



I2APM

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International Coordination 1:

Public Private Partnerships Activities Supporting International Adoption

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Overview

- Public Private Partnerships, what and why?
- I2APM introduction and goals
- Current and Ongoing Activity
- Collaboration Examples and Updates



Public Private Partnerships

- PPPs facilitate the introduction of new technologies
- C-SOPS, CMAC, RCPE, and SSPC are all examples of existing PPPs focused on Advanced Pharmaceutical Manufacturing
- While PPPs may have been important to other technology introductions (i.e. microchip manufacture), it is perhaps more important if not critical within a regulated industry like pharma



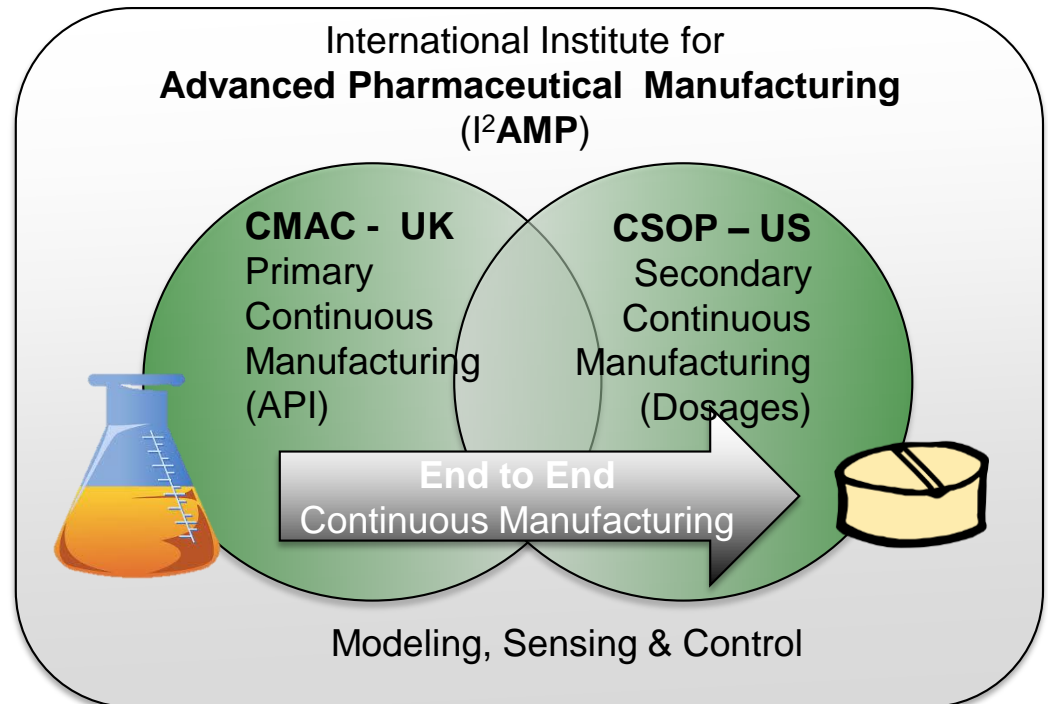
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I2APM Introduction

I2APM was founded by C-SOPS and CMAC in order to help align the PPPs working in APM, and in particular at this current time CM

I²APM ← **NSF (USA)**
EPSRC (UK)





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I2APM Goals

Support International Adoption of Advanced Pharmaceutical Manufacturing Technologies including CM through:

- Providing the needed trained workforce focused on emerging manufacturing technologies to support implementation in industry.
- Supporting development of relevant expertise at regulatory agencies
- Creating common language, shared store of knowledge, common perspective and understanding of technology and terminology
- Working in close collaboration with industry members to identify and develop appropriate curriculum materials and competencies.



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I2APM Current and ongoing activity

- Meetings/Workshops
- Educational efforts
- Research collaborations



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First Meeting

February 22-24, 2015
Graz, Austria

Hosted by
ERC-SOPS (USA)
CMAC (UK)
RCPE (Austria)



February 22-24, 2015
Graz, Austria

IIAPM Workshop
International Institute for Advanced
Pharmaceutical Manufacturing



Inffeldgasse 13
Ground floor
Room HS i8





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International Workshops and Seminars

USP C-SOPS Continuous Manufacturing Technology & Quality Roadmapping Roundtable -- June 27 – June 28, 2016

Roundtable Purpose

- Provide an open platform to share knowledge about pharmaceutical continuous manufacturing (PCM) and insights on the future role of quality standard in this arena
- Convene an interactive discussion on key technological and quality challenges and opportunities in PCM and recommendations for corresponding research paths
- Identify scientifically sound, novel technologies and control strategies that will enable and grow PCM to improve drug quality
- Build a technology and quality roadmap for accelerating development, implementation, and standardization of PCM
- Organize a working group to provide a post-meeting report on the USP CM Technology Road-mapping Roundtable.

Personnel from C-SOPS, CMAC and RCPE were presenting/attending



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International Workshops and Seminars

I2APM international symposium and training day

November 30th - December 1st 2016

The **symposium** will be an internal event with attendees from **CMAC, C-SOPS and RCPE**, whereby the staff and students from all three centers will come together to learn about research being carried out across all institutions. The training workgroup will be organizing a day of **training** on 1st December following the symposium



I2APM Training Day

Draft Schedule - Thurs 1st December 2016

Time	Activity	Facilitator	Location
08.45	Tea/coffee	N/A	Level 2 Foyer
09.00 – 10.30	Training session - overview of CM for solid dosage	Fernando Muzzio (C-SOPS)	Conference rooms 6/7
10.30 – 12.00	Training session – topic tbc	Johannes Khinast (RCPE)	Conference rooms 6/7
12.00 – 13.00	Lunch	N/A	Level 2 Foyer
13.00 – 15.00	Problem Solving Workshop	Chris Rielly (CMAC) Claire Ordoyno (CMAC) Others tbc	Conference rooms 6/7
15.00 – 15.30	Laboratory Tour - Overview	Thomas McGlone (CMAC)	Level 6 and 8 laboratories
15.30 – 16.30	Laboratory Session – Equipment Demos	Tbc but will be a mixture of primary and secondary equipment, with CMAC researchers explaining the different pieces of equipment and their research	Level 6 and 8 laboratories
16.30 – 17.00	Researcher Networking Session	Chris Rielly (CMAC)	Conference rooms 6/7
17.00 – 17.15	Wrap up and closing remarks	Chris Rielly (CMAC)	Conference rooms 6/7



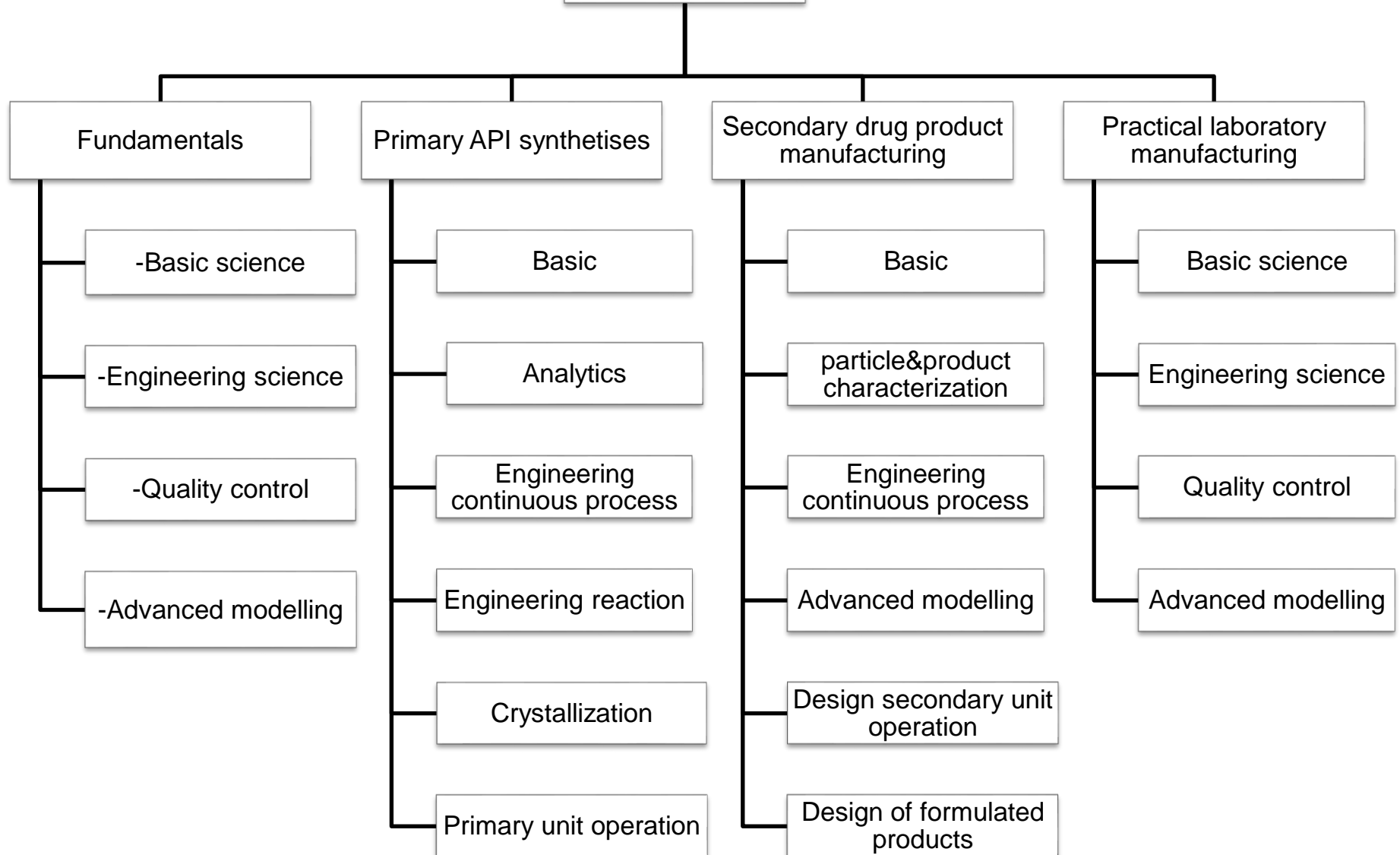
Educational Agenda

- The **goal** is to create a training package for industry, researchers, regulators and faculty across leading edge concepts. this industry relevant package will cover different aspects of continuous manufacturing
- **Outcome:** Each center collated a list of teaching materials available: titles and description of modules, then the overlap in courses or gaps in any teaching areas has been identified to improve and modification. These materials can be offered as courses, seminars and other educational packages for industrial or academic researchers.



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Sample of Research Collaborations

- 1) Hybrid approach for primary/secondary continuous manufacturing (CSOPS-CMAC)
- 2) Integration of continuous manufacturing strategies for nano-based drug products (CSOPS-SSPC)



1) Hybrid approach for primary/secondary continuous manufacturing (CSOPS-CMAC)

Create an integrated modeling tool comprising from API to finished product:

- Examine the dependence of continuous manufacturing with respect to variations in API properties
 - API synthesis -- CMAC
 - API characterization – CMAC
 - Product Fabrication by Continuous Manufacturing (C-SOPS)
 - Process/Product Characterization (C-SOPS)

- Develop of end-to-end flow-sheet case study
 - Development API synthesis of flow-sheet unit operations (CMAC-CSOPS)
 - Implementation of integrated API synthesis to product manufacturing flow-sheet model (C-SOPS)



1) Hybrid approach for primary/secondary continuous manufacturing (CSOPS-CMAC)

Create an integrated modeling tool comprising from API to finished product:

- Validate of integrated flow-sheet modeling
 - Selection of a API properties and processing conditions for target product properties (CMAC-CSOPS)
 - Evaluate degree of predictability of modeling strategy (CMAC-CSOPS)
- Report findings/learning to define subsequent case studies
 - Through sharing information on existing testing and characterization capabilities to assess material properties and required performance criteria, model systems will be identified and agreed. This may include transfer of samples recrystallized to manipulate specific attributes from CMAC for testing in the world-leading facilities within CSOPS. The results from these preliminary investigations will provide the basis for novel approaches to develop the control of particle formation for formulation. Also sharing of experimental data already accumulated from the CMAC and CSOPS will be shared.



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2) Integration of continuous manufac. strategies for nanobased drug products (CSOPS-SSPC)

*Center for Structured
Organic Particulate
Systems (CSOPS)*

*Synthesis and Solid
State Pharmaceutical
Centre (SSPC)*

Centre for
Pharmaceutical
Sciences (CPS) at
Queens University

Sponsored by the US
National Science
Foundation

Funded by Science
Foundation Ireland and
the Pharmaceutical
industry

EU and industrial
funding support

4 university sites in the USA
(Rutgers, Purdue, NJIT,
UPRM)

9 research performing
organizations in Ireland

Institute of Precision Medicine
and Pharmaceutical Sciences at
Queens University (Northern
Ireland)

Drug product manufacturing,
PAT, modeling and control

Drug substance manufacturing and pharmaceutical science



2) Integration of continuous manufac. strategies for nanobased drug products (CSOPS-SSPC)

1. Supercritical
Enhanced
Atomization (SEA)

2. Continuous
Heterogeneous
Crystallization of APIs
in and onto
Excipients

3. Continuous
manufacture of co-
crystal APIs using in-
line Raman
spectroscopy



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2) Integration of continuous manufac. strategies for nanobased drug products (CSOPS-SSPC)

- **March 2016:** members of C-SOPS were invited to attend the annual St. Patricks day celebration hosted by the Republic of Ireland Embassy in Washington DC, to learn more about the Irish-U.S. research partnerships
- **March 2016:** Irish collaborators visited Rutgers University (C-SOPS) the next day for a more informative 1 day meeting to learn more about the work done at Rutgers University and to also present work done at SSPC.
- **May 2016:** 4 PhD students (Shaikh Rahamatullah, Seyedeh Pishnamaz, Shaza Darwish, Saeed Shirazian) from the group of Gavin Walker (CPS) visited Rutgers for 1 week student exchange. A detailed training program was incorporated for the students to learn in detail part of the work done at Rutgers that would be beneficial for the current proposal.
- **July 2016:** Ramachandran (Rutgers faculty member) visited SSPC researchers at University of Limerick, Ireland for further detailed planning and execution of research activities.





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2) Integration of continuous manufac. strategies for nanobased drug products (CSOPS-SSPC)

Advances:

- Developed **three novel processes** for the continuous manufacture of particles with enhanced bioavailability and improved manufacturability (via direct compaction)
- **Process intensification** through integration of Drug Substance (DS) and Drug Product (DP)
- Used in situ **PAT for mechanistic understanding** and **feedback control** – critical for integrated DS+DP manufacturing
- Established **international collaboration** among three centers helps promoting and adopting continuous manufacturing in pharma
- Increased **scientific impact** and **international dimension** of CSOPS research



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