Operationalizing Software Engineering Theories for Practical Validation

APPENDIX-D. Hypothesis Generated

This appendix presents 115 initially generated and a refined set of 83 hypotheses from operationalizing 26 propositions related to team collaboration, automation, platform services, and organizational practices.

The 25 hypotheses removed from the initial list are highlighted in red, along with a justification for their removal.

P1. A TEAM CULTURE BASED ON RESPONSIBILITY/OWNERSHIP SHARING ENABLES COLLABORATION

Categoric relationship			Team		
			responsibility/ownership sharing		
			full sharing	medium sharing	minimal or null sharing
Collaboration	frequency	daily	h1.1	h1.2	
		eventual	h1.4	h1.5	
	quality	high	h1.7	h1.8	
		low	h1.10	h1.11	

• H1.1 (h1.1 and h1.4): A team culture based on the full sharing of responsibilities makes it possible to move from eventual collaboration between team members to daily collaboration.
• H1.2 (h1.7 and h1.10): A team culture based on the full sharing of responsibilities makes it possible to move from low-quality collaboration between team members to high-quality collaboration.
• H1.3 (h1.2 and h1.5): A team culture based on the medium sharing of responsibilities makes it possible to move from eventual collaboration between team members to daily collaboration.
• H1.4 (h1.8 and h1.11): A team culture based on the medium sharing of responsibilities makes it possible to move from low-quality collaboration between team members to high-quality collaboration.

P2. PROMOTING COLLABORATION REDUCES ORGANIZATIONAL SILOS/CONFLICTS

Categoric relationship			Silo	
			type	
			organizational	cultural
Collaboration	frequency	daily	H2.1	
		eventual	H2.2	
	quality	high	H2.3	
		low	H2.4	

- H2.1 Teams with daily collaboration are associated with fewer organizational silos.
- H2.2 Teams with eventual collaboration are associated with fewer organizational silos.
- H2.3 Teams with high-quality collaboration are associated with fewer organizational silos.
- H2.4 Teams with low-quality collaboration are associated with fewer organizational silos.

P3. AUTOMATED APPLICATION LIFE-CYCLE MANAGEMENT IS ASSOCIATED WITH COLLABORATION. COLLABORATION IMPACTS AUTOMATED APPLICATION LIFE-CYCLE MANAGEMENT AND VICE VERSA. AUTOMATION AND COLLABORATION MUTUALLY FACILITATE THE ADOPTION OF THE OTHER, SO THEY ARE COMPLEMENTARY

Categoric relationship			Automation	
			type	
			Automated application life-cycle management	Automated infrastructure management
Collaboration	frequency	daily	H3.1-H3.1’	
		eventual	H3.2-H3.2’	
	quality	high	H3.3-H3.3’	
		low	H3.4-H3.4’	

- H3.1 Teams using automated application life-cycle management are associated with daily collaboration
- H3.1’ Teams with daily collaboration are associated with automated application life-cycle

management
• H3.2 Teams using automated application life-cycle management are associated with eventual collaboration
(If automation is well established, it typically supports continuous work, not eventual collaboration. Eventual collaboration might indicate a lack of process maturity.)
• H3.2' Teams with eventual collaboration are associated with automated application life-cycle management
(If teams collaborate only occasionally, it may not create enough pressure to drive automation adoption.)
• H3.3 Teams using automated application life-cycle management are associated with high collaboration
• H3.3' Teams with high collaboration are associated with automated application life-cycle management
• H3.4 Teams using automated application life-cycle management are associated with low collaboration
(Low collaboration might indicate process friction or resistance to automation, not facilitation.)
• H3.4' Team with low collaboration are associated with automated application life-cycle management
(If collaboration is low, it might hinder automation efforts, rather than facilitate it.)

P4. A TEAM CULTURE BASED ON KNOWLEDGE SHARING ENABLES COLLABORATION

Categoric relationship			Team		
			knowledge sharing		
			full sharing	medium sharing	minimal or null sharing
Collaboration	frequency	daily	H4.1	H4.2	H4.3
		eventual	H4.4	H4.5	H4.6
	quality	high	H4.7	H4.8	H4.9
		low	H4.10	H4.11	H4.12

• H4.1: A team culture based on full knowledge sharing are associated with daily collaboration between team members
• H4.2: A team culture based on medium knowledge sharing are associated with daily collaboration between team members
• H4.3: A team culture based on minimal knowledge sharing are associated with daily collaboration between team members
(Minimal knowledge sharing is unlikely to support daily collaboration.)
• H4.4: A team culture based on full knowledge sharing are associated with eventual collaboration between team members
• H4.5: A team culture based on medium knowledge sharing are associated with eventual collaboration between team members
• H4.6: A team culture based on minimal knowledge sharing are associated with eventual

collaboration between team members
• H4.7: A team culture based on full knowledge sharing are associated with high quality collaboration between team members
• H4.8: A team culture based on medium knowledge sharing are associated with high quality collaboration between team members
• H4.9: A team culture based on minimal knowledge sharing are associated with high quality collaboration between team members
(Minimal sharing does not align with high-quality collaboration.)
• H4.10: A team culture based on full knowledge sharing are associated with low quality collaboration between team members
• H4.11: A team culture based on medium knowledge sharing are associated with low quality collaboration between team members
• H4.12: A team culture based on minimal knowledge sharing are associated with low quality collaboration between team members

P5. IF A TEAM IS CHARACTERIZED BY CROSS-FUNCTIONALITY/SKILLS THIS WILL INCREASE COLLABORATION

Categoric relationship			Team	
			cross-functionality/skills	
			true	false
Collaboration	frequency	daily	H5.1	
		eventual	H5.2	
	quality	high	H5.3	
		low	H5.4	

• H5.1 Multidisciplinary/poly-skilled teams (i.e., teams with all the necessary skills such as development, infrastructure, etc.) are associated with a daily collaboration with other teams
• H5.2 Multidisciplinary/poly-skilled teams (i.e., teams with all the necessary skills such as development, infrastructure, etc.) are associated with a eventual collaboration with other teams
• H5.3 Multidisciplinary/poly-skilled teams (i.e., teams with all the necessary skills such as development, infrastructure, etc.) are associated with a high collaboration with other teams
• H5.4 Multidisciplinary/poly-skilled teams (i.e., teams with all the necessary skills such as development, infrastructure, etc.) are associated with a low collaboration with other teams

P6. COLLABORATION IS A PROPERTY OF TEAMS IN WHICH SKILLS TAKE PRECEDENCE OVER ROLES, I.E., THE ROLE DEFINITION/ATTRIBUTIONS CODE; HENCE, IF THERE ARE ALREADY SEPARATE ROLES, RESPONSIBILITIES ARE VERY CLEAR AND COLLABORATION IS NOT FOSTERED OR PROMOTED

Categoric relationship			Team	
			role definitions/attributions	
			true	false
Collaboration	frequency	daily	H6.1	H6.2
		eventual	H6.3	H6.4
	quality	high	H6.5	H6.6
		low	H6.7	H6.8

• H6.1: Teams with well-defined and differentiated roles are associated with a daily collaboration
(Contradicts P6: P6 suggests clear roles hinder collaboration, so this is unlikely)
• H6.2: Teams where skills take precedence over roles are associated with daily collaboration
• H6.3: Teams with well-defined and differentiated roles are associated with a eventual collaboration
• H6.4: Teams where skills take precedence over roles are associated with eventual collaboration
• H6.5: Teams with well-defined and differentiated roles are associated with a high collaboration
(Contradicts P6: P6 suggests clear roles hinder collaboration, so this is unlikely)
• H6.6: Teams where skills take precedence over roles are associated with high-quality collaboration
• H6.7: Teams with well-defined and differentiated roles are associated with a low-quality collaboration
• H6.8: Teams where skills take precedence over roles are associated with low-quality collaboration

P7. A COLLABORATION-BASED CULTURE REQUIRES ALIGNMENT OF DEV & OPS GOALS

Categoric relationship			Team	
			alignment of dev & ops	
			Local optimization	product thinking
Collaboration	frequency	daily	H7.1	H7.2
		eventual	H7.3	H7.4
	quality	high	H7.5	H7.6
		low	H7.7	H7.8

• H7.1: Teams aligned with local optimization are associated with daily collaboration
(Local optimization is typically a siloed mindset; daily collaboration is less expected)
• H7.2: Teams aligned with product thinking are associated with daily collaboration
• H7.3: Teams aligned with local optimization are associated with eventual collaboration
• H7.4: Teams aligned with product thinking are associated with eventual collaboration
• H7.5: Teams aligned with local optimization are associated with high-quality collaboration
(High-quality collaboration is unlikely in siloed/local optimization environments)
• H7.6: Teams aligned with product thinking are associated with high-quality collaboration.
• H7.7: Teams aligned with local optimization are associated with low-quality collaboration
• H7.8: Teams aligned with product thinking are associated with low-quality collaboration
(Even in product thinking environments, low-quality collaboration might still occur due to other team dysfunctions)

P8. A TEAM CULTURE BASED ON METRICS/VISIBILITY/FEEDBACK ENABLES COLLABORATION

Categoric relationship			Management	
			metrics/visibility/feedback	
			true	false
Collaboration	frequency	daily	H8.1	
		eventual	H8.2	
	quality	high	H8.3	
		low	H8.4	

• H8.1: Teams with a culture based on metrics/visibility/feedback are associated with daily

collaboration.
• H8.2: Teams with a culture based on metrics/visibility/feedback are associated with eventual collaboration.
(Metrics-based cultures typically encourage continuous collaboration; eventual collaboration is less expected but possible.)
• H8.3: Teams with a culture based on metrics/visibility/feedback are associated with high-quality collaboration.
• H8.4: Teams with a culture based on metrics/visibility/feedback are associated with low-quality collaboration.
(Metrics could reduce collaboration quality if they create pressure or are misused, though this is less expected based on the enabler tone.)

P9. RESPONSIBILITY/OWNERSHIP SHARING IS A PROPERTY OF CROSS-FUNCTIONALITY/SKILLS TEAMS

Categoric relationship			Team	
			cross functionality/skills	
			true	false
Team	responsibility/ ownership sharing	full sharing	H9.1	H9.2
		medium sharing	H9.3	H9.4
		Minimal or null sharing	H9.5	H9.6

• H9.1: Teams characterized by cross-functionality/skills are associated with full responsibility/ownership sharing.
• H9.2: Teams not characterized by cross-functionality/skills are associated with full responsibility/ownership sharing.
• H9.3: Teams characterized by cross-functionality/skills are associated with medium responsibility/ownership sharing.
• H9.4: Teams not characterized by cross-functionality/skills are associated with medium responsibility/ownership sharing.
• H9.5: Teams characterized by cross-functionality/skills are associated with minimal or null responsibility/ownership sharing.
(Cross-functional teams generally promote sharing; minimal/null sharing may indicate dysfunction.)
• H9.6: Teams not characterized by cross-functionality/skills are associated with minimal or null responsibility/ownership sharing.

P10. RESPONSIBILITY/OWNERSHIP SHARING REDUCES ORGANIZATIONAL SILOS/CONFLICTS

Categoric relationship			Silo type	
			organizational	cultural
Team	responsibility/ ownership sharing	full sharing	H10.1	
		medium sharing	H10.2	
		Minimal or null sharing	H10.3	

• H10.1: Teams characterized by full responsibility/ownership sharing are associated with organizational silos.
• H10.2: Teams characterized by medium responsibility/ownership sharing are associated with organizational silos.
• H10.3: Teams characterized by minimal or null responsibility/ownership sharing are associated with organizational silos.

P11. RESPONSIBILITY/OWNERSHIP SHARING IS A PROPERTY OF ORGANIZATIONAL STRUCTURES THAT RELY ON AN ENABLER (PLATFORM) TEAM. THE EXISTENCE OF PLATFORM TEAMS DOES NOT LEAD TO A SEPARATION OF RESPONSIBILITIES BUT RATHER THEY BECOME FACILITATORS AND MAKE OWNERSHIP SHARING POSSIBLE, UNLIKE DEV OPS (BRIDGE) TEAMS THAT BECOME NEW SILOS WITH THEIR OWN RESPONSIBILITIES (E.G., DEPLOYMENT, MONITORING, ETC.).

categoric			Team Enabler (platform)	
			true	false
Team	responsibility/ ownership sharing	full sharing	H11.1	
		medium sharing	H11.2	
		Minimal or null sharing	H11.3	

• H11.1: Full responsibility/ownership sharing are associated with organizational structures that rely on an enabler (platform) team.
• H11.2: Medium responsibility/ownership sharing are associated with organizational structures

that rely on an enabler (platform) team.
• H11.3: Minimal or null responsibility/ownership sharing are associated with organizational structures that rely on an enabler (platform) team.
(Platform teams are intended to enable sharing; minimal/null sharing may indicate dysfunction.)

P12. RESPONSIBILITY/OWNERSHIP SHARING IS A PROPERTY OF TEAM SELF-ORGANIZATION AUTONOMY

Categoric relationship			Team	
			Autonomy	
			self organization	dependent
Team	responsibility/ ownership sharing	full sharing	H12.1	
		medium sharing	H12.2	
		Minimal or null sharing	H12.3	

• H12.1: Teams characterized by self-organization autonomy are associated with full responsibility/ownership sharing.
• H12.2: Teams characterized by self-organization autonomy are associated with medium responsibility/ownership sharing.
• H12.3: Teams characterized by self-organization autonomy are associated with minimal or null responsibility/ownership sharing.
(Self-organization aims to avoid minimal/null sharing; this may indicate dysfunction.)

P13. A TEAM CULTURE BASED ON RESPONSIBILITY/OWNERSHIP SHARING ENABLES COMMUNICATION

Categoric relationship			Communication	
			type	
			poor/ rare	frequent
team	responsibility/ ownership sharing	full sharing	H13.1	H13.2
		medium sharing	H13.3	H13.4
		Minimal or null sharing	H13.5	H13.6

• H13.1: Teams characterized by full responsibility/ownership sharing are associated with poor/rare communication.
(Unlikely; full sharing is generally associated with open communication.)
• H13.2: Teams characterized by full responsibility/ownership sharing are associated with frequent communication.
• H13.3: Teams characterized by medium responsibility/ownership sharing are associated with poor/rare communication.
(Possible if boundaries are unclear.)
• H13.4: Teams characterized by medium responsibility/ownership sharing are associated with frequent communication.
• H13.5: Teams characterized by minimal or null responsibility/ownership sharing are associated with poor/rare communication.
• H13.6: Teams characterized by minimal or null responsibility/ownership sharing are associated with frequent communication.
(Less expected; silos often limit communication.)

P14. RESPONSIBILITY/OWNERSHIP SHARING IS ASSOCIATED WITH THE TRANSFER OF WORK BETWEEN TEAMS. IF THERE IS NO SHARED RESPONSIBILITY, THERE IS NECESSARILY A TRANSFER OF WORK BETWEEN DEVELOPMENT TO PRODUCTION AND OPERATION TEAMS (AND VICE VERSA)

Categoric relationship			Team	
			transfer of work	
			true	false
Team	responsibility/ ownership sharing	full sharing	H14.1 - H14.1’	
		medium sharing	H14.2 - H14.2’	
		Minimal or null sharing	H14.3 - H14.3’	

• H14.1: Teams characterized by full responsibility/ownership sharing are associated with the absence of work transfer between teams.
• H14.2: Teams characterized by medium responsibility/ownership sharing are associated with the absence of work transfer between teams.
• H14.3: Teams characterized by minimal or null responsibility/ownership sharing are associated with the presence of work transfer between teams.
• H14.1': The absence of work transfer between teams is associated with teams characterized by full responsibility/ownership sharing.
• H14.2': The absence of work transfer between teams is associated with teams characterized by medium responsibility/ownership sharing.
• H14.3': The presence of work transfer between teams is associated with teams characterized by minimal or null responsibility/ownership sharing.

P15. AUTOMATED INFRASTRUCTURE MANAGEMENT ENABLES RESPONSIBILITY/OWNERSHIP SHARING

Categoric relationship			Automation	
			type	
			Automated Infrastructure Management	Automated Application Life Cycle Management
Team	responsibility/ ownership sharing	full sharing	H15.1	
		medium sharing	H15.2	
		Minimal or null sharing	H15.3	

• H15.1: Teams relying on automated infrastructure management are associated with full responsibility/ownership sharing.
• H15.2: Teams relying on automated infrastructure management are associated with medium responsibility/ownership sharing.
• H15.3: Teams relying on automated infrastructure management are associated with minimal or null responsibility/ownership sharing.
(Possible in dysfunctional teams but inconsistent with the enabling logic of P15)

P16. AUTOMATED APPLICATION LIFE-CYCLE MANAGEMENT ENABLES RESPONSIBILITY/OWNERSHIP SHARING

Categoric relationship			Automation	
			type	
			Automated Infrastructure Management	Automated Application Life Cycle Management
Team	responsibility/ ownership sharing	full sharing		H16.1
		medium sharing		H16.2
		Minimal or null sharing		H16.3

• H16.1: Teams relying on automated application life-cycle management are associated with full responsibility/ownership sharing.

• H16.2: Teams relying on automated application life-cycle management are associated with medium responsibility/ownership sharing.
• H16.3: Teams relying on automated application life-cycle management are associated with minimal or null responsibility/ownership sharing.
(Possible in dysfunctional teams but inconsistent with the enabling logic of P16)

P17. SKILLS/KNOWLEDGE SHARING IS A PROPERTY OF TEAMS CHARACTERIZED BY CROSS- FUNCTIONALITY/SKILLS

Categoric relationship			Team	
			cross-functionalityskills	
			true	false
Team	skills/knowledge sharing	full sharing	H17.1	
		medium sharing	H17.2	
		Minimal or null sharing	H17.3	

• H17.1: Teams characterized by cross-functionality/skills are associated with full skills/knowledge sharing.
• H17.2: Teams characterized by cross-functionality/skills are associated with medium skills/knowledge sharing.
• H17.3: Teams characterized by cross-functionality/skills are associated with minimal or null skills/knowledge sharing.
(Possible in dysfunctional teams but inconsistent with the enabling logic of P17)

P18. CROSS-FUNCTIONALITY/SKILLS IS A PROPERTY OF ENABLER (PLATFORM) TEAM

categoric			Team	
			cross-functionality/skills	
			true	false
Team	Enabler Team	true	H18.1	H18.2
		false	H18.3	H18.4

• H18.1: Teams characterized as enabler (platform) teams are associated with being cross-functional.
• H18.2: Teams characterized as enabler (platform) teams are associated with not being cross-functional.
(enabler teams are cross-functional.)

• H18.3: Teams not characterized as enabler (platform) teams are associated with being cross-functional.
• H18.4: Teams not characterized as enabler (platform) teams are associated with not being cross-functional.

P19. CROSS-FUNCTIONALITY/SKILLS REDUCES ORGANIZATIONAL SILOS/CONFLICTS

Categoric relationship			Team	
			Cross-functionality/skills	
			true	false
Silo	type	organizational	H19.1	H19.2
		cultural		

• H19.1: Teams characterized by cross-functionality/skills are associated with fewer organizational silos.
• H19.2: Teams not characterized by cross-functionality/skills are associated with the presence of organizational silos.

P20. IF A TEAM IS CHARACTERIZED BY CROSS-FUNCTIONALITY/SKILLS THIS WILL INCREASE AUTOMATED APPLICATION LIFE-CYCLE MANAGEMENT

Categoric relationship			Team	
			cross-functionality/skills	
			true	false
Automation	type	Automated Infrastructure Management		
		Automated Application Life Cycle Management	H20.1	H20.2

• H20.1: Teams characterized by cross-functionality/skills are associated with the use of automated application life-cycle management.
• H20.2: Teams not characterized by cross-functionality/skills are associated with the use of automated application life-cycle management.
(non-cross-functional teams are less likely to demand application automation)

P21. ORGANIZATIONAL SILOS/CONFLICTS MAKE THE ADOPTION OF AN AUTOMATED

APPLICATION LIFE-CYCLE MANAGEMENT DIFFICULT

Categoric relationship			Silo	
			type	
			true	false
Automation	type	Automated Infrastructure Management		
		Automated Application Life Cycle Management	H21.1	

• H21.1: The presence of organizational silos/conflicts is associated with difficulty in adopting automated application life-cycle management.

P22. METRICS, VISIBILITY & FEEDBACK ENABLES AUTOMATED APPLICATION LIFE-CYCLE MANAGEMENT

Categoric relationship			Management	
			metrics/visibility/feedback	
			true	false
Automation	type	Automated Infrastructure Management		
		Automated Application Life Cycle Management	H22.1	

• H22.1: Teams characterized by metrics, visibility, and feedback are associated with the adoption of automated application life-cycle management.

P23. AUTOMATED APPLICATION LIFE-CYCLE MANAGEMENT ENABLES SKILLS/KNOWLEDGE SHARING

Categoric relationship			Team		
			skills/knowledge sharing		
			full sharing	medium sharing	minimal or null sharing
Automation	type	Automated Infrastructure Management			
		Automated Application Life Cycle Management	H23.1	H23.2	H23.3

• H23.1: Teams relying on automated application life-cycle management are associated with full skills/knowledge sharing.
• H23.2: Teams relying on automated application life-cycle management are associated with medium skills/knowledge sharing.
• H23.3: Teams relying on automated application life-cycle management are associated with minimal or null skills/knowledge sharing.
(Possible in dysfunctional teams but inconsistent with the enabling logic of P23.)

P24. ENABLER (PLATFORM) TEAM ENABLES TEAM SELF-ORGANIZATION & AUTONOMY

Categoric relationship			Team	
			Autonomy	
			self organization	dependent
Team	Horizontal Enabler	true	H24.1	
		false		

• H24.1: Teams supported by an enabler (platform) team are associated with self-organization and autonomy.

P25. ENABLER (PLATFORM) TEAM PROVIDES PLATFORM SERVICING

Categoric relationship	Team	
	Horizontal Enabler	
	true	false

Platform	provided interface	IaC	H25.1	
		ALM Interface	H25.2	
		Automated Infrastructure Management	H25.3	
		Automated Application Life Cycle Management	H25.4	

• H25.1: Teams characterized as enabler (platform) teams are associated with providing Infrastructure as Code (IaC) platform services.
• H25.2: Teams characterized as enabler (platform) teams are associated with providing Application Life-Cycle Management (ALM) platform services.
• H25.3: Teams characterized as enabler (platform) teams are associated with providing automated infrastructure management platform services.
• H25.4: Teams characterized as enabler (platform) teams are associated with providing automated application life-cycle management platform services.

P26. AUTOMATED APPLICATION LIFE-CYCLE MANAGEMENT IS A PLATFORM SERVICING

categoric			Automation	
			type	
			Automated Infrastructure Management	Automated Application Life Cycle Management
Platform	provided interface	IaC		
		ALM Interface		
		Automated Infrastructure Management		
		Automated Application Life Cycle Management		H26.1

• H26.1: Automated application life-cycle management is associated with being a

platform-provided service.

P27. AUTOMATED INFRASTRUCTURE MANAGEMENT IS A PLATFORM SERVICING

categoric			Automation	
			type	
			Automated Infrastructure Management	Automated Application Life Cycle Management
Platform	provided interface	IaC		
		ALM Interface		
		Automated Infrastructure Management	H27.1	
		Automated Application Life Cycle Management		

• H27.1: Automated infrastructure management is associated with being a platform-provided service.

P28. ENABLER (PLATFORM) TEAMS PROVIDE AUTOMATED APPLICATION LIFE-CYCLE MANAGEMENT

categoric			Automation	
			type	
			Automated Infrastructure Management	Automated Application Life Cycle Management
team	Horizontal Enabler	true		28.1
		false		

• H28.1: Teams characterized as enabler (platform) teams are associated with providing automated application life-cycle management platform services.