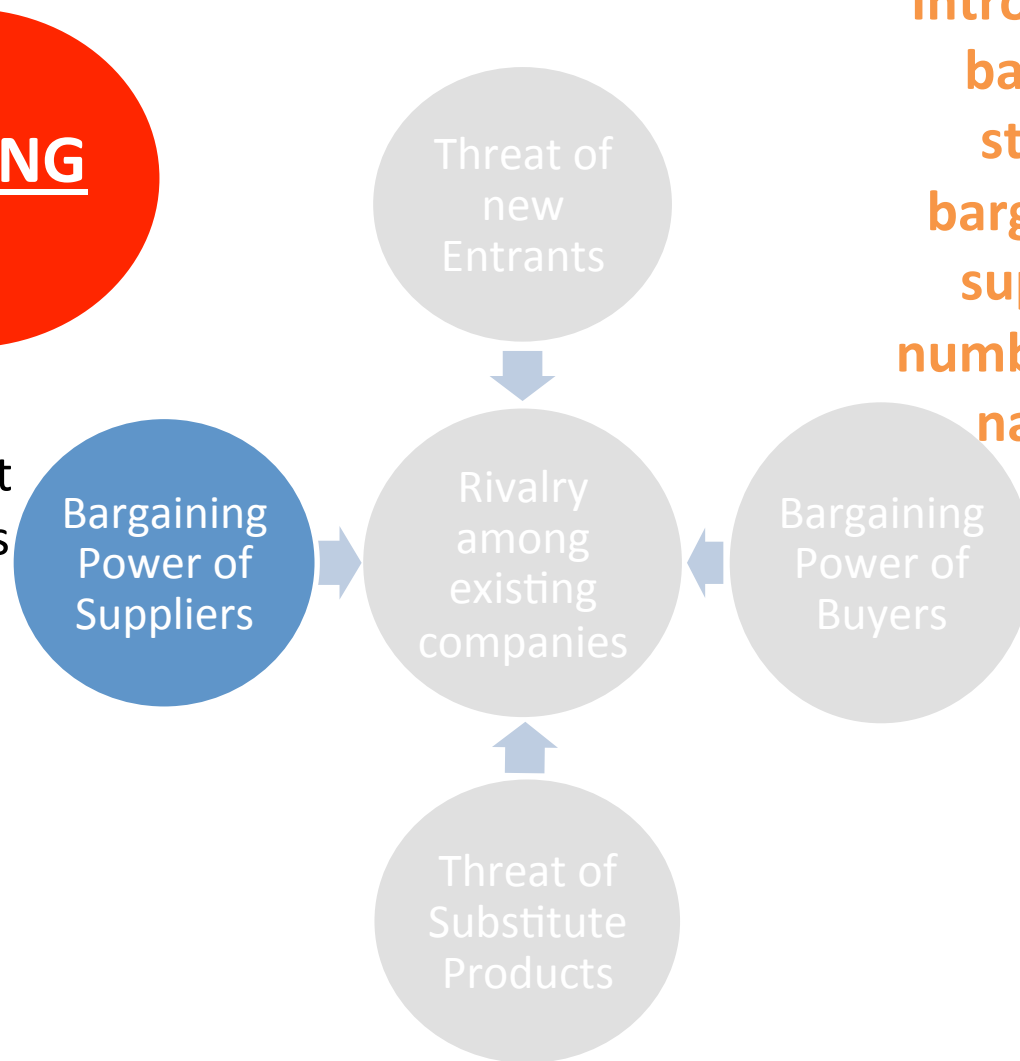
***ALTOGETHER STRONG BARGAINING POWER FROM SUPPLIERS
BECAUSE OF PRICE VOLATILITY AND NECESSITY OF USE***

A. Porter analysis of the Paint Industry

STRONG

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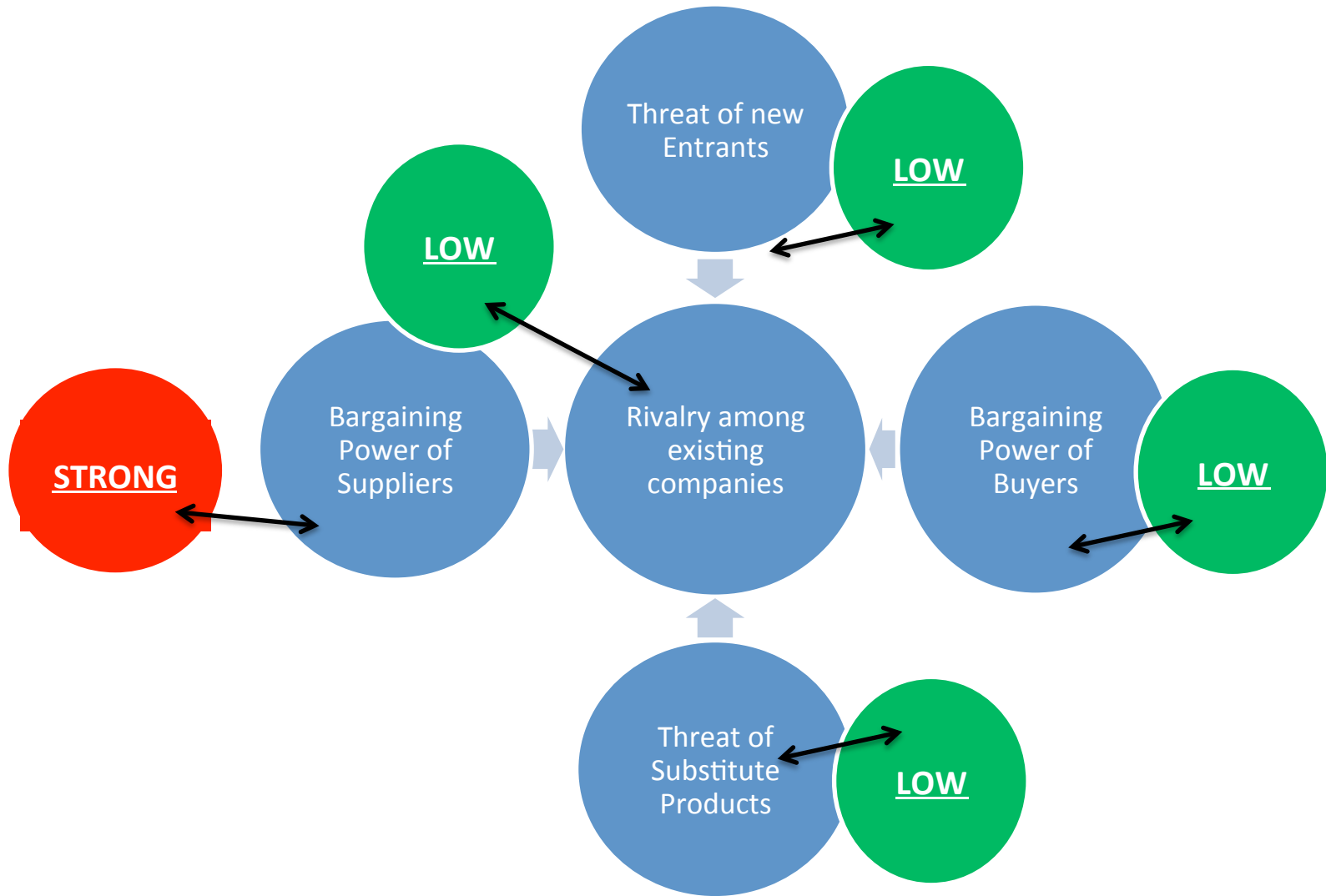
➤ Main suppliers of paint industry are chemical manufacturers



Introduction of nano-based materials : strengthens the bargaining power of suppliers (limited number of suppliers of nano-based raw materials).

ALTOGETHER STRONG BARGAINING POWER FROM SUPPLIERS BECAUSE OF PRICE VOLATILITY AND NECESSITY OF USE

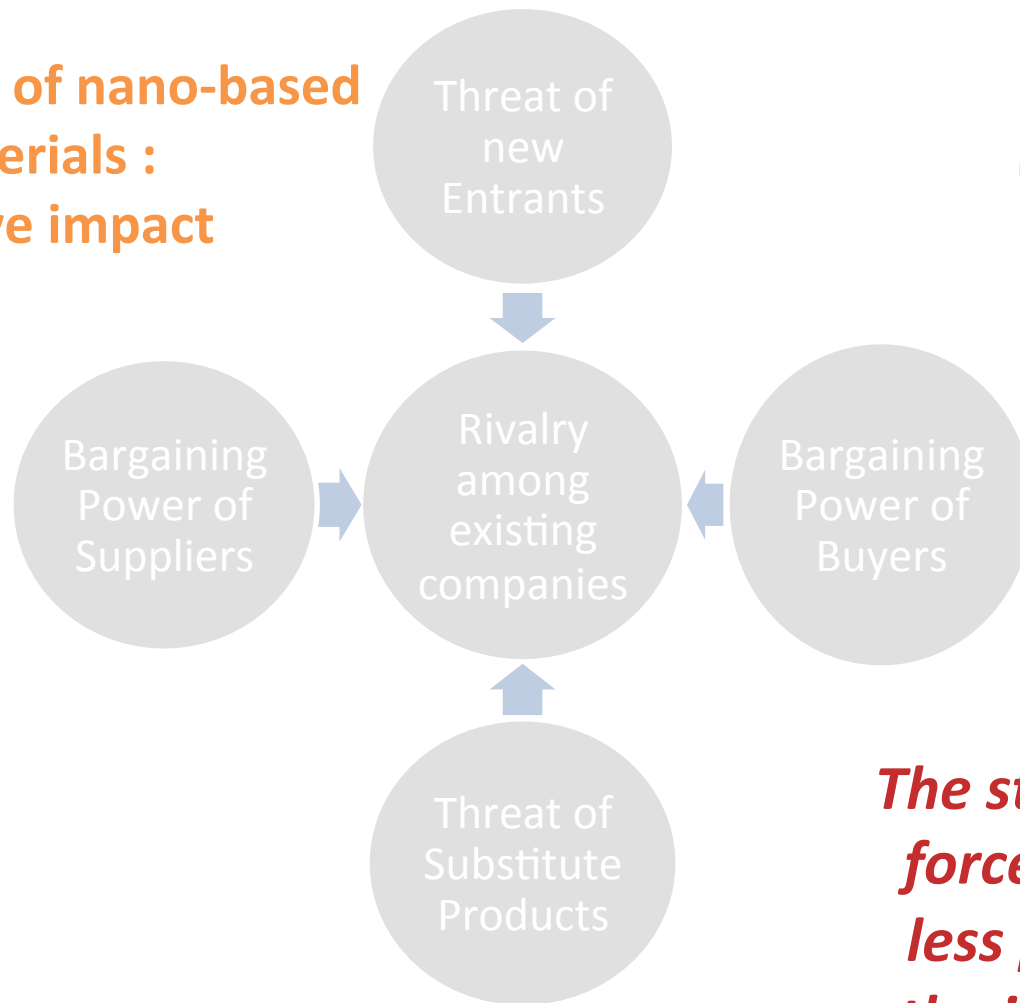
A. Porter analysis of the Paint Industry



The five forces that shape industry competition

A. Porter analysis conclusion

Introduction of nano-based materials :
positive impact



The stronger the forces are, the less profitable the industry is.

FORCES ARE LOW IN GENERAL

Case study – Elements to consider

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Potential applications of nano-based product paints

Manufactured nanoparticles properties	Ag	TiO2	CNT
Abrasion resistance			x
Antimicrobial activity	X	x	
Antistatic	X		x
Dirt repellent/ easy to clean		x	
Electrical conductivity	X		x
Flame retardant		x	x
Hydrophobic (water repellent)			X
Improved mechanical properties (stiffness and hardness)			x
UV reflection		x	
Photo catalytic activity		x	
Pigment		x	
Self-cleaning	x	x	
Thermal conductivity	x		x
Thermal insulation		x	x

Potential applications impressive : scope of use and economic performance.

Some examples of nano-paint



Antibacterial Water-resistant Paint

Category: Coatings - paints
Nanomaterials: silver (Ag) nanoparticles
Company: Nano Acceleration Network



Johnstone's Stormshield Self-Cleaning Masonry Paint

Category: Coatings - paints
Nanomaterials: unspecified nanoparticles
Company: Johnstones (Manufacturer) Decorating Warehouse (Distributor)



Bioni Medical

Category: Coatings - paints
Nanomaterials: modified Nano silver complex
Company: Bioni USA and Americas LLC



Nano-Clear for Industrial Applications

Category: Coatings - paints
Nanomaterials: proprietary 3D nanostructured polymers
Company: Nanovere Technologies, LLC.



Coat of Silence™ - Acoustical Paint

Category: Coatings - paints
Nanomaterials: formation of nano membranes
Company: Acoustical Surfaces, Inc.



PAINT SHIELD

Category: Coatings - paints
Nanomaterials: super conductor nanomaterials such as graphene fibers
Company: Graphenstone US



KNOxOUT™ Acrylic Air Cleaning Paint

Category: Coatings - paints
Nanomaterials: ultrafine titanium dioxide (TiO₂) manufactured by Cristal Global
Company: Environmental Imports, Inc.



PHOTO CATALYTIC PAINT

Category: Coatings - paints
Nanomaterials: low density graphene fibers, titanium dioxide nanoparticles
Company: Graphenstone US

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C. Checklist of the steps needed to go from idea to market using a SBD approach



AMIPAIN Nano

Category : Coatings – paints

Nanomaterials :

Modified Nano silver complex

Nano Titanium dioxide

To prevent microbial growth

Company : AMIPAIN France

C. Checklist of the steps needed to go from idea to market using a SBD approach



AMIPAIN Nano

Category : Coatings – paints

Nanomaterials :

Modified Nano silver complex

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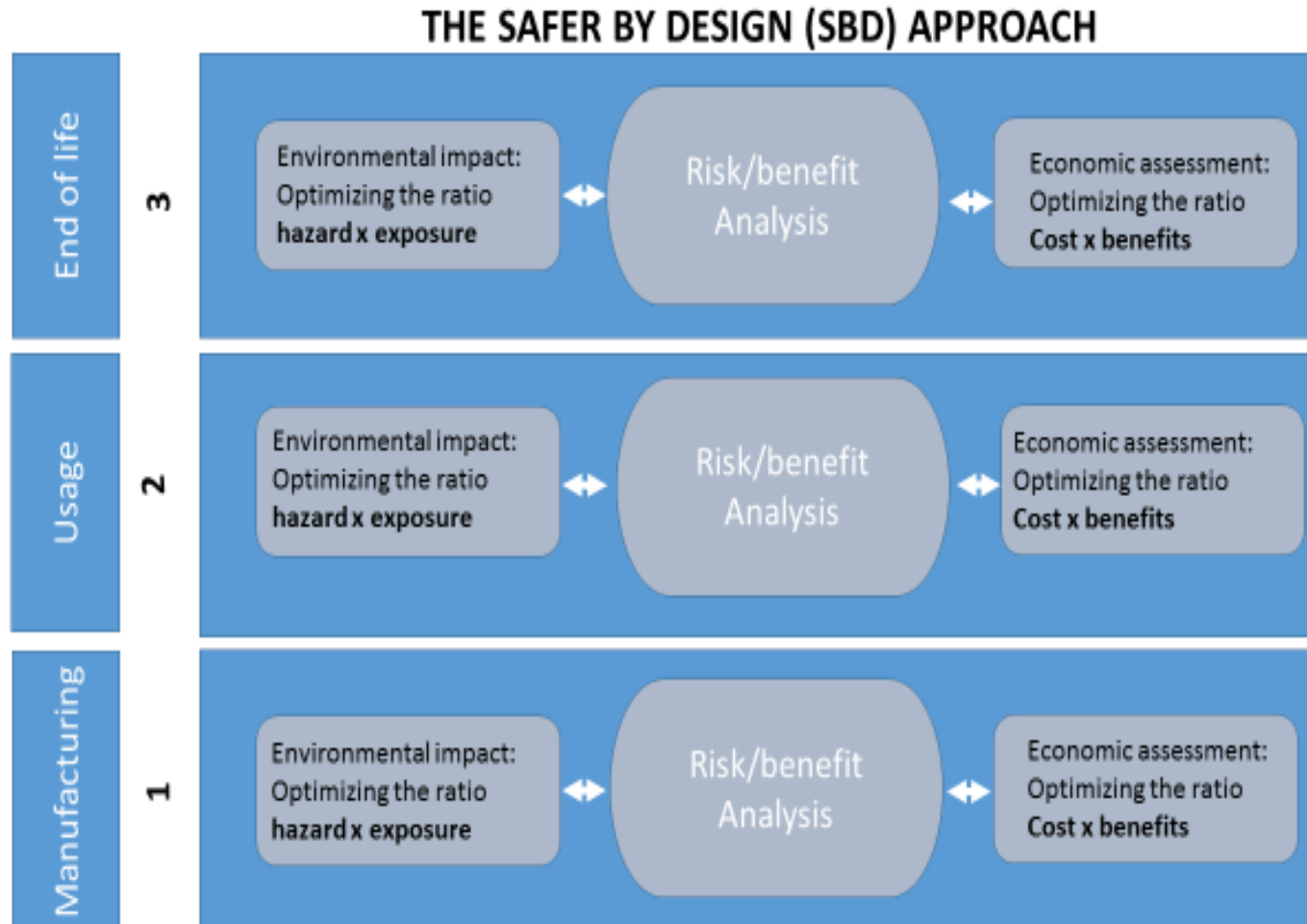
To prevent microbial growth

Company : AMIPAIN France

1. Establish a panorama of the state of the art of scientific research
2. Look for business development opportunities
3. Feasibility study

The Safer-By-Design (SBD) approach applied to nanotechnology.

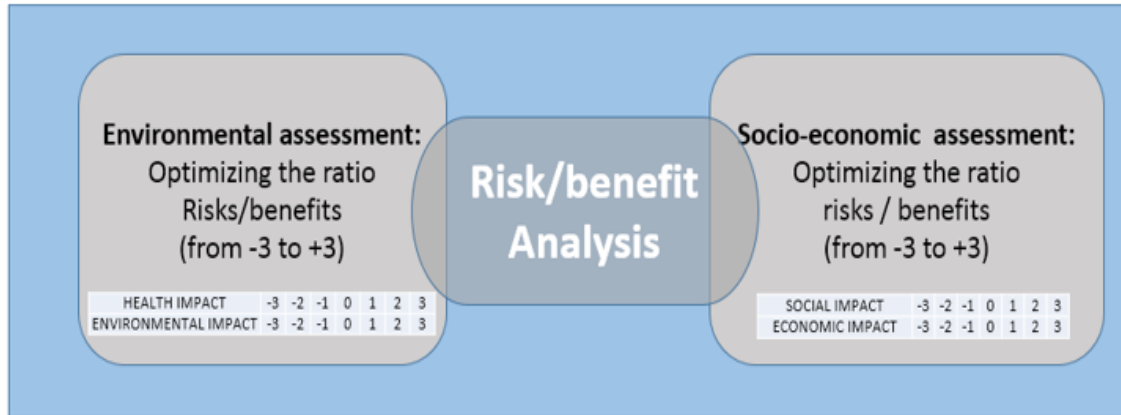
The Novancia Business School defines a multidisciplinary “Safer by Design” approach for each stage of the life cycle



Source: Auplat et al., 2015

Safer By Design matrix

THE SAFER BY DESIGN (SBD) approach at each stage of the life cycle



The SbD approach provides matrix-based scenarios that can be used at each stage of the life cycle to optimize decision making. It should help decision makers and business executives to identify the best risk/benefit ratio to support their choices.



Integrated approach over the entire life cycle of the product .

1. State of the art

- a) Analyze current developments in nanosilver and TiO₂ patenting (who does what and where?).
- b) Look for all the range of possible applications.
- c) What does it mean in terms of raw materials?
Mapping the raw material flows.
- d) What does it mean in terms of processes? Could AMIPAIN'T seek backward integration?

2. Look for business development opportunities

- a) Look for potential markets.
- b) Can AMIPAIN'T produce the materials that meet market demand, with the required specifications? (quality grades, volumes, maximum sales price...)
- c) Use competitive intelligence .

3. Feasibility study

- a) Assess technical and environmental risks.
- b) Choose options: Build a separate prototype, integrate directly into an existing production unit, or run a parallel production unit.
- c) Analyze the regulatory framework and engage in compliance processes (REACH, ISO certification...)
- d) Establish commercial contacts.

Case study – Elements to consider

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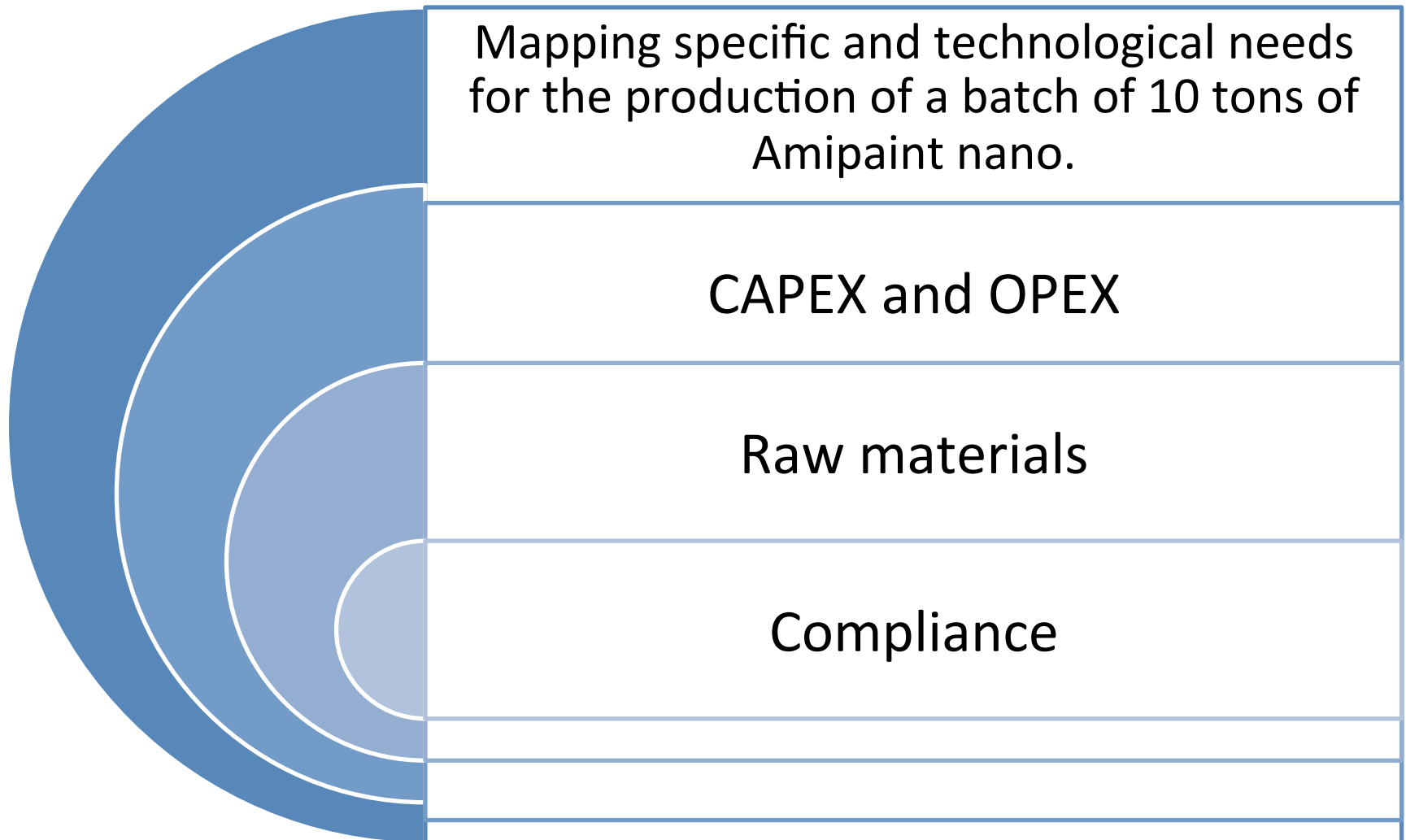
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D. Elements to take into account to evaluate the cost over 5 years of developing a nano-based paint.



CAPEX and OPEX

Expense category (for the production of 10 tons of paint)	Item	Price, euros	Comments
CAPEX	Equipment	16 000,00 €	
	Mounting works (ventilation hood, equipment, electro-water supply)	1 600,00 €	10% of equipment cost
	Technology, documentation and project service cost	25 000,00 €	
OPEX	Raw materials (for 10 tons of paint)	35 000,00 €	
	Production overheads (electricity, water etc)	1 000,00 €	(0,1 euros / 1 kg of paint on average)
	2 workers + 1 electrician	8 000,00 €	20% of equipment cost
	Other production expenses	800,00 €	5% of equipment cost
Total		87 400,00 €	

Compliance

- ✓ **REACH Regulation.** (Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals).
- ✓ **CLP Regulation** (Classification, Labelling and Packaging) - (EC) No 1272/2008
- ✓ **Cosmetics Regulation:** (EC) No 1223/2009
- ✓ **Food Regulation :** (EC) 2015/2283
- ✓ **Medical devices:** instance COM (2012) 542
- ✓ **Biocidal regulation:** (EU) No 528/2012
- **General regulation for safety in the workplace:** COUNCIL DIRECTIVE of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (89/391/EEC).
- **FDS** (Safety Data Sheets): these documents contain information about the safe use and potential hazards of substances. They follow an international format (16 sections) and are part of REACH requirements. They must be made available by the manufacturer to each institution or independent worker who work with their products.
- **R Nano registry** - In France, since January 2013, all producers, importers or distributors of products containing nanosubstances must fill the R-Nano Registry (L. 523-1 à L. 523-8 du Code de l'environnement- loi Grenelle II du 12 juillet 2010).
- ✓ **European Directive 2004/42/CE :** reduction of emissions of volatile organic compounds (VOCs).
- ✓ **Directive SEVESO.** Management of major industrial risks related to the production of basic organic chemicals.

CONCLUSIONS



This case is not intended to provide a single answer but to stimulate discussions about several solutions. AND to :

- Introduce the Safer-By-Design approach in management. The Safer-By-Design approach is supported by joint efforts of the EU, OECD, COR, EU-USA.
- The business case is targeted for MBA or executive MBA students, for Ms students, and also for seminars or Summer Schools for Doctoral students.
- It may be used to familiarize management or business students with the challenges of developing nano-based products in a SME.
- And in schools of engineering or life sciences to bring together innovation and management issues.
- Explore the management challenges that SMEs need to meet to develop a competitive advantage with nano-based products.

OTHER BUSINESS CASE STUDY



- Cosmetics –Cosmetic sector with a focus on sunscreen (Marie-Catherine Mars & Camille de Garidel-Thoron)



- Institutional settings for firm creation and product development - Tire sector with Michelin Company (*Sonia Ben Slimane - **Michelin***)



- Contribution of Information Systems to the adoption of nanobased products :Agribusiness sector - indicator device (*Marie-Cécile Drain - **Anéolia***)



- Financing of innovation and entrepreneurship for nano-based products or services - private financing on nanotechnological starts- up (*Emmanuel Fremiot - **Aénitis***)

THANK YOU!

