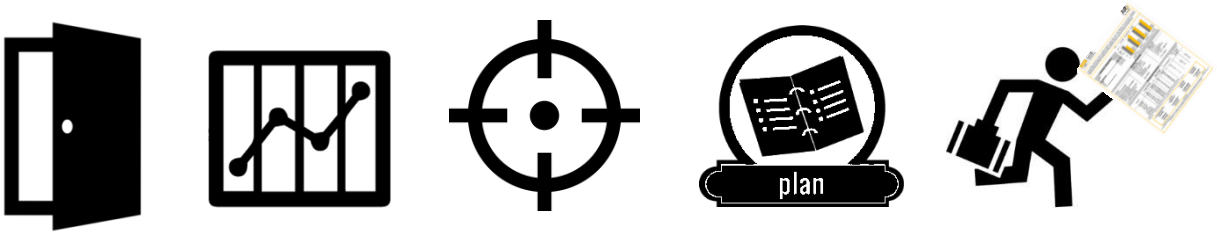
Lance Leverette

Market Research & Commercialization Consultant

Applied Market Intelligence Solutions for
Industrial & Technical Applications

Dr. Yulia Matskevich

Brunel University London Research Manager (EU) /
EU funding Consultant

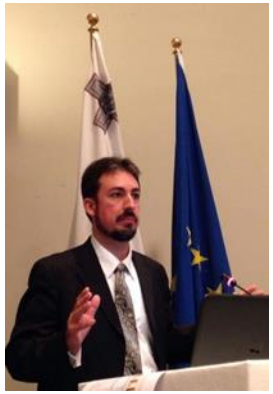


Maximizing Partners for Commercial Success

Lance Leverette

Training & Consulting

- Market Research
- New Product Development
- Market Focused Organization
- Market Strategy
- Commercialization



LONDON HIGHER EUROPE
London's Universities working in Europe

TU Graz
Graz University of Technology

CHALMERS
UNIVERSITY OF TECHNOLOGY

hhaResearch

National Technical University of Athens

Brunel University London

SMITHERS APEX

SMITHERS RAPRA

Linnæus University

Xjenza

The Malta Council for Science & Technology

Dr. Yulia Matskevich

Consulting

- Strategic partnership building
- EU proposal development
- Project management
- Brussels based support for universities

Yerun
Young European Research Universities

LONDON HIGHER
EUROPE
London's Universities working in Europe

ERRIN
European Regions
Research and Innovation Network

Vision
2020
The Horizon Network

EARMA
European Association of
Research Managers and Administrators

Brunel
University
London

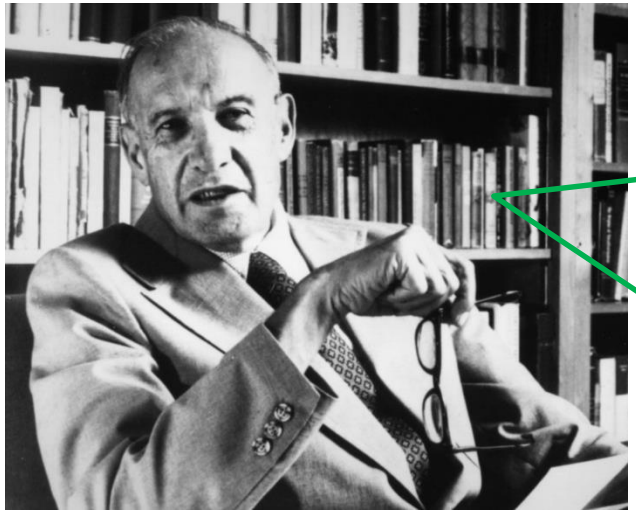
LEITAT
Technological Center

National
Technical
University of
Athens

CI

IK4 CIDETEC
Research Alliance

Why worry about markets?



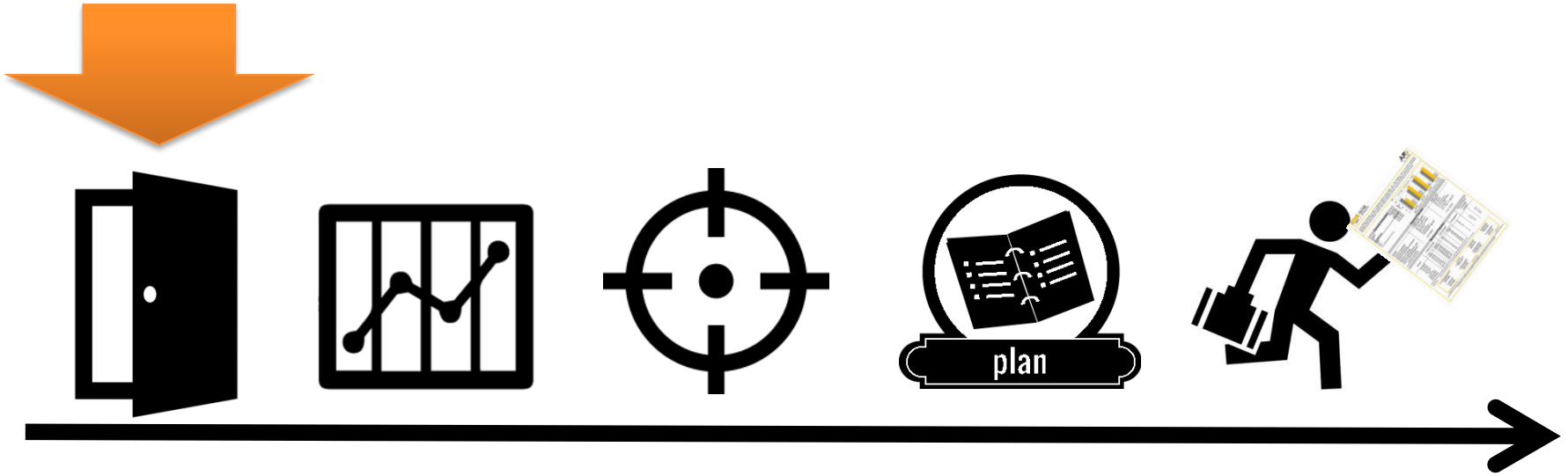
"The aim of marketing is to know and understand the customer so well the product or service fits him and sells itself."

Peter Drucker

Father of modern marketing

Introduction: The Market Ready Methodology

Applying the first stage of the Market Ready Methodology for choosing the best partners internationally



Go / No- Go Analysis

Market Analysis

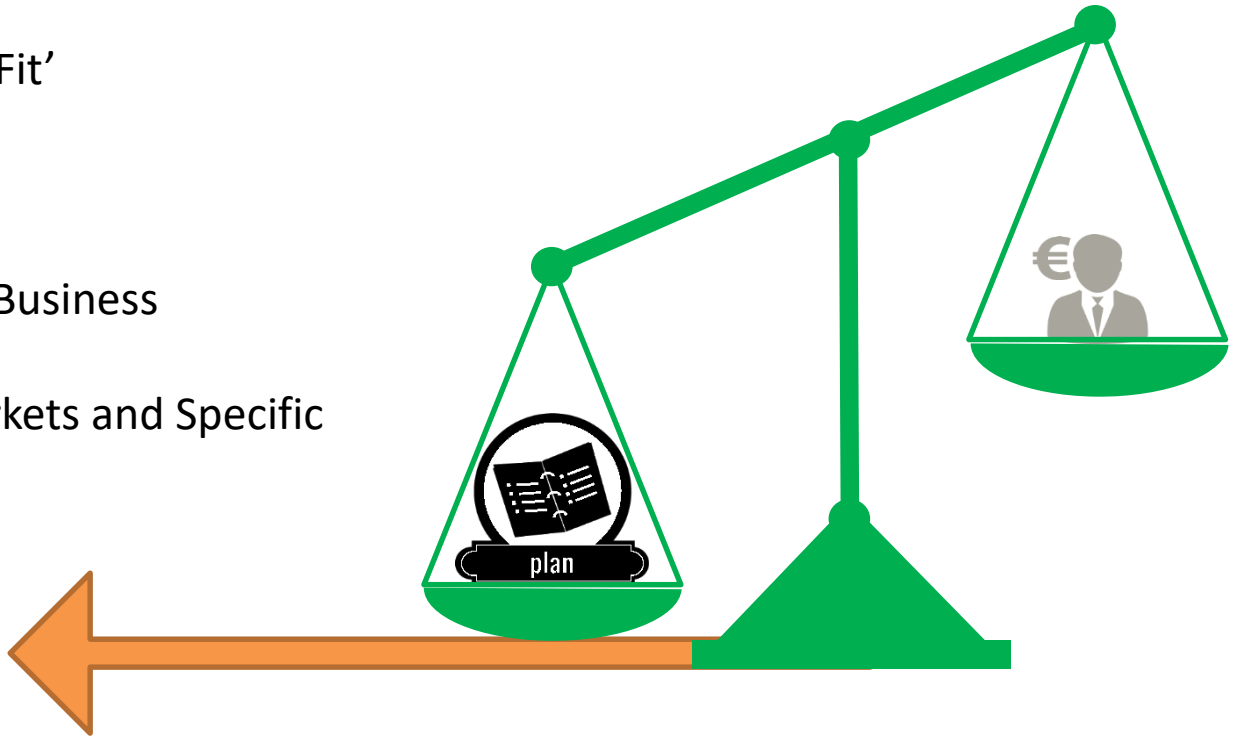
Application Analysis

Market Strategy

Funding / Go-To Market

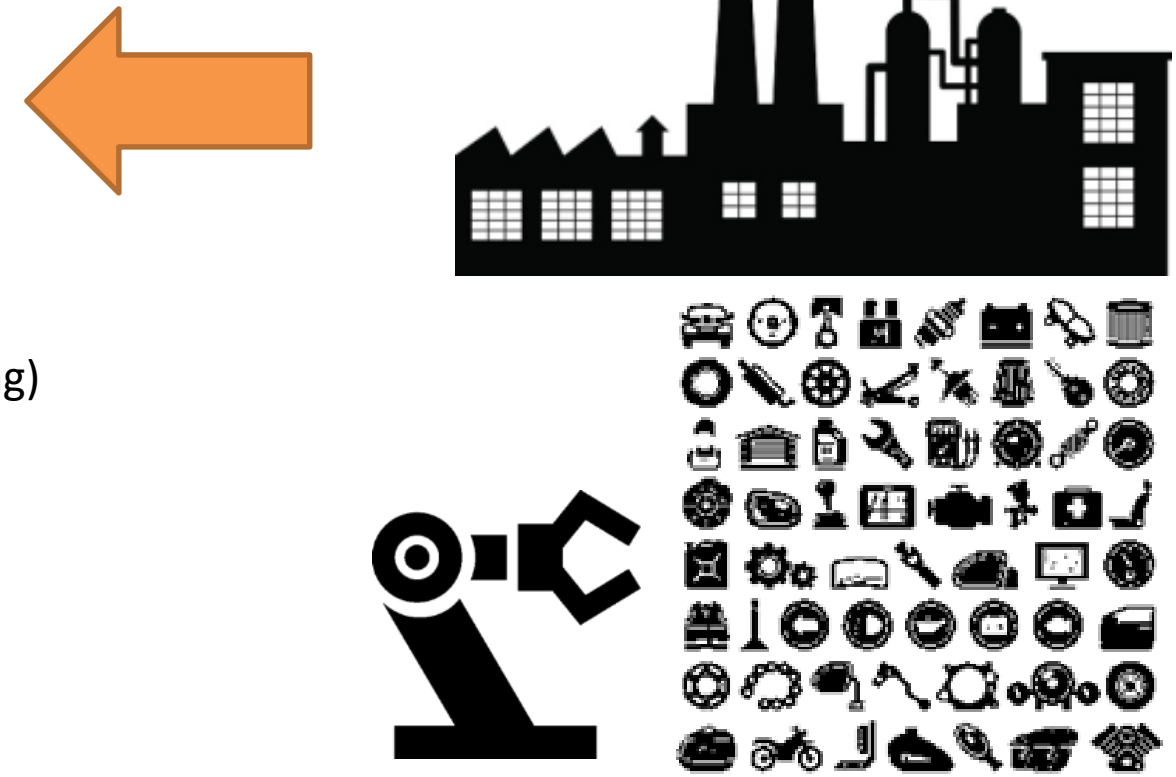
Why conduct market research?

- The ‘Impact Statement’-Creating internal information for further research grants
- Determining Market ‘Fit’
- Due Diligence
- Bridging Science and Business
- Developing IP for Markets and Specific Applications
- **Leverage and Choice**



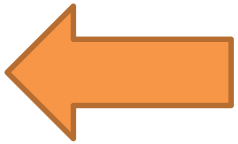
Leverage and Choice: Partners & Co-Developers

- **Project Partners**
- **Co-Developers**
- Investors
- End-Users (Licensing)

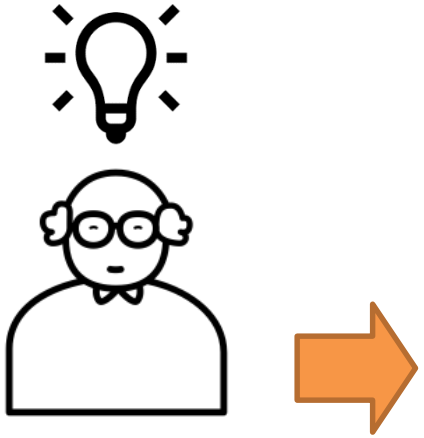


Why Worry about Partners?

 **Universities**	• Will not allocate funds/time toward market research • Complicate IP ownership • Little/no market experience
 **Tech Centers**	• Grant generators • Are contract R&D centers NOT incubators • Market research is an expense- cuts their profits
 **Large Corporations**	• Will take ownership of the IP • Will hold back IP progress
 **Specialized SME's**	• Need more than one • Need time to find the best • May not be easy to find



Ideation: Positioning for the best partners

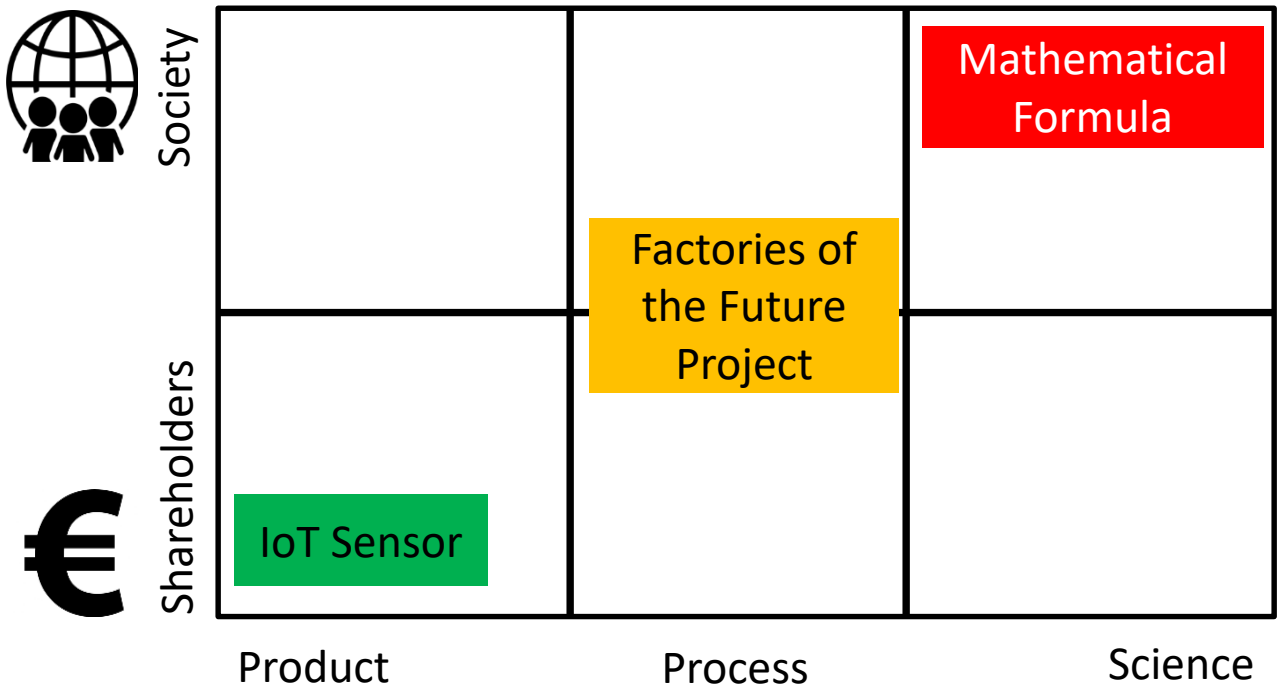


- What is the ultimate goal?
- What is the core research?
- Where will the research ultimately end up?
- **What will be needed to get the idea to market?**
- **Where is the most expertise complimentary to the research?**

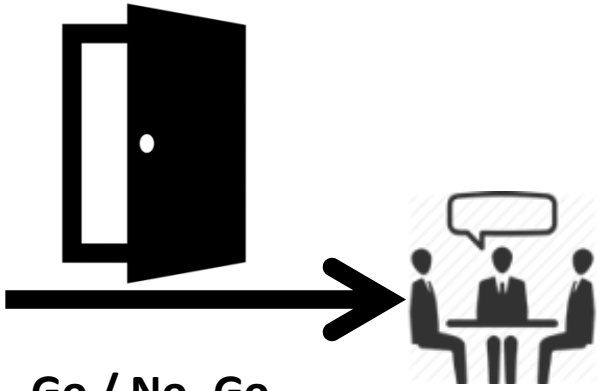
IP Target Matrix

- **Don't waste time trying to bring an unquantifiable project to market!**

- It is important to define the IP to determine if it will be purely a scientific exercise or can be isolated, packaged, and sold as a product or technology



Ideation



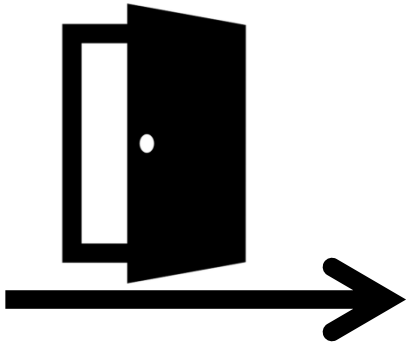
Go / No- Go Analysis

- It is important not to be married to the research idea
- Play ‘devil’s advocate’ and begin to see weaknesses early on
- Be sure to know where the research fits
- Begin to determine what the ‘product’ will be
- Determine the search parameters for the next phase

Go / No-Go: '3 P Triangulation'

In order to determine if the IP will have potential thoroughly search:

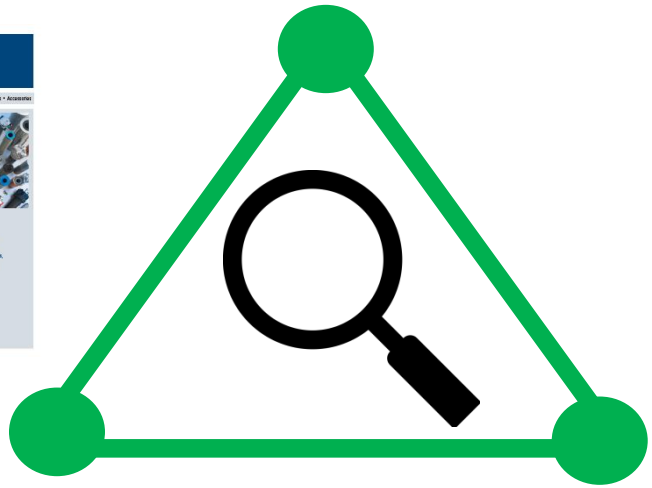
Patents, Commercial ***P***roducts, and ***P***ublications **(3 Ps)**



Go / No- Go Analysis

Patent Searches

Product Searches



Publication Searches

Product Searches

- Google it!
- Understand ‘Product Positioning’
- List end-use companies
- Determine basic specifications

Patent Searches

- If the technology is attracting investment (growth/mature)
- Where is the most attention being paid
- Who are the major players both competitively and complimentary
- Where the IP can fit multiple areas, what markets or applications the IP will fit

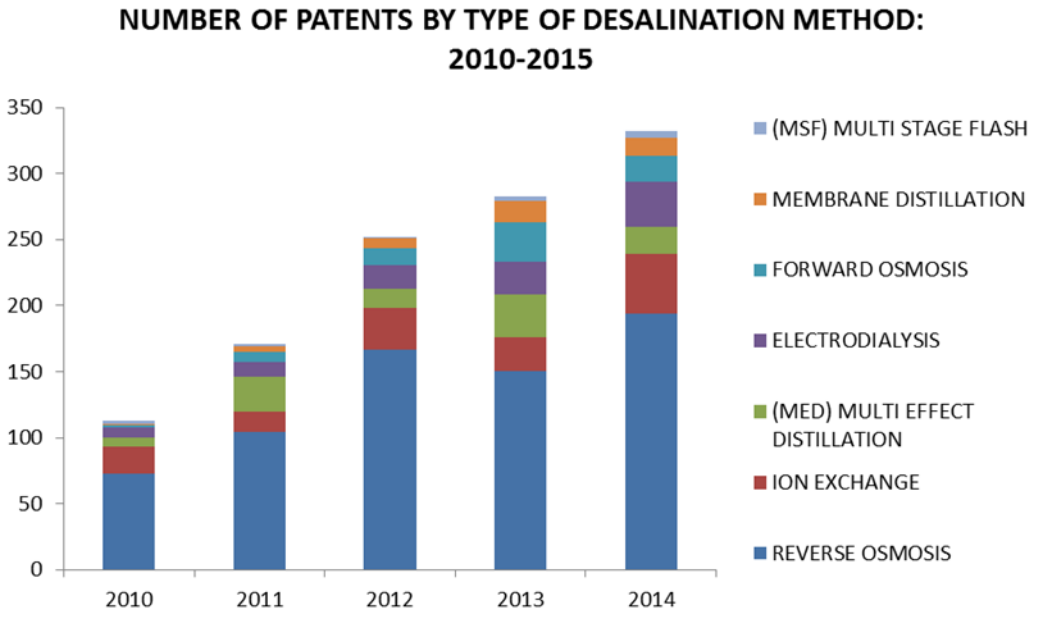
Patent Trending Example: Desalination

EXAMPLE OF PATENT TREND ANALYSIS- Desalination

Methodology

Research was made from the European Patent Office (EPO) for worldwide patents using the following search terms in the title and abstract for the years 2010 up to and including 2014:

MED or multi effect and desalination
MSF or multi stage flash and desalination
Electrodialysis and desalination
Ion Exchange and desalination
Reverse Osmosis and desalination
Forward Osmosis and desalination
Membrane Distillation and desalination



Patent Trending Example: Desalination

Findings

Reverse osmosis has continued to be the dominant R&D investment by volume of patents followed by ion exchange and MED. MED however over this five year period had 8.8% of patents or 101 out of 1,151. Dominant global organizations such as GE or Hitachi appear to be concentrating on RO while China Shenhua Energy Co Ltd and China Electronics Engineering Design Institute patented 10 patents apiece in MED systems.

NUMBER OF PATENTS BY TYPE OF DESALINATION METHOD:2010-2015

	2010	2011	2012	2013	2014	TOTAL 2010-2015	% of TOTAL 2010-2015
REVERSE OSMOSIS	73	104	167	150	194	688	59.8
ION EXCHANGE	20	16	31	26	45	138	12.0
(MED) MULTI EFFECT DISTILLATION	7	26	15	32	21	101	8.8
ELECTRODIALYSIS	8	11	18	25	34	96	8.3
FORWARD OSMOSIS	1	8	12	30	19	70	6.1
MEMBRANE DISTILLATION	1	4	8	16	14	43	3.7
(MSF) MULTI STAGE FLASH	3	2	1	4	5	15	1.3
Total	**113**	**171**	**252**	**283**	**332**	**1,151**	**100.0%**

Patent Trending Example: Desalination

TOP APPLICANTS TO TECHNOLOGIES 2010-2015 Applicants with Five or More Patents by Technology	
APPLICANT / TECHNOLOGY	**NUMBER OF PATENTS 2010-2015**
REVERSE OSMOSIS	
HITACHI LTD	22
MITSUBISHI HEAVY IND LTD	15
NO APPLICANT LISTED	10
GEN ELECTRIC	9
UNIV TIANJIN NORMAL	8
TOSHIBA KK	8
ZHANG ZHIXIONG	8
EBARA CORP	7
UNIV ZHEJIANG SCIENCE & TECH	6
UNIV GUANGDONG OCEAN	6
DEGREMONT	6
CHINA PETROLEUM & CHEMICAL	6
INST SEAWATER DESALINATION & MULTIPURPOSE UTILIZATION SOA TIANJIN	6
HITACHI PLANT TECHNOLOGIES LTD	6
KOREA INST CONSTRUCTION TECH	6
TORAY INDUSTRIES	5
BAOSHAN IRON & STEEL	5
(MED) MULTI EFFECT DISTILLATION	
CHINA SHENHUA ENERGY CO LTD	10
CHINA ELECTRONICS ENGINEERING DESIGN INST	10
ION EXCHANGE	
GEN ELECTRIC	6
ORGANO KK	6
ORGANO CORP	5
FORWARD OSMOSIS	
KOREA MACH & MATERIALS INST	7
ELECTRODIALYSIS	
GEN ELECTRIC	5
MEMBRANE DISTILLATION	
KOREA INST CONSTRUCTION TECH	5

What is often overlooked in a Patent

US 20160126202A1

(19) **United States**

(12) **Patent Application Publication**

Brunschwiler et al.

(10) **Pub. No.: US 2016/0126202 A1**

(43) **Pub. Date: May 5, 2016**

(54) **BRIDGING ARRANGEMENT, MICROELECTRONIC COMPONENT AND METHOD FOR MANUFACTURING A BRIDGING ARRANGEMENT**

(71) Applicants: **International Business Machines Corporation**, Armonk, NY (US); **Conpart AS**, Skjetten (NO); **Intrinsiq Materials Ltd.**, Rochester, NY (US); **Jerzy Haber Institute of Catalysis and Surface Chemistry**, Cracow (PL)

(72) Inventors: **Thomas J. Brunschwiler**, Rueschlikon (CH); **Brian Burg**, Rueschlikon (CH); **Richard Dixon**, Rochester, NY (US); **Helge Kristiansen**, Skjetten (NO); **Piotr Warszynski**, Krakow (PL); **Jonas Zuercher**, Rueschlikon (CH)

(21) Appl. No.: **14/880,648**

(22) Filed: **Oct. 12, 2015**

(30) **Foreign Application Priority Data**

Oct. 29, 2014 (GB) 1419268.6

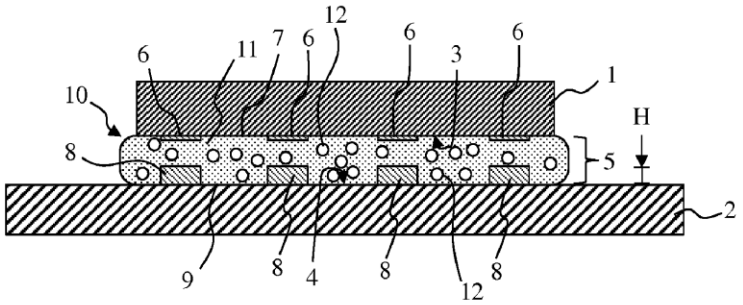
Publication Classification

(51) **Int. Cl.**
H01L 23/00 (2006.01)

(52) **U.S. Cl.**
CPC ***H01L 24/11*** (2013.01); ***H01L 24/14*** (2013.01); *H01L 2224/11524* (2013.01)

(57) **ABSTRACT**

A bridging arrangement includes a first and a second surface defining a gap therebetween. At least one surface of the first and second surface has an anisotropic energy landscape. A plurality of particles defines a path between the first and second surface bridging the gap.



Publication Searches

- Use as a base to understand the most cutting edge techniques and technologies
- Do not use as a market indicator

Journal of Membrane Science 527 (2017) 207–227

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/memsci

Membrane bioreactors – A review on recent developments in energy reduction, fouling control, novel configurations, LCA and market prospects

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[b] Industrial Strategic Market Consultant, 257 Gano Street #7 Providence, Rhode Island 02906, United States
[c] Department of Water Resources and Environmental Engineering, School of Civil Engineering, National Technical University of Athens, 5 Iroon Polytechniou St., GR-15780, Athens, Greece
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ARTICLE INFO

Keywords:
Membrane bioreactors (MBRs)
Energy consumption
Fouling mitigation
Novel configurations
LCA
Market analysis

ABSTRACT

Membrane bioreactor (MBR) technology is considered a well-established, mature technology with many full-scale plants around the world treating municipal and industrial wastewater. However, membrane fouling and energy consumption still remain serious obstacles and challenges in the wider spread of the MBR technology. Therefore, considerable research and development efforts are still underway. Recent developments are primarily focused on aspects related to energy reduction, fouling control and novel configurations for enhanced process performance. This review addresses the recent work on the above mentioned aspects and it discusses the overall life cycle of MBRs and the market prospects for MBR technology. Novel MBR configurations and integrations with other technologies are also reviewed. Finally, the challenges that need to be addressed in order to facilitate market penetration of MBR technology are highlighted.

1. Introduction

Membrane bioreactor (MBR) technology is considered a well-established, mature technology with many full-scale plants around the world treating municipal and industrial wastewater. However, as membrane fouling and energy consumption still remain serious operational obstacles and challenges in the wider spread of the MBR technology, considerable research and development efforts are still underway. These R & D efforts and continuous interest in MBR technology has led to an increased number of academic publications and MBR-related reviews in the recent years.

Current reviews focused on aspects, such as fouling characterization, visualization and foulants identification [1,2], modelling [3–5], membrane cleaning [6], addition of activated carbon [7], fouling control [8], process monitoring [9], osmotic MBRs [10–12], removal of pharmaceutical compounds/CECs [13] and treatment of industrial wastewaters [14,15]. However, recent developments often resulting in novel configurations or focused on aspects related to energy reduction has attracted little attention. Therefore, it is necessary to review these new developments in MBR technology in a systematic and comprehensive study.

To this end, the purpose of this review is to address the recent R & D advances in MBR technology with regard to energy demand reduction and membrane fouling mitigation, both being the technology key challenges and important aspects of MBR functioning. Novel configurations are also discussed, based on the recent literature on the

Abbreviations: A^2O MBR, anaerobic–anoxic–oxic membrane bioreactor; AnMBR, anaerobic membrane bioreactor; AO or A/O, anoxic–oxic membrane bioreactor; AOXMBR, airlift oxidation ditch membrane bioreactor; BEMR, bioelectrochemical membrane reactor or bio-entrapped membrane reactor; BG-MBR, batch granulation membrane bioreactor; BMBR, baffled membrane bioreactor; e-MBR, electro-membrane bioreactor; EMBR, electrochemical membrane bioreactor; CAGR, compound annual growth rate; CAS, conventional activated sludge; COD, chemical oxygen demand; DO, dissolved oxygen; EPS, extracellular polymeric substances; FO, forward osmosis; GAC, granular activated carbon; HFPV-MBR, high frequency powerful vibration membrane bioreactor; HG-MBR, hybrid growth membrane bioreactor; HO MBR, hypoxic/oxic membrane bioreactor; LCA, life cycle assessment; MB, moving bed bioreactor; MBR, membrane bioreactor; MCP, mechanical cleaning process; MEBR, membrane electro-bioreactor; MF, microfiltration; MFC, microbial fuel cells; MLE, modified Ludzacke Ettinger; MLSS, mixed liquor suspended solids; MMV-MBR, magnetically induced membrane vibration membrane bioreactor; MPBR, membrane photobioreactor; OG, graphene oxide; OMBR, osmotic membrane bioreactor; PAC, powdered activated carbon; PBM, polymerisable biocontinuous microemulsion; PVDF, polyvinylidene fluoride; QQ, quorum quenching; rMBR, reciprocation membrane bioreactor; SADp, specific aeration demand per permeate volume; SADm, specific aeration demand per membrane area; SBAR, sequencing batch airlift reactor; SED, specific energy demand; SMP, soluble microbial products; TN, total nitrogen; TMP, trans membrane pressure; TOC, total organic carbon; TP, total phosphorous; UCT, University Cape Town; UF, ultrafiltration; VMBR, vibrating membrane bioreactor or vertical membrane bioreactor; WWTP, wastewater treatment plant

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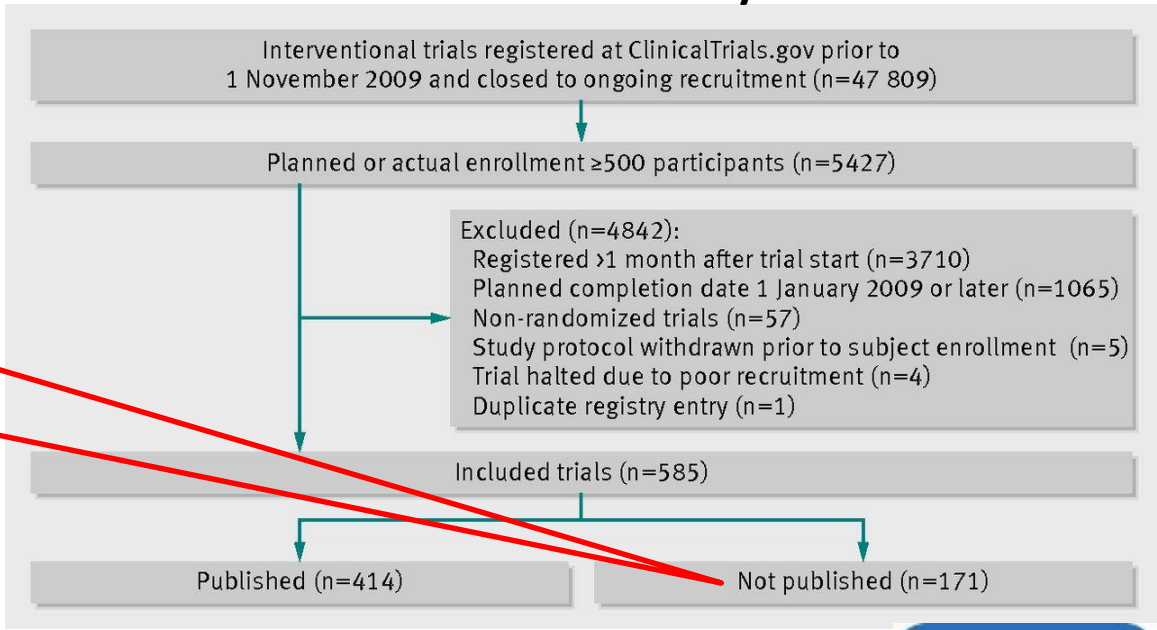
Available online 10 December 2016
0376-7388/

The overreliance on scientific journals

29% of clinical trials were NOT published

Non-publication of large randomized clinical trials: cross sectional analysis

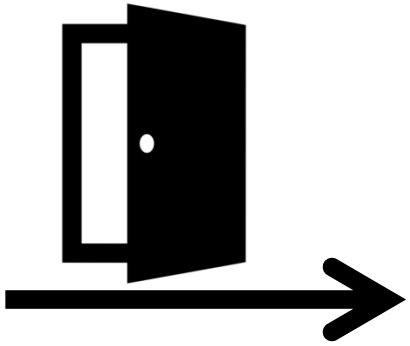


Christopher W Jones et al. BMJ 2013;347:bmj.f6104

http://www.bmj.com/content/347/bmj.f6104

thebmj

Go / No-Go: Will your idea stand a chance?



Go / No- Go Analysis

No Go

x The IP is mature
x The IP has many commoditized substitutes
x The IP will not replace existing technologies and/or compliment existing products
x The IP will be costly to produce / will have limited supply

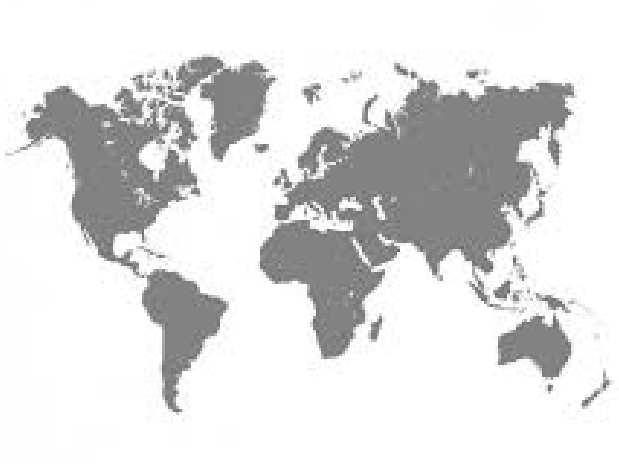
Weak / Reassess

? The IP is in a highly competitive space
? The IP will compete with large organizations
? The market is commoditized and price sensitive
? The IP runs the risk of not adding enough value to the market

Go

✓ The IP is unique
✓ The IP has no direct substitute
✓ The IP can compliment or replace existing products / technologies
✓ The IP will offer superior performance and/or price

The Results

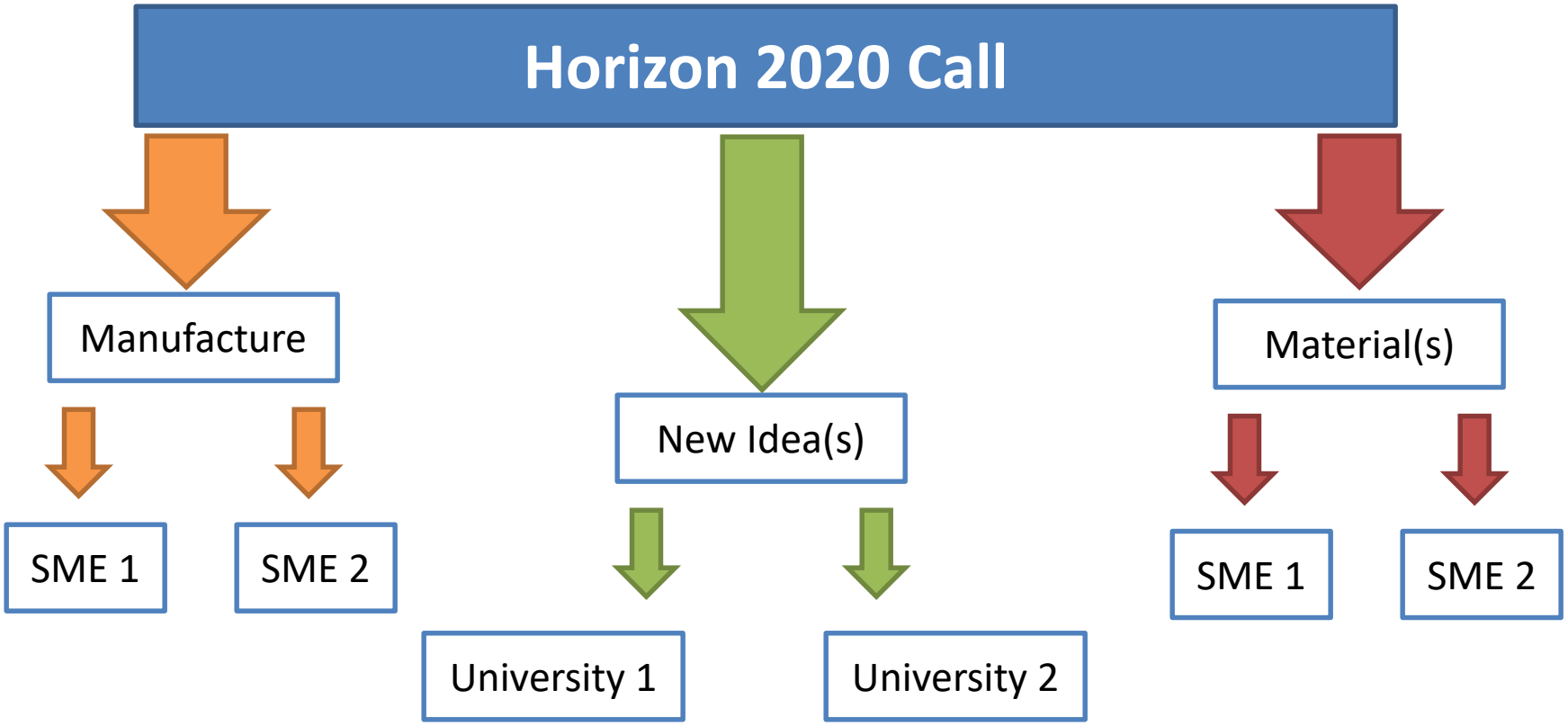


- Geographical trends
- Lists of companies that are active in the research space
- Specific contacts
- Trends in research
- Complimentary technology and production methods

IP Generation: H2020 vs. NC State

	**Horizon 2020**	**2014 + 2015**	
		Patents Filed	109
		Patents Issued	29
		Publications	1760
NC STATE UNIVERSITY	**North Carolina State University**	**FY 2016 <u>Only</u>**	
		Patents Filed	229
		Patents Issued	65
		Commercialization Agreements	164
		Start-Ups	12
		Products to Market	4
		Revenue	**$3.8 million**

The Opportunities and Loopholes for International Partners

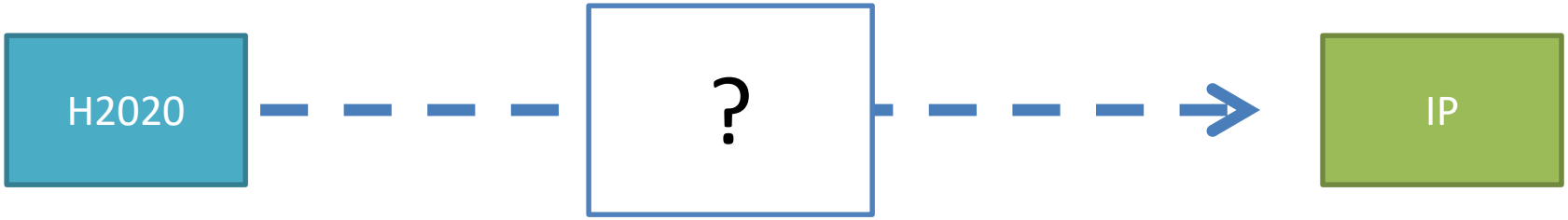


Direct IP / Indirect IP

2014 – 2015 Horizon 2020 Industrial Partner Examples

IP is being generated but where?

Company	Company Contribution (€)	Total Projects Cost (€)
Robert Bosch	12,186,411.03	162,749,418.59
Philips Medical Systems Nederland	5,929,964.72	120,785,495.79
NEC Europe	7,262,586.03	83,995,765.00
Arkema France	4,898,209.25	78,323,072.46
Valeo Equipements Electriques Moteur SAS	1,219,151.20	64,687,095.99
Man Truck & Bus	4,940,848.88	60,128,632.82
Schneider Electric Industries SAS	796,402.25	59,392,674.34
BASF SE	6,356,979.81	54,348,436.87
Huawei Technologies Düsseldorf	4,199,467.88	50,744,546.50
Volkswagen	3,845,982.72	47,307,485.11



Selected companies participating without receiving funds: 2016 & 2017

Organization	Total Project(s) Cost	
SAAB AKTIEBOLAG	€	267,564,646.45
IBM RESEARCH GMBH	€	127,210,981.03
RENAULT TRUCKS SAS	€	106,223,890.71
BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT	€	106,223,890.71
RENAULT SAS	€	106,223,890.71
Nissan Motor Manufacturing (UK) Limited	€	106,223,890.71
AUDI AKTIENGESELLSCHAFT	€	106,223,890.71
BASF SCHWEIZ AG	€	82,265,195.88
KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY	€	38,933,105.00
F. Hoffmann-La Roche Ltd	€	36,122,153.25
OPTOMEC, INC.	€	9,429,875.00

US for Profit Organizations Participating in H2020: 2016 & 2017

US For Profit Organizations
Start Year 2016 and 2017

Organization Name	Project Acronym	EC Contribution	Total Project Cost
UNIVERSITY OF MICHIGAN THE REGENTS OF THE UNIVERSITY OF MICHIGAN	BEAt-DKD		€ 29,421,038.00
OPTOMEC, INC.	4D hybrid		€ 9,429,875.00
PRIMA POWER LASERDYNE LLC	4D hybrid		
IOTANGO INC.	AGILE		€ 6,957,550.00
STARKEY LABORATORIES INC	SENSE-Cog		€ 6,868,286.25
VENTURE & CAPITAL INTERNATIONAL LLC	NearUS	€ 503,500.00	€ 2,999,917.50
HONEYWELL INTERNATIONAL INC	PICASSO		€ 1,160,031.25
LANTANA CONSULTING GROUP, LLC	Trillium II		€ 1,104,547.50
THE PROVIDENCE GROUP LLC	AEGIS	€ 20,000.00	€ 744,262.50
YANTRIC INC FOR PROFIT CORPORATION	HapticCell	€ 21,966.00	€ 149,982.00
Total		**€ 545,466.00**	**€ 58,835,490.00**

Rules of participation: US partners

- As a general rule, US partners can participate as an unfunded third country, except SC1 (Health) where there is a bilateral agreement for funding.

- Otherwise, US entities would only be funded if their participation was considered essential for the project (for example US partner has a specific expertise, a patent, market access or anything that cannot be found within the EU)

- No particular IP rules or issues associated with US entities participation. Exception the provisions of article 30.3 which allows the EU to object to any transfer or licencing of IP to non-EU countries on the grounds of competition or security.

Questions