KU LEUVEN

Managing Positive and Negative Complexity

Design and Validation of an IT Project Complexity Management Framework

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IT projects are complex

IT projects and products are
more and more challenging,
more and more rewarding

- *31% of projects are canceled*
- *52% of projects cost 189% the original estimate*
- *16.2% are on-time/on-budget*

(Standish Group, 1995)


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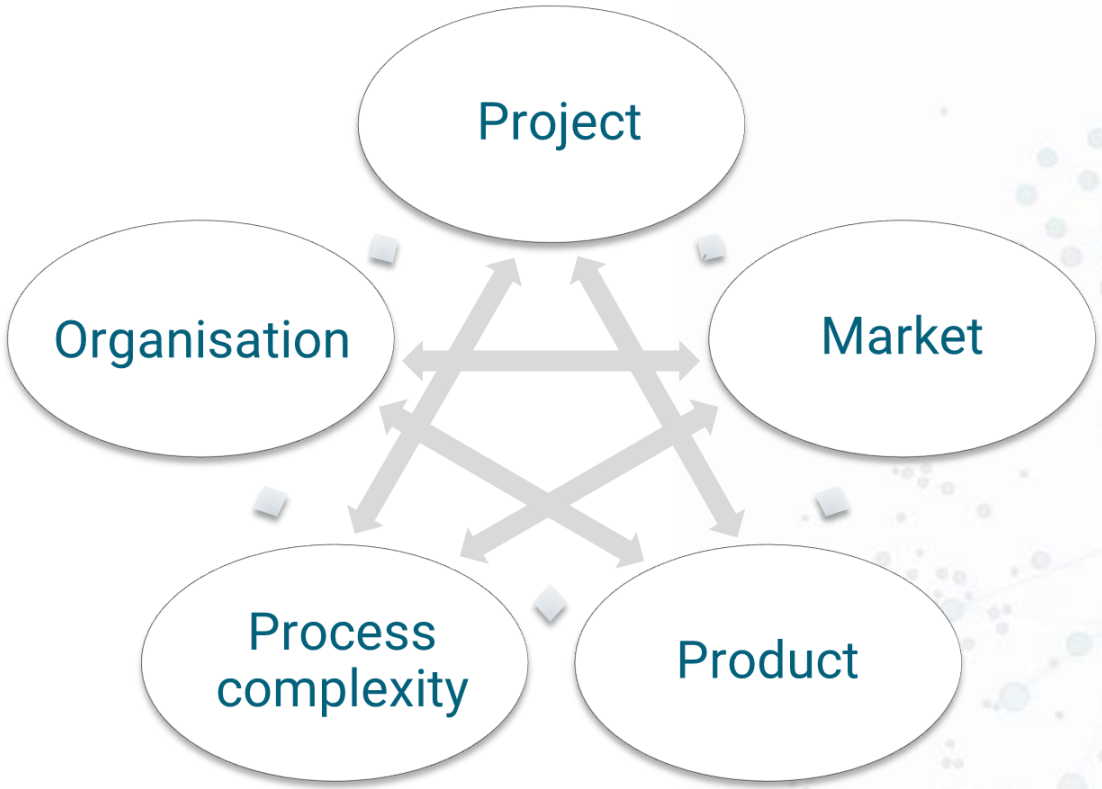
Complexity works.

Complexity works.



Modern IT engineering uses complexity to deliver value, benefits, functionality.

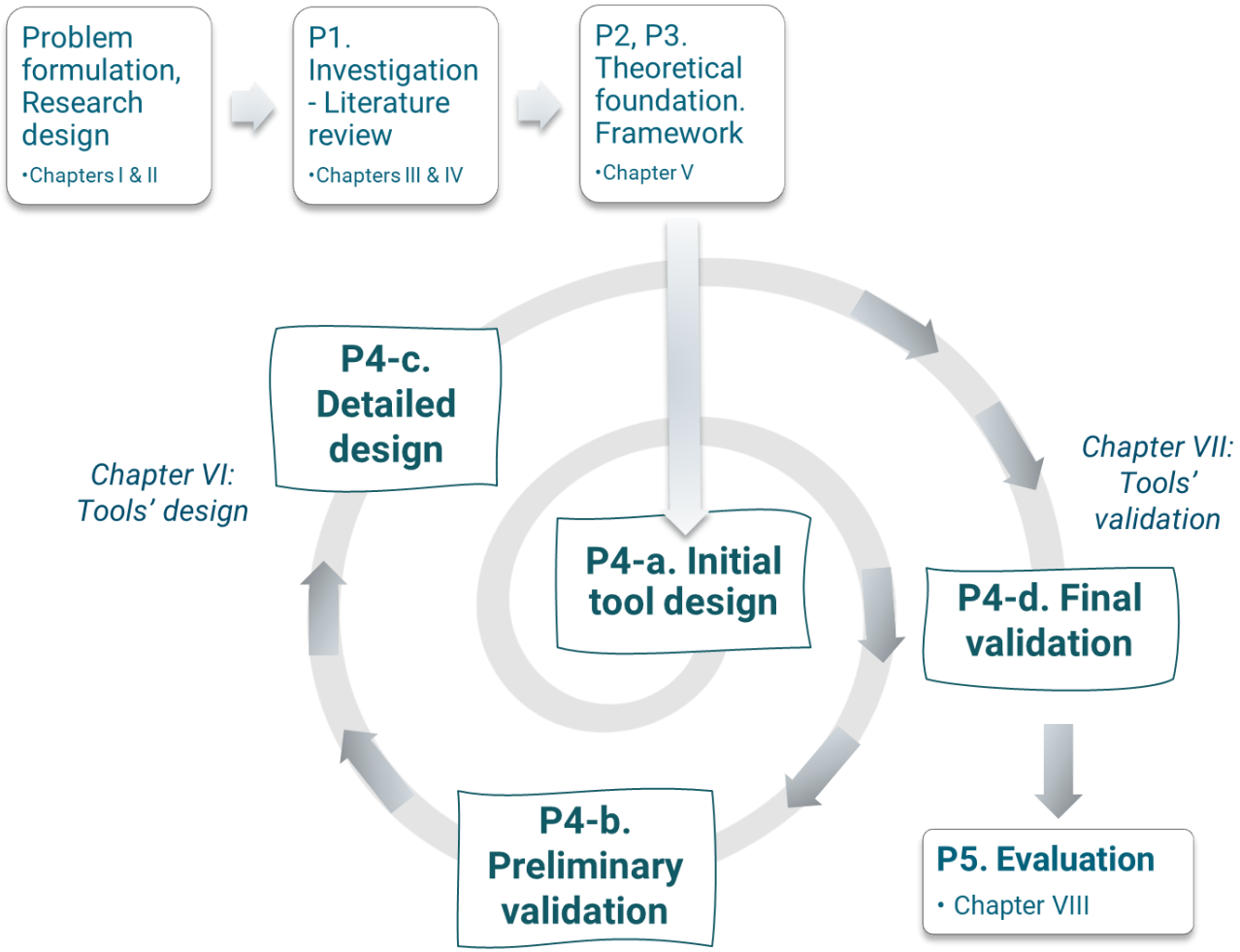
Complex projects create complex products, for complex markets, in complex organizations, with complex processes.

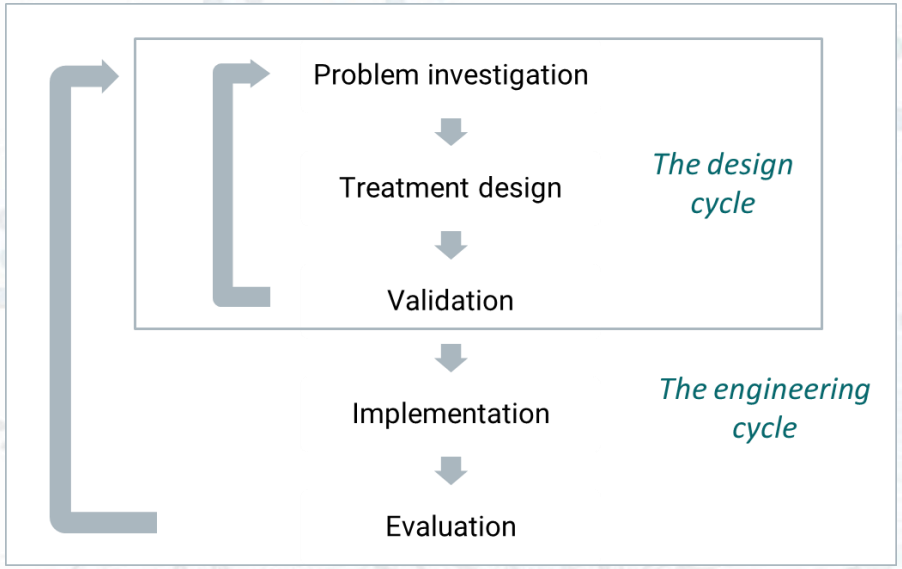
Research goal & overall objective

- **Goal**: contribute to the understanding and management of complex IT projects
  - *Enterprise and IT governance: why, how, align*

- **Objective**: Design, validation, and evaluation of a set of tools for the identification, analysis, and management of IT project complexity

Iterative design-and-validation methodology





Sub-projects, objectives, research questions

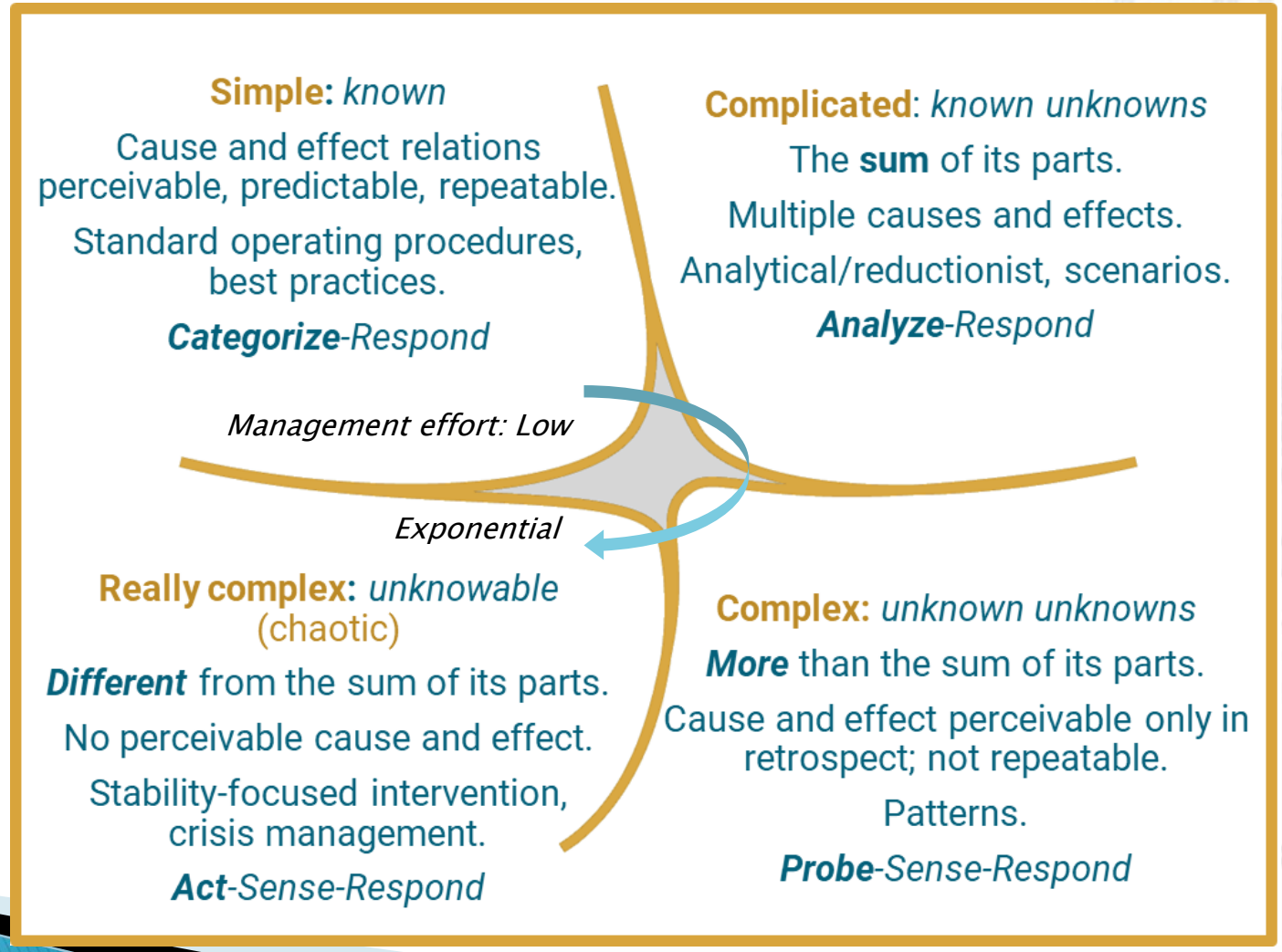
Sub-project	Research questions. Results hightlights	*Chapter*	*Published results*
P1.Investigation. Systematic literature review	RQ1. Definitions and approaches RQ2. Characteristics RQ3. Identification & measurement tools	*III*	*(Morcov, Pintelon, & Kusters, 2020a)*
P2. Theoretical foundation	RQ4. Appropriate theoretical foundation/approach. **Positive, Negative, & Appropriate Complexity**	*IV*	*Published as part of P4*
P3. Framework design	RQ5. **IT-PCM Framework** supporting the tools design & deployment	*V*	*(Morcov, Pintelon, & Kusters, 2021a)*
P4. Tools design-and-validation	RQ6. Tools for complexity identification, analysis, management: ***Complexity Effect Scale – CES*** ***Complexity Source/Effect Segmentation Matrix – COSM*** ***Mitigation Strategies Matrix – MSM*** ***Complexity Register – CoRe***	*VI, VII*	*(Morcov, Pintelon, & Kusters, 2020b)*
P5. Practical evaluation	RQ7. What is the contribution of the designed tools to project success	*VIII*	*(Morcov, Pintelon, & Kusters, 2021b)*

P1. Complex projects: definition

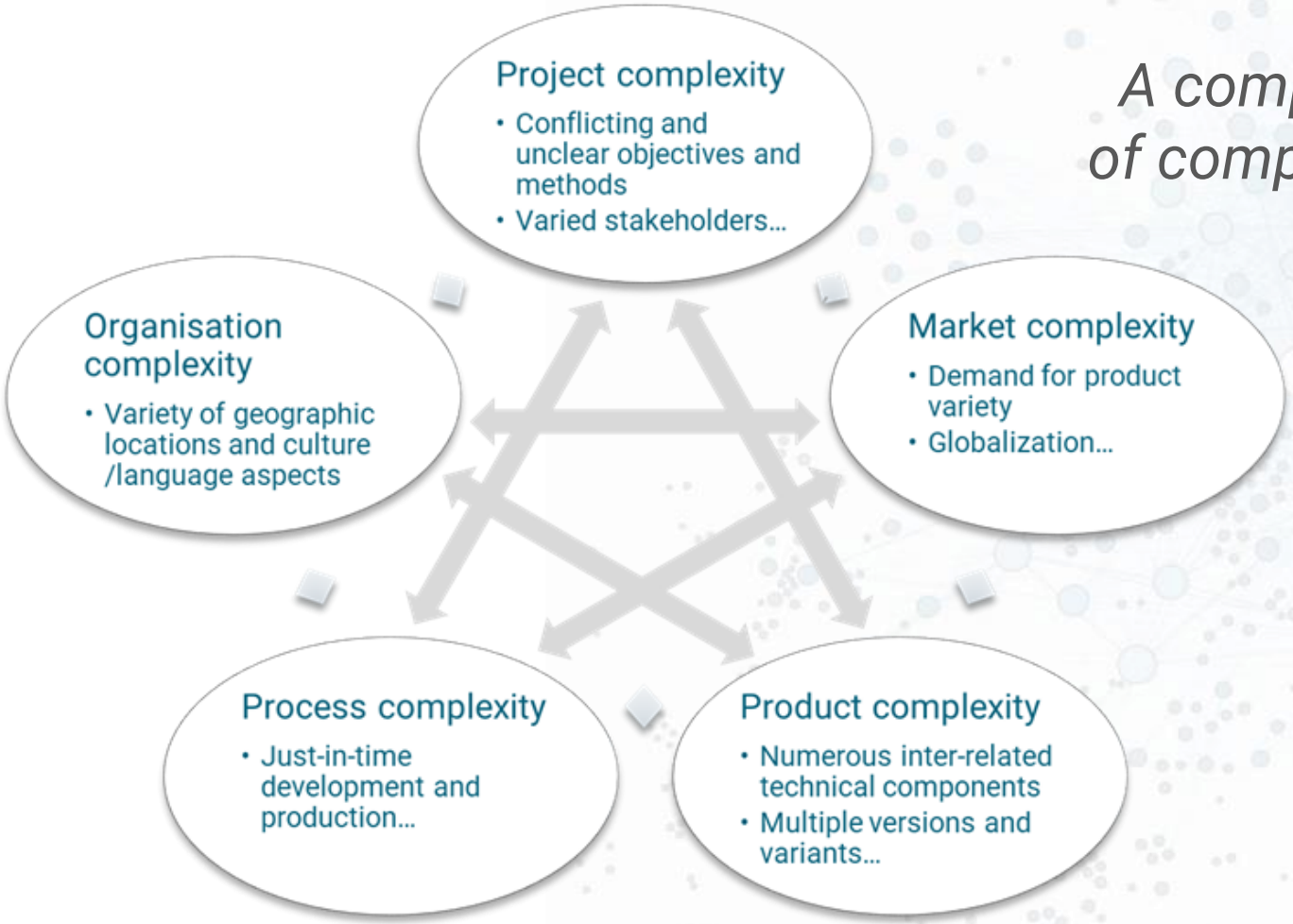
"Difficult to understand, foresee and keep under control, even when given reasonably complete information about its components."

- Structural complexity: complicated. *Consisting of many varied interrelated parts*
- Dynamic complexity: *ambiguity, uncertainty, propagation, chaos*
  - nonlinearity, complex feedback loops, significant impact of small factors (Lorenz's Butterfly effect, Taleb's Black Swan)

P1. Complexity domains, based on the Cynefin framework



P2. Holistic view



A complexity of complexities

P2. Complexity Effect Scale - CES

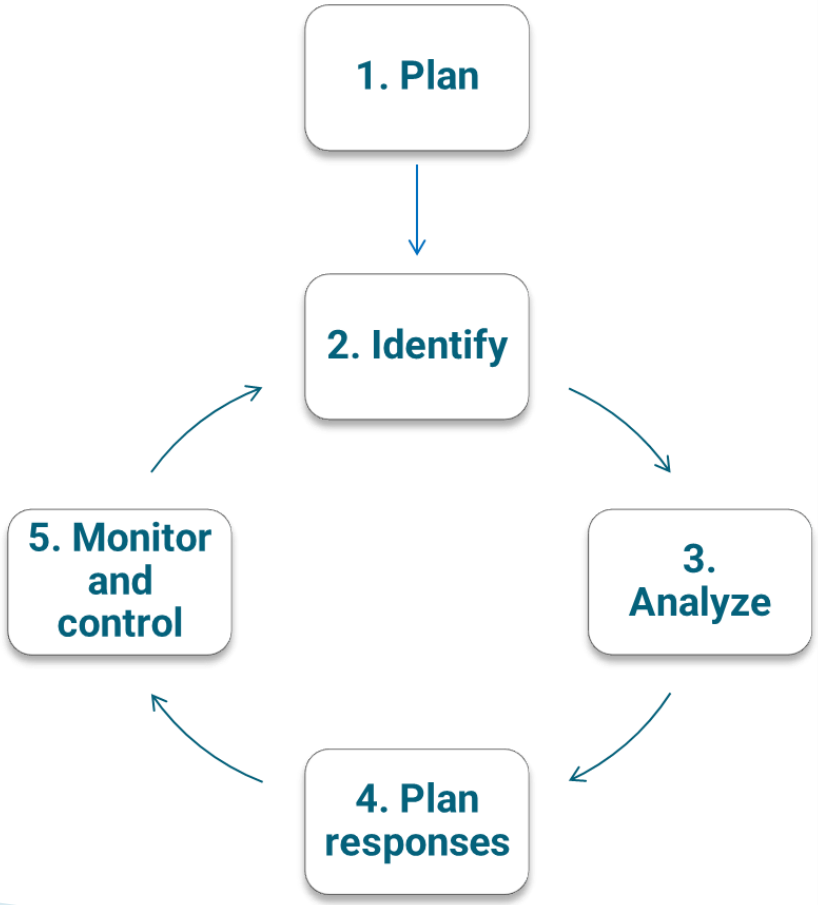
Positive complexity	Appropriate complexity	Negative complexity
Benefit > cost	Benefit ≈ cost	Benefit < cost
Desirable, creates value	Not desirable, but needed, or too expensive to mitigate	Not desirable
Mitigation strategy: create or enhance	Mitigation strategy: accept	Mitigation strategy: avoid, reduce, eliminate

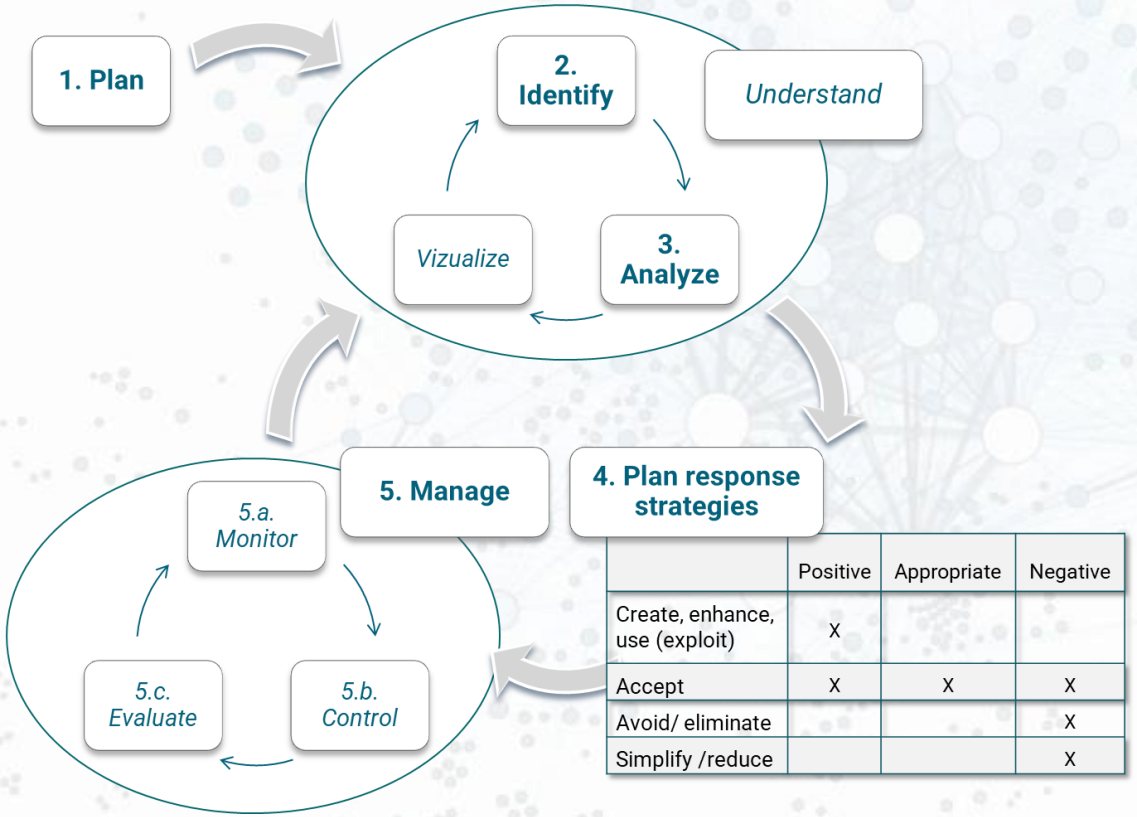
Project Complexity Management

- *The project management Knowledge Area that includes processes to understand, plan strategy and responses, and manage project complexity*

- It supports project success, by:
  - enhancing Positive Complexity
  - reducing Negative Complexity

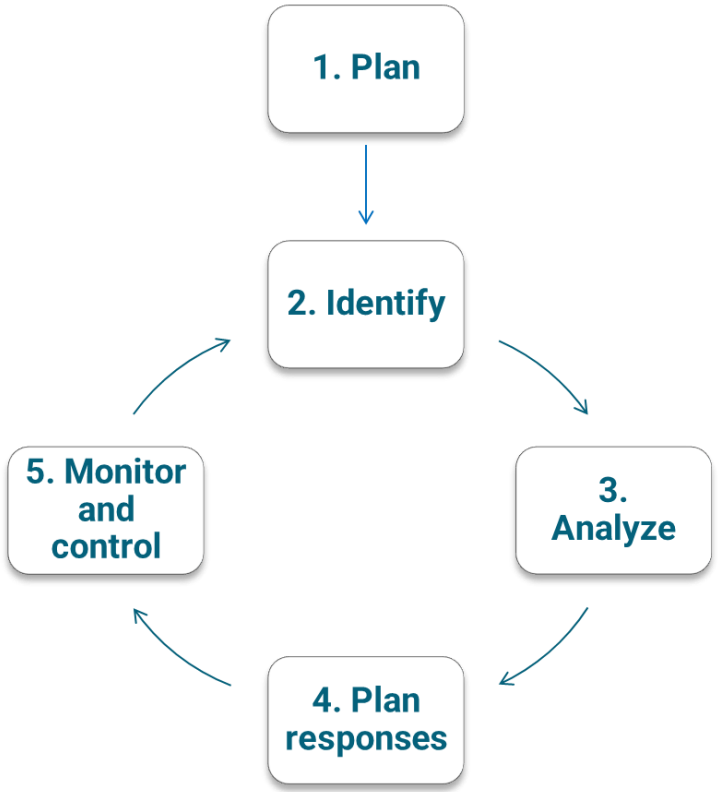
P3. IT-PCM:
IT Project Complexity Management Framework





	Positive	Appropriate	Negative
Create, enhance, use (exploit)	X		
Accept	X	X	X
Avoid/ eliminate			X
Simplify /reduce			X

P3. IT-PCM: IT Project Complexity Management Framework



IT Project Complexity Management overview

1. Plan IT project complexity management

.1. Inputs
- Scope statement
- Risk management plan
- Communication management plan
- Schedule management plan
- Cost management plan
- Enterprise environmental factors

.2. Outputs
- Project complexity measurement/red-flag
- Complexity management plan

.3. Tools & Techniques
- Complexity measurement tools

2.Identify IT project complexity

.1. Inputs
- Scope statement
- Stakeholder register
- Schedule baseline
- Risk register
- Enterprise environmental factors

.2. Outputs
- Complexity Register

.3. Tools & Techniques
- Checklists and classifications of project complexity
- CES, COSM
- Risk and vulnerability identification methods
- Breakdown Structures
- Expert judgment

5. Monitor and Control IT project complexity

.1. Inputs
- Complexity Register, Risk register
- Performance reports, project performance information, project management performance information
- Stakeholder registers
- Scope statement, initial assumptions

.2. Outputs
- Complexity Register updates
- Updates to Scope statement, Communication plan, Project management plan, Project documents

.3. Tools & Techniques
- Audits and reviews, Status meetings
- Monitor for change in project, product, processes, organization, market; in stakeholders and ~ interests, objectives, scope; environment.
- Complexity management response strategies
- Program management
- EVM, AgileEVM
- Role definition
- Complexity measurement and evaluation tools

3. Analyse IT project complexity

.1. Inputs
- Complexity register
- Risk register
- Stakeholder register
- Project management plan
- Scope, schedule, cost, communication management plans

.2. Outputs
- Complexity Register updates
- Positive/appropriate/negative complexity classification
- Complexity and system diagrams

.3. Tools & Techniques
- CES, COSM
- Cause analysis, Pareto, cost-benefit
- Expert judgment
- Use-case analysis
- Visualization tools: diagrams, Goals-and-methods, mapping: DSM, DMM, MDM, Causal-loop, Process and workflow diagrams, UML, SoaML, SysML

4. Plan IT project complexity response strategy

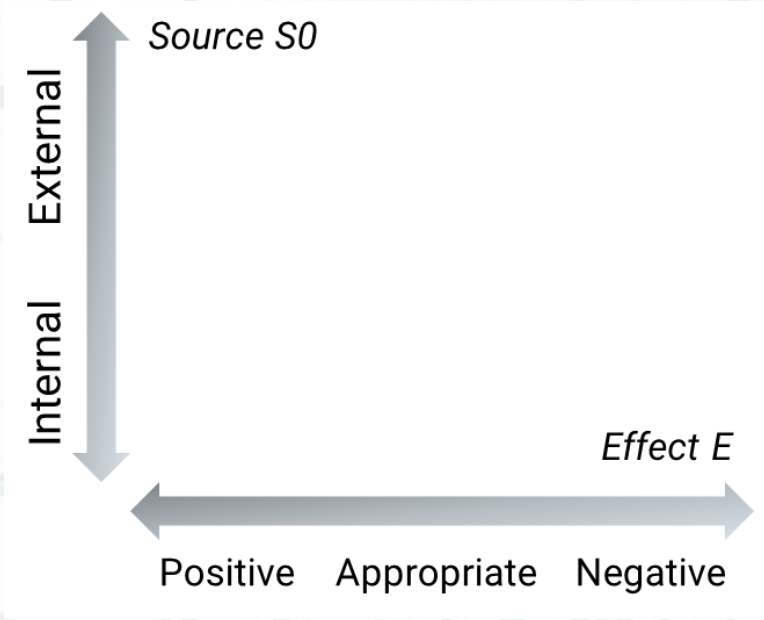
.1. Inputs
- Complexity Register
- Complexity management plan
- Organizational assets
- Market information

.2. Outputs
- Complexity Register updates
- Decisions regarding contract management, schedule, project objectives
- Updates to scope statement, Project management plan, Communication plan

.3. Tools & Techniques
- Response strategies for positive and negative complexity: Mitigation Strategies Matrix – MSM
- Expert judgment

P4. CoSM.
Complexity Source/Effect Segmentation Matrix

Effects / Sources	Positive & Appropriate	Negative
Internal	*Reusability*	*Many varied inter-dependent technologies*
External	*Large budget, political priority. New technologies. Unclear objectives – scope agility*	*Large number and variety of stakeholders. Unclear objectives*

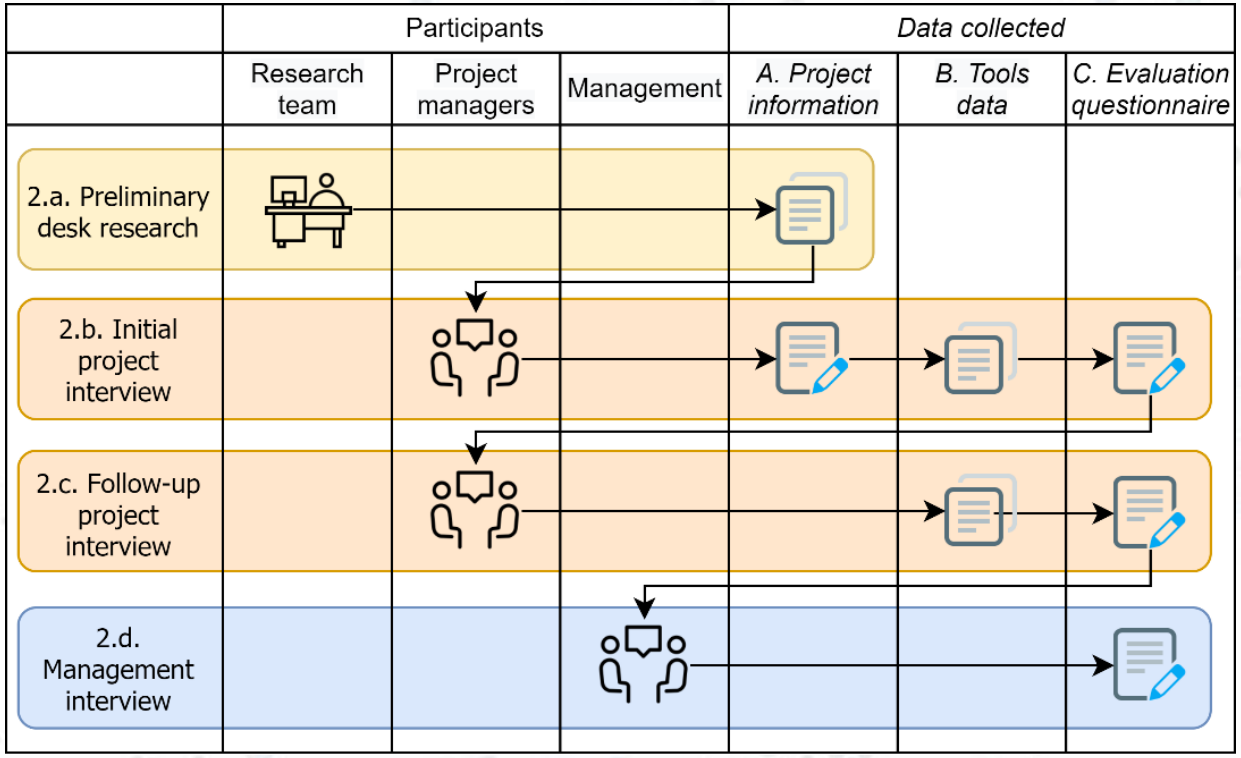


P4. Mitigation Strategies Matrix - MSM

Response strategy	Complexity Effect		
	Positive	Appropriate	Negative
Create, enhance	x		
Use (exploit)	x		
Accept / ignore	x	x	x
Simplify / reduce			x
Avoid / eliminate			x

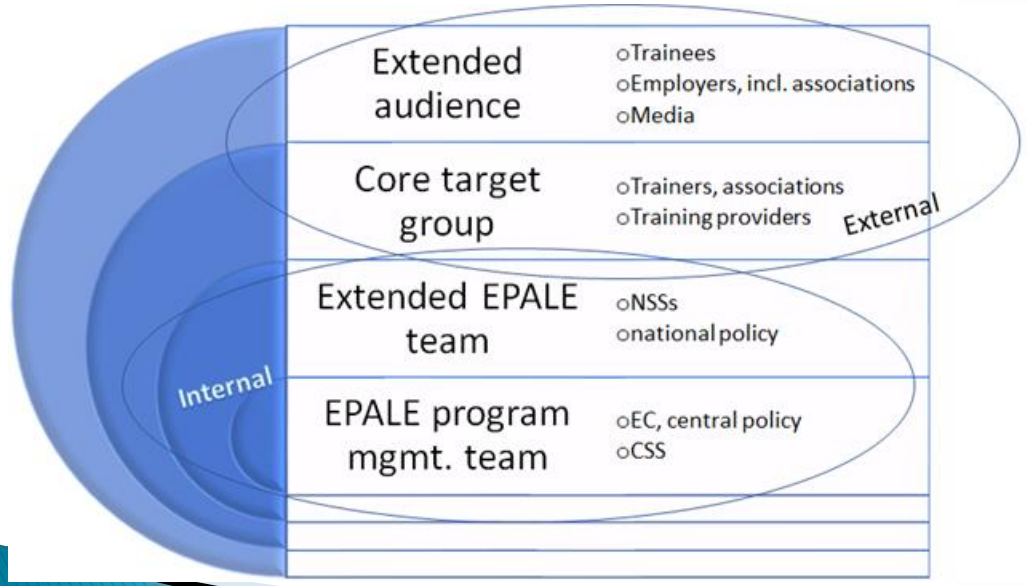
P5. Evaluation

- Tools deployed, tested and evaluated repeatedly over several months
- Focus on qualitative and negative feedback.
  Why, when, why not, how



Case study: EPALE - European platform for adult learning

- EPALE is the pan-European, multilingual, open membership community of adult learning professionals and policymakers
- European Commission project

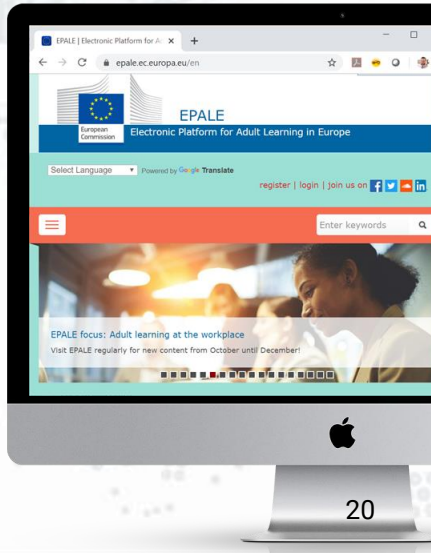


Solution:

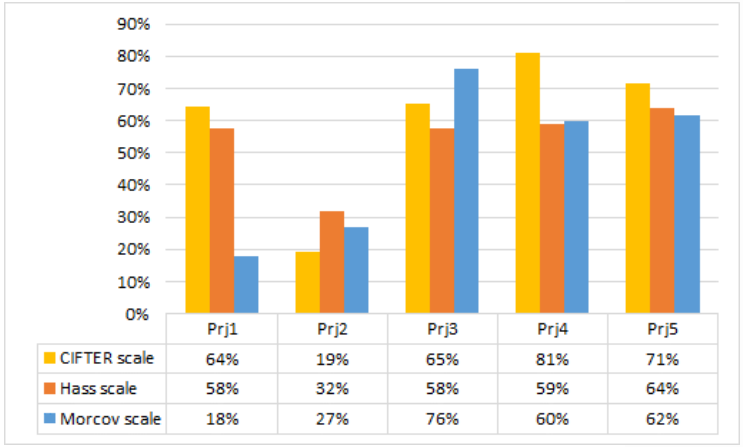
- Collaboration and eLearning portal, mobile app. (Drupal, Open Europa, Moodle, AWS)
- Content, hosting, maintenance, operation
- Management of the EU Central Support Service
- Coordination of 38 National Support Service centers, community management
- Communication, social media, large-scale events

Stakeholders:

- 5 Directorates and Agencies of EC
- National authorities
- Consortium of 2 partners
- Various subcontractors
- Central Support team
- 38 National teams
- 4000 participants attended the Annual Conference 2020

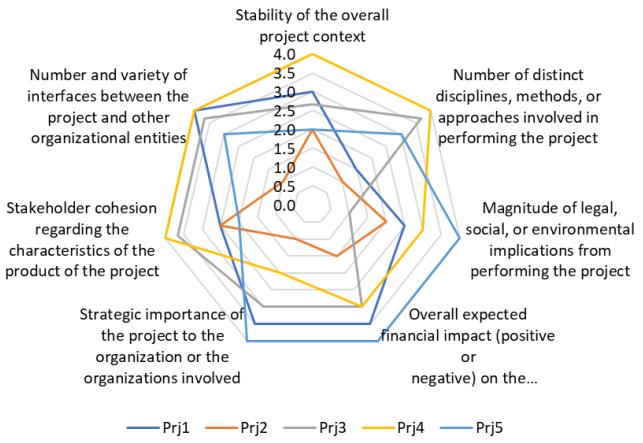


P5. Complexity identification & measurement

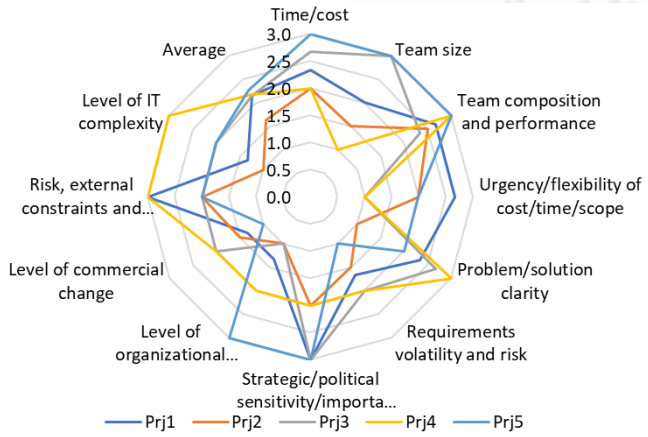


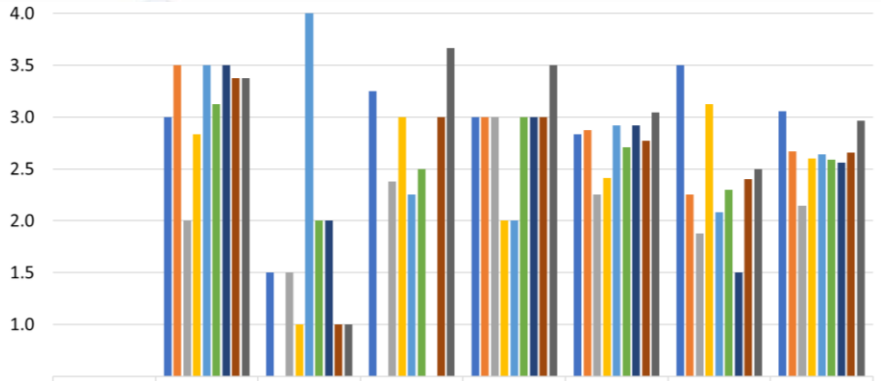
	Prj1	Prj2	Prj3	Prj4	Prj5
CIFTER scale	64%	19%	65%	81%	71%
Hass scale	58%	32%	58%	59%	64%
Morcov scale	18%	27%	76%	60%	62%

Cifter tool



Hass tool





	Answers	Prj1 avg.	Prj2	Prj3	Prj5	PM avg.	Top mgmt.	Overall avg.
Measuring/red-flag.	18	3.0	1.5	3.3	3.0	2.8	3.5	3.1
Morcov tool	6	3.5			3.0	2.9	2.3	2.7
CIFTER tool	14	2.0	1.5	2.4	3.0	2.3	1.9	2.1
Haas tool	15	2.8	1.0	3.0	2.0	2.4	3.1	2.6
SWOT	18	3.5	4.0	2.3	2.0	2.9	2.1	2.6
Positive / neg. - CES	17	3.1	2.0	2.5	3.0	2.7	2.3	2.6
COSM	8	3.5	2.0		3.0	2.9	1.5	2.6
Complexity Register	16	3.4	1.0	3.0	3.0	2.8	2.4	2.7
Mitigation Strategies MSM	13	3.4	1.0	3.7	3.5	3.0	2.5	3.0

Tools assessment by group of participants

P5. Evaluation - outputs

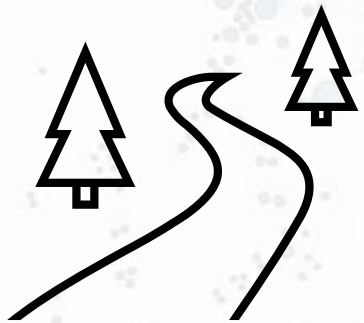
- Fit-for-purpose: only projects “red-flagged” as complex should receive special treatment
- Checklists and templates needed
- Risks and complexity management overlap, but are also complementary
- The importance of awareness
- Positive complexity supports focusing on opportunities

Results highlights

- Review of the state-of-the art
  - Common language. Structured literature review (RQ1-3)
- Insights, new perspectives on complexity
  - Positive, Negative & Appropriate Complexity. Holistic model (RQ4)
  - IT Project Complexity Management. IT-PCM Framework (RQ5)
- Practical tools
  - Measurement tool
  - Complexity Effect Scale – CES
  - Complexity Source/Effect Segmentation Matrix – COSM
  - Mitigation Strategies Matrix – MSM
  - Complexity Register – CoRe (RQ6-7)

Contributions & limitations

- Theoretical and practical contributions
- No golden bullet or universal solution
- Qualitative research / design science is a journey, formed of trial-and-error cycles



Conclusions

- The proposed tools aim to support
  - recognizing, understanding, managing complexity in a structured way
  - prioritizing projects, resource planning
  - reducing risks, increasing project success rates
- Complexity is a ubiquitous reality in modern engineering & management
  - It generates risk, but also creates opportunities.
- Modern IT engineering uses complexity to deliver value
  - Positive & Appropriate complexity can act as catalysts for opportunities

Thank you !

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Appendices, additional slides

Definitions

- **Project complexity** is the property of a project which makes it difficult to understand, foresee and manage its behavior, even when given reasonably complete information about the project system.
- **Complexity of Complexities** paradigm: The IT project is an ecosystem formed of complex sub-systems, interrelated and influencing each other in ways we cannot predict, nor control based on what we know about each complex sub-system individually .
  - IT engineering develops complex IT products for complex markets in complex organizations with complex processes through complex projects
- "**Project Complexity Management**" is the project management Knowledge Area that includes processes to understand, plan strategy and responses, and manage project complexity.
  - Its objective is to support project success, by enhancing Positive Complexity and reducing Negative Complexity.
- "**Positive complexity**" is "the complexity that adds value to our project, and whose contribution to project success outweighs the associated negative consequences".
- "**Appropriate, or requisite, complexity**" is "the complexity that is needed for the project to reach its objectives, or whose contribution to project success balances the negative effects, or the cost of mitigation outweighs negative manifestations".
- "**Negative complexity**" is "the complexity that hinders project success".

Vulnerability management

Vulnerability management deals with negative (external) events, analyses their impact, and the system's capability to cope with them.

1. **Resistance** is a static characteristic of a system, that refers to its capacity to withstand instantaneous damage incurred by external negative events.
2. **Resilience** is a dynamic characteristic of a system, that refers to its capacity to recover in time to a previous state.

3. **Antifragility** is the capacity of a system to not only resist to, or recover from, adverse events; but also to ***improve*** because of adverse events (Taleb, 2012)

Major publications

- Morcov, S., Pintelon, L., & Kusters, R. J. (2021). *A Practical Assessment of Modern IT Project Complexity Management Tools*. International Journal of Information Technology Project Management
- Morcov, S., Pintelon, L., & Kusters, R. J. (2021). *A Framework for IT Project Complexity Management*. IADIS IS 2021 (pp. 61-68)
- Morcov, S., Pintelon, L., & Kusters, R. J. (2020). *IT Project Complexity Management Based on Sources and Effects: Positive, Appropriate and Negative*. Proceedings of the Romanian Academy - Series A, 21(4), 329-336
- Morcov, S., Pintelon, L., & Kusters, R. J. (2020). *Definitions, characteristics and measures of IT Project Complexity - a Systematic Literature Review*. International Journal of Information Systems and Project Management, 8(2), 5-21

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