A WEBINAR ON:

The Composites Knowledge in Practice Centre

An open resource for composites manufacturing knowledge and best practices

CO-HOSTED BY:

CKN
Composites Knowledge Network

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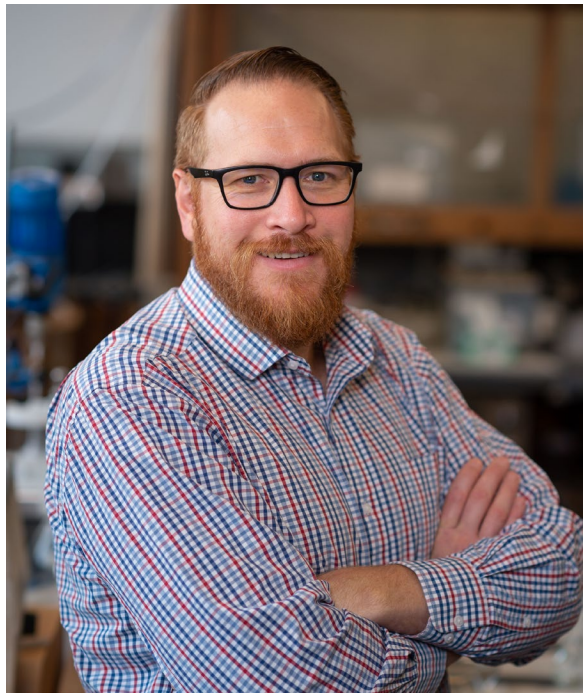


Casey Keulen, Ph.D, P.Eng.
Assistant Professor of Teaching, University of British Columbia
Co-Director of Advanced Materials Manufacturing MEL Program, UBC
Lead of Continuing Professional Development, CKN

- Ph.D. and M.A.Sc. in Composite Materials Engineering
- Over 15 years experience in industry and academia working on polymer matrix composites in aerospace, automotive, marine, energy, recreation and others
- Experience working with over 150 companies from SME to major international corporations
- Expertise in liquid composite moulding and thermal management

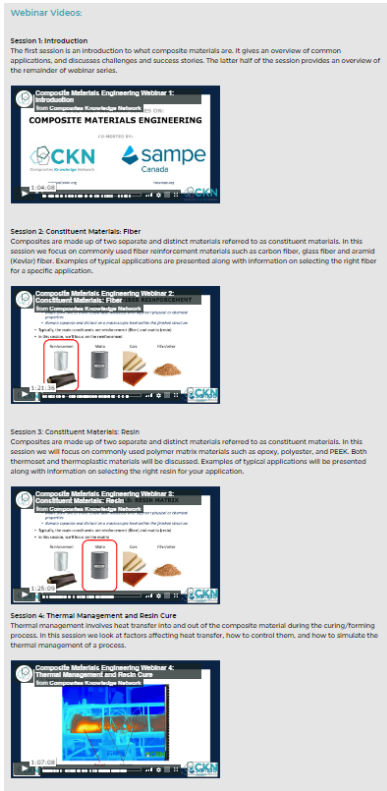
YOUR HOSTS

Dr. Anoush Poursartip, PhD, PEng, FCAE
Professor, The University of British Columbia
Co-Director, Composites Knowledge Network (CKN)
Director, Composites Research Network (CRN)
Director of Research, Convergent Manufacturing Technologies

- 40+ years experience in composites
- Research has always had a focus on bridging academia and industry & linking knowledge and practice
- Numerous awards and recognitions:
  - Fellow of Canadian Academy of Engineering, SAMPE, ICCM
  - Medal of Excellence in Composites from University of Delaware
  - ASTM Wayne Stinchcomb Award
  - Multiple Boeing awards

PAST WEBINAR RECORDINGS AVAILABLE

compositeskn.org



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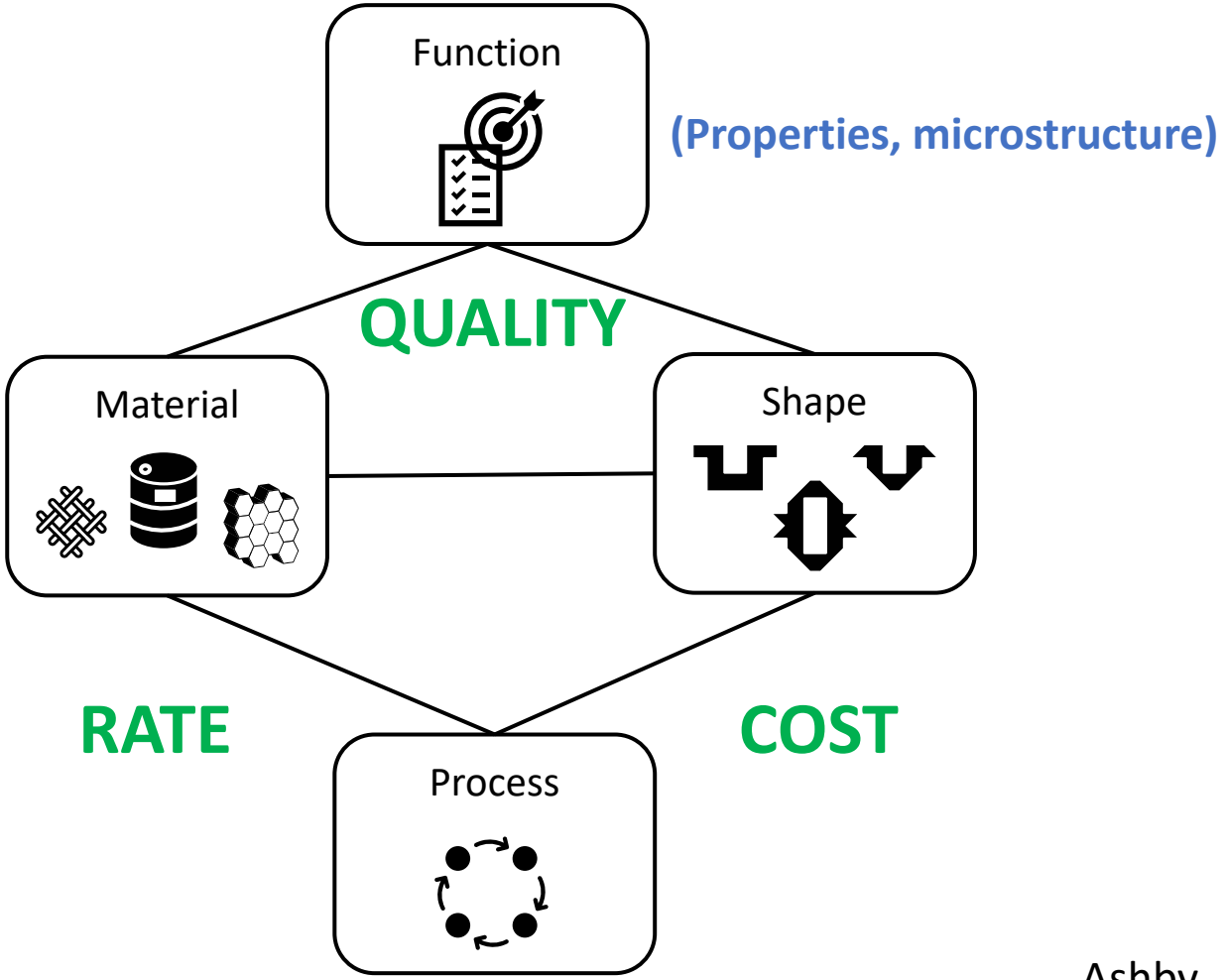
Introduction to the KPC

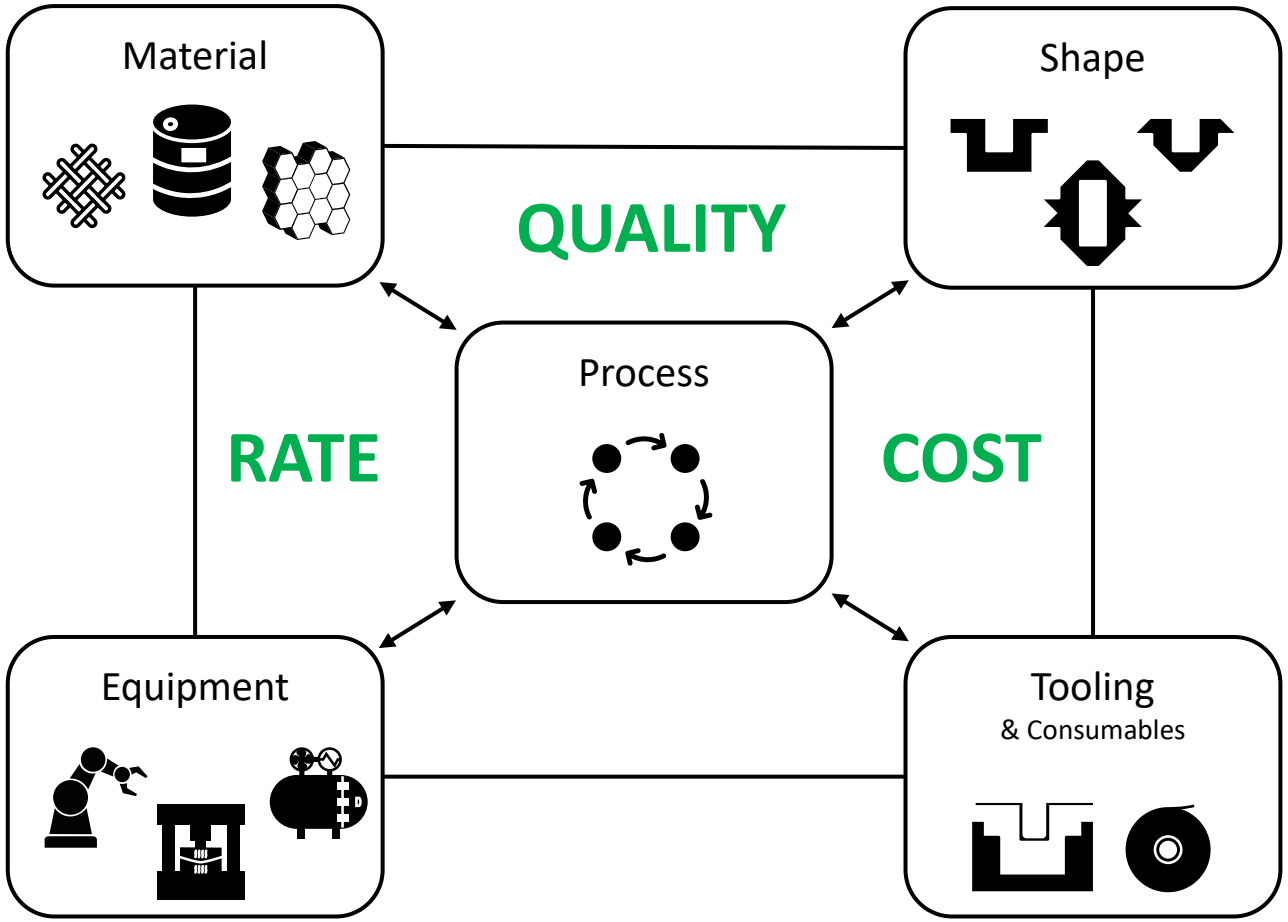
- Polymer composites are excellent materials for a wide range of industries, from aerospace to clean energy to industrial
- The value comes from their versatility in shape, properties, flexibility in manufacturing
- But manufacturing is not easy, and so many of the impediments to further growth in composites use can be traced back to the complexities of composites manufacturing
- The Knowledge in Practice Centre (KPC) has been developed to help you navigate this complexity
- Understanding the KPC approach is key to using it
- Today, we provide a high-level overview of how it all comes together

Design and Manufacturing

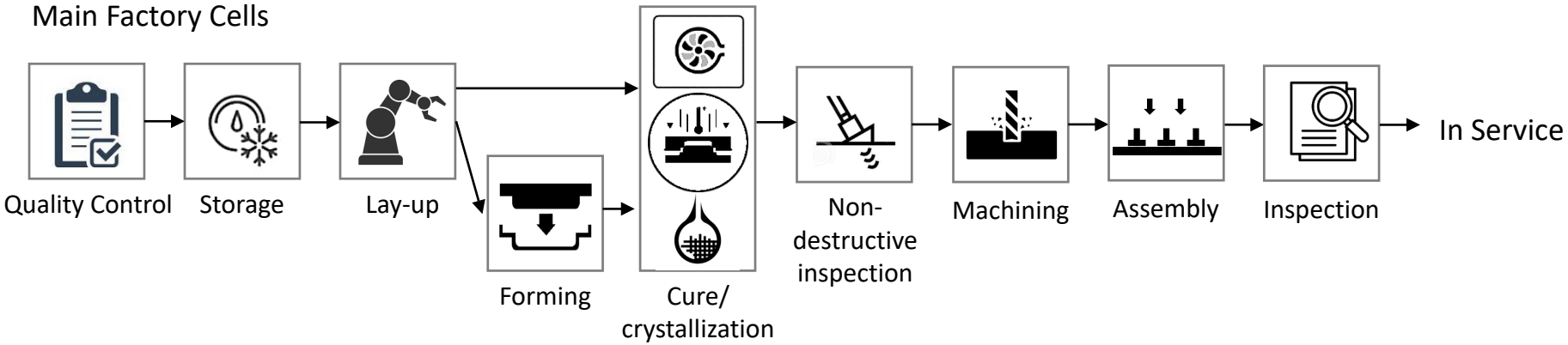


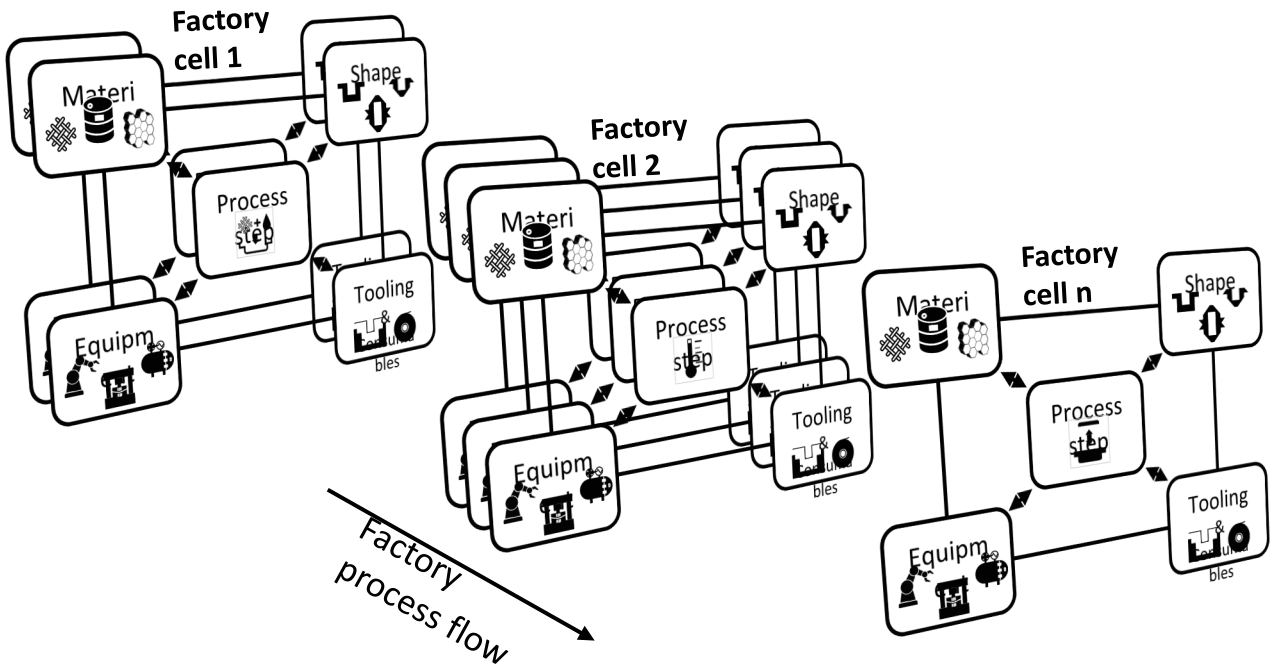
Ashby

Design and Manufacturing



A Generic (Prepreg) Composites Factory





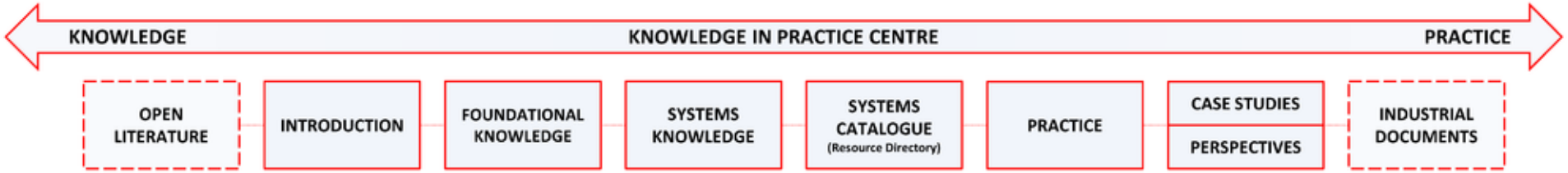
Managing Quality Outcomes in the Factory

- Quality outcomes are managed in the process workflow through the factory via
  - Thermal management
  - Materials deposition management
  - Flow and compaction management
  - Residual stress and deformation management
- Quality is always traded off with cost and rate
- We make these decisions during development of the process, when optimizing the process, and when troubleshooting the process

How to use the KPC

- You may be here with a very specific practice problem
  - I am making thicker parts than previously – how do I avoid exotherms? How do I find the shortest cycle?
- You may be here with a broader practice question
  - I am buying a new oven. What should I look for?
- You may be here as a learner, for general education
  - How do thermoset resins cure?
- Using the structured approach I have just introduced, we share not just the practical knowledge but also the supporting testing, analysis and experience

KPC Architecture



KPC Demonstration

Summary

- In using the KPC, remember
  - What we are sharing is not perfect
  - We are continuously adding content
  - Whether content or navigation, your feedback on how to make it better is much appreciated
  - We are moving towards enabling you to contribute as well, please tell us if you are interested
  - The CKN is a not-for-profit enterprise, with the aim to help the composites community, not just in Canada but internationally
  - We welcome collaboration and involvement
- Explore and hopefully enjoy!

Thank you for joining us!

Keep an eye out for announcements on the next AIM events

Questions?

For more information on future dates and times visit:

compositeskn.org

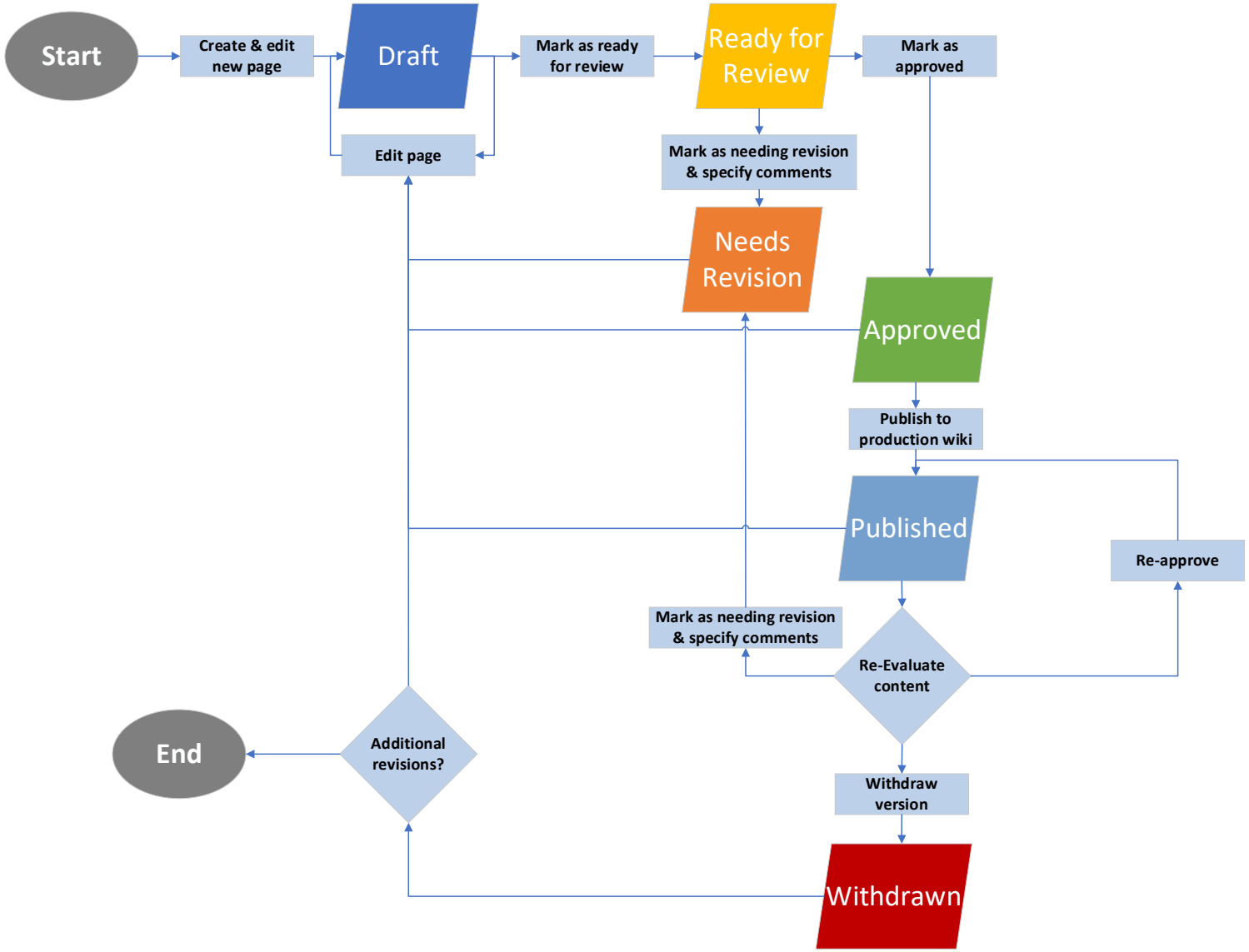
CKN | Knowledge in Practice Centre

The Architecture behind the Knowledge in Practice Centre

Knowledge in Practice Centre (KPC)

- Built on the MediaWiki platform
  - Open source, customizable knowledge transfer platform
  - Same platform used by Wikipedia
- Semantic MediaWiki enabled templates
  - (information → data → information)
- Publishing workflow integration
  - (edit → review → approve → publish → version control)

Publishing Workflow



Production & Development KPC's

- A "production" and "development" server configuration has been implemented for IT security
- The publicly visible production server only contains versions of pages that we want to be published
- The non-publicly visible development server is used for drafting content
- The "Push" extension is used to transfer approved pages from the Development KPC to the Production KPC

Semantic MediaWiki

- Information → data → information
  - Writers embed information into the KPC
  - This information is stored in a structured way as data inside the relational database
  - This data can be queried and turned back into information that is useful to the readers
- E.g.
  - Within the pages for “Hot press”, “Oven” and “Autoclave”, the objects are specified as “Equipment” belonging to certain factory cells (like “Thermal transformation cell”)
  - On the page describing the thermal transformation cell, a query is embedded to list all “Equipment” belonging to the “Thermal transformation cell”
  - This query updates automatically as new equipment is added. The page with the query does not need to be updated, and is always consistent

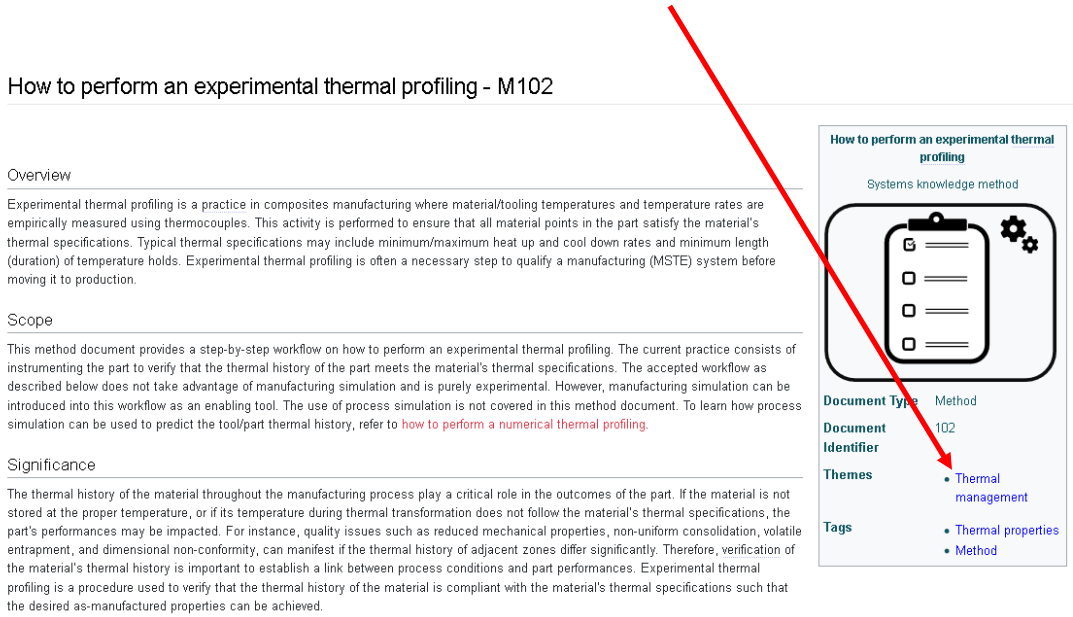
Equipment used during thermal transformation

- Hot press - A176
- Oven - A174
- Room temperature transformation - A175

Semantic MediaWiki

- E.g. 2
  - List all pages related to the “Thermal management” theme

Clicking on the theme…



How to perform an experimental thermal profiling - M102

Overview

Experimental thermal profiling is a practice in composites manufacturing where material/tooling temperatures and temperature rates are empirically measured using thermocouples. This activity is performed to ensure that all material points in the part satisfy the material's thermal specifications. Typical thermal specifications may include minimum/maximum heat up and cool down rates and minimum length (duration) of temperature holds. Experimental thermal profiling is often a necessary step to qualify a manufacturing (MSTE) system before moving it to production.

Scope

This method document provides a step-by-step workflow on how to perform an experimental thermal profiling. The current practice consists of instrumenting the part to verify that the thermal history of the part meets the material's thermal specifications. The accepted workflow as described below does not take advantage of manufacturing simulation and is purely experimental. However, manufacturing simulation can be introduced into this workflow as an enabling tool. The use of process simulation is not covered in this method document. To learn how process simulation can be used to predict the tool/part thermal history, refer to how to perform a numerical thermal profiling.

Significance

The thermal history of the material throughout the manufacturing process play a critical role in the outcomes of the part. If the material is not stored at the proper temperature, or if its temperature during thermal transformation does not follow the material's thermal specifications, the part's performances may be impacted. For instance, quality issues such as reduced mechanical properties, non-uniform consolidation, volatile entrapment, and dimensional non-conformity, can manifest if the thermal history of adjacent zones differ significantly. Therefore, verification of the material's thermal history is important to establish a link between process conditions and part performances. Experimental thermal profiling is a procedure used to verify that the thermal history of the material is compliant with the material's thermal specifications such that the desired as-manufactured properties can be achieved.

How to perform an experimental thermal profiling

Systems knowledge method

Document Type: Method

Document Identifier: 102

Themes: Thermal management

Tags: Thermal properties, Method

…gives an organized listing of all related pages

Foundational Knowledge Articles	• Material structure - A152 • Materials science - A235 • Polymer properties - A212 • Processing science - A151 • Reinforcement properties - A213 • Specific heat capacity - A117 • Thermal behaviour - A232 • Thermal conductivity - A116 • Thermal diffusivity - A143 • Thermal phase transitions of polymers - A102 • Thermoplastic polymers - A161 • Thermoset polymers - A105
Foundational Knowledge Method Documents	• How to measure gel time - M101
Foundational Knowledge Worked Examples	-
Systems Knowledge Articles	• Effect of equipment in a thermal management system - A110 • Effect of material in a thermal management system - A155 • Effect of shape in a thermal management system - A154 • Effect of tooling in a thermal management system - A142 • System interactions - A109 • System parameters - A108 • Systems knowledge method documents - A191 • Thermal management - A107
Systems Knowledge Method Documents	• How to perform an experimental thermal profiling - M102