

Appendix: Detailed analysis of eight cases of technology collaboration

Legend
U Unplanned Alternation
P Planned Alternation
→ Participant Activation

Case #1: Security – (M)acbeth & (F)alstaff (Rotating Leadership)

Phase (Length)	#1 (1 mo)	#2 (10 mo)	#3 (5 mo)	#4 (4 mo)	#5 (5 mo)	#6 (2 mo)	#7 (3 mo)	Totals (Summaries)
Focus	Agreement - craft written agreement about basic structure of collaboration	Roadmapping - high-level alignment of technology standards and milestones	Design - crafting detailed plans for new technologies, platforms, and products	Prototyping - creating physical models of technologies or products that can be refined	Product Development - using new technologies to improve or create new products that can be sold to customers	Dividing IP - agreeing to divide technologies and codified intellectual property between partners	Marketing - creating interest in new technologies, platforms, and products that were developed jointly	7 Phases (30 Months)
Decisions	(M)acbeth unilateral mutual (F)alstaff unilateral	F&M	P M,M,M	P F, F	U M,M,M,M	M	M,M	(Extensive Alternation) 3 Alternations
Changes in Objectives	Initial Objectives: Develop new integrated circuits and system software that improves enterprise network security using M's circuit F's system expertise	1. Jointly develop three new security and manageability technologies 2. Decouple circuit and system marketing.	3. Use new technologies in one new M product and one new F product	4. Also include new technologies in an old F product	5. Eliminate planned modifications to security technology standards. 6. Facilitate outside companies to develop complementary products	7. Time-limited joint sales agreement		(Extensive Zig-Zagging) 7 Objectives Changed
Participation								
Activation Cascades	M Director → F Sales manager → F CTO → F SVP and Technical Leads	F CTO → F CDO, F SVPs and Various F Directors → Various M Directors, Two M Project Managers → M Marketing Manager; F SVP and M Director → M & F Legal Reps	M CTO → M engineering VP → Two M Project Managers → M Lab Director → M Security/Managability Development Teams; M CTO & M VP → F CTO & CDO → F Security Team	F VP → F Lab Head & F alliance manager → M Alliance Manager & F Engineering Director → F Security Team, M Security experts, M Director → M General Manager	M CTO → M engineering VP → F Lab Head, M Alliance Manager, M Director & M Circuit Teams	M CTO → M engineering VP → F Lab Head, F Alliance Manager, & M Director → M Legal Team → F Legal Rep	M CTO → M engineering VP & M marketing VP → M marketing team → F Alliance Manager & F VP Marketing → F CDO & F CTO	(Extensive Fluctuation)
Different from Prior Phase		70%	78%	88%	60%	43%	67%	69% Different Participants (Weighted Average)
New to Collaboration		70%	78%	75%	20%	0%	44%	52% New Participants (Weighted Average)
Technological Outcomes		Roadmaps with common industrial objectives	Design documents for two technologies	Chipset technologies	Security and Managability firmware. New interfaces for complementors	Systems software to access firmware	Joint security tech marketing program	Innovation Performance: 19 Patent Apps, 9 Subjective Evaluation Circuits and firmware with new security and manageability linkages to network equipment.

Case #2: Middleware – (A)riel & (C)leopatra (Rotating Leadership)

Phase (Length)	#1 (2 mo)	#2 (11 mo)	#3 (6 mo)	#4 (6 mo)	#5 (12 mo)	#6 (6 mo)	#7 (2 mo)	Totals (Summaries)
Focus	Agreement - craft written agreement about basic structure of collaboration	Roadmapping - high-level alignment of technology standards and milestones	Problem Identification - finding opportunities to improve existing technologies, products, or platforms	Platform Development - creating set of technologies that can be reused across multiple products	Middleware Development - developing technologies that connect software components and applications	Ecosystem Application Development - coordinating with small complementor firms to develop applications that utilize a new platform	Marketing - creating interest in new technologies, platforms, and products that were developed jointly	7 Phases (45 Months)
Decisions	(A)riel unilateral mutual (C)leopatra unilateral	P A,A	P C,C	C,C,C,C	U C	U A,A	C	(Extensive Alternation) 4 Alternations
Changes in Objectives	Initial Objectives: Develop robust new middleware underlying C's enterprise applications using A's infrastructure expertise	1. Expand joint R&D and support arrangement to focus on Middleware underlying new internet-enabled applications	2. Add interfaces to facilitate development of complementary software. 3. Develop new C platform based on A software	4. Integrate applications and platform using new middleware		5. Extend migration path of old C platform	6. Enable reference customer to resolve bugs	(Extensive Zig-Zagging) 6 Objectives Changed
Participation								
Activation Cascades	C CTO → C SVP → A CEO → A VP	A VP → A Two Senior Software Directors → A Two Project Managers	C CTO → C SVP → C Project Managers → C Software Architects	A Project Manager & C Project Manager → C CTO, C & A VP → A and C Software Development Teams	A Project Manager & C Project Manager → C CTO, C & A VP → C Software Development Teams	A VP → A Senior Software Director → A and C Project Teams → A Marketing Group	C Marketing VP → C CTO, C Software Director & C Marketing Team	(Extensive Fluctuation)
Different from Prior Phase		67%	100%	67%	17%	80%	100%	68% Different Participants (Weighted Average)
New to Collaboration		67%	50%	67%	0%	60%	75%	50% New Participants (Weighted Average)
Technological Outcomes			Prototype of robust enterprise software platform	Fully tested enterprise software platform	Finish robust middleware software. Release 1st version	New enterprise application software	Bug-free version of application and platform	Innovation Performance: 18 Patent Apps, 9 Subjective Evaluation Robust enterprise-ready middleware and programming platform supporting virtualization, portals, authentication.

Case #3: VPN System – (R)osalind & (P)rospero (Rotating Leadership)

Totals (Summaries)

Phase (Length)	#1 (6 mo)	#2 (5 mo)	#3 (3 mo)	#4 (3 mo)	#5 (3 mo)	#6 (5 mo)	6 Phases (25 Months)
Focus	Roadmapping - high-level alignment of technology standards and milestones	Design - crafting detailed plans for new technologies, platforms, and products	Platform Development - creating set of technologies that can be reused across multiple products	Application Porting and Design - making existing applications work on new platform and creating plans for new features	Application Development - product development for software applications working on a common platform	Marketing - creating interest in new technologies, platforms, and products that were developed jointly	
			(P)	(P)	(U)		
Decisions	(R)osalind unilateral mutual (P)rospero unilateral	R	R,E	R,P	R,R,R	R	(Extensive Alternation) 3 Alternations
Changes in Objectives	Initial Objectives: Develop high-performance virtual private networking appliance using R's hardware and P's security software	1. Port existing software elements to Linux. 2. Add new security functions. 3. Add mobile security functions	4. Simply VPN system kernel	5. Develop appliance on upgraded hardware. 6. Validate system with key customers	7. Add new mobile VPN functions	8. Add certification requirements for external vendors	(Extensive Zig-Zagging) 8 Objectives Changed
Participation							
Activation Cascades	R EVP → R VP & R Director → P VP → P CEO & P Director	P VP → P Director & R VP → R Director → R Platform Team	R Director → R VP, R Alliance Director & P Director → R & P Platform Teams	P Director → P Security Engineering Team & R Alliance Director → R Director	R Alliance Director → R VP, R Platform Team & R Application Team	R VP → R EVP → R Marketing Group, P VP & P CEO → P Marketing Group	(Moderate Fluctuation)
Different from Prior Phase		40%	33%	25%	75%	80%	50% Different Participants (Weighted Average)
New to Collaboration		40%	33%	25%	25%	20%	29% New Participants (Weighted Average)
Technological Outcomes			New Linux Platform	Improved VPN product on New Platform	Customer Validation. New Mobile VPN applications	Joint Marketing Plan. Certification Requirements. R downsizes	Innovation Performance: 18 Patent Apps, 7 Subjective Evaluation VPN appliance with speed, memory, multi-threading, and firewall improvements and linkages to mobile devices.

Case #4: Mobile Email – (R)osalind & (P)ortia (Rotating Leadership)

Totals (Summaries)

Phase (Length)	#1 (11 mo)	#2 (5 mo)	#3 (6 mo)	#4 (7 mo)	#5 (7 mo)	#6 (6 mo)	6 Phases (42 Months)
Focus	Agreement - craft written agreement about basic structure of collaboration	Roadmapping - high-level alignment of technology standards and milestones	Product Porting - making an existing product work on new platform, architecture, or set of technologies	Product Development - using new technologies to improve or create new products that can be sold to customers	Application Integration - bringing together different applications in the same system or platform	Marketing - creating interest in new technologies, platforms, and products that were developed jointly	
			(P)		(U)	(P)	
Decisions	(R)osalind unilateral mutual (P)ortia unilateral	R,P	R,R	R,R	R,P	R,R	(Extensive Alternation) 3 Alternations
Changes in Objectives	Initial Objectives: Develop mobile devices with push email capability using R's phone platform and P's email software	1. Modularize R's phone platform so apps install seamlessly. 2. Test new platform on multiple environments	3. Develop email standards to work with multiple carriers. 4. Improve voice robustness of new phone platform	5. Add speakerphone function. 6. Add E-faxing function	7. Build first product using old hardware 8. Prioritize system integration apps over productivity apps		(Extensive Zig-Zagging) 8 Objectives Changed
Participation							
Activation Cascades	P CEO → R EVP & P VP → R VP, R Director, P Technical Lead, P Director	P VP → P Director & R Director → P Technical Lead → P Software Team	R Director → R Hardware Integration Team & P Technical Lead → P Software Team	R EVP & R VP → P VP & R Director → R Hardware Integration Team	P Technical Lead → P Software Team, P Testing Team & P Director → R Director → R Testing Team & R Hardware Integration Team	R EVP → R VP Marketing → R Handset Marketing Group & P VP → P Marketing Team	(Moderate Fluctuation)
Different from Prior Phase		20%	50%	60%	71%	100%	62% Different Participants (Weighted Average)
New to Collaboration		20%	50%	0%	29%	60%	31% New Participants (Weighted Average)
Technological Outcomes		Robust and Modular Platform	Mobile Data Phone with Voice Robustness. Basic Email and Instant Message Applications	New Conference Calling. Security Locking and System Integration Applications	Two Additional Phones with New Functionalities	Launch with all major carriers worldwide	Innovation Performance: 13 Patent Apps, 7 Subjective Evaluation New phone platform and new handset products with push email and smartphone applications.

Case #5: E-Commerce Tools – (L)ear & (M)ercutio (Dominating Leadership / Rotating Leadership)

Totals (Summaries)

Phase (Length)	#1 (3 mo)	#2 (3 mo)	#3 (1 mo)	#4 (5 mo)	#5 (3 mo)	#6 (3 mo)	Totals (Summaries)
Focus	Agreement - craft written agreement about basic structure of collaboration	Roadmapping - high-level alignment of technology standards and milestones	Platform Development - creating set of technologies that can be reused across multiple products	Product Development - using new technologies to improve or create new products that can be sold to customers	Testing - ensuring the new technologies, products, and platform work effectively	Marketing - creating interest in new technologies, platforms, and products that were developed jointly	6 Phases (18 Months)
Decisions	(L)ear unilateral	L,L	L	(U)	(U)	L,L	(Moderate Alternation) 2 Alternations
	(M)ercutio mutual	L&M,L&M,L&M		L&M		L,L	
Changes in Objectives	Initial Objectives: Develop e-commerce tools that access M's website and are integrated into L's applications	1. Use XML technologies to develop light-footprint linkages to L's applications		2. Build general-purpose web-development tools that work with Lear's system.	3. Add an email interface to these tools.		(Moderate Zig-Zagging) 3 Objectives Changed
	Participation						
Activation Cascades	L Salesperson → M Director & L Program Manager → L Director & L Alliance Manager → L Technical Lead	L Alliance Manger & M Director → L Technical Lead & M Technical Lead → L Program Manager	L Technical Lead → L Director, L Product Group & L Alliance Manager → M Technical Lead	M Technical Lead → M Web-Finance Director → M Web-Finance Team → L Technical Lead	L Technical Lead → L Director, L Product Group & L Alliance Manager → M Technical Lead	L Director → L CEO, L Marketing Group, M Director, M Web-Finance Director	(Moderate Fluctuation)
Different from Prior Phase		20%	40%	50%	60%	80%	50% Different Participants (Weighted Average) 25% New Participants (Weighted Average)
New to Collaboration		20%	20%	50%	0%	40%	
Technological Outcomes			GUI Platform Demo Using XML	E-commerce product with tools and email interfaces	Full Client Application using XML	L CEO Launch, Limited Roll-Out	Innovation Performance: 7 Patent Apps, 7 Subjective Evaluation New software tools that link client applications to some internet content.

Case #6: Wireless Networks – (M)acbeth & (F)alstaff (Consensus Leadership)

Totals (Summaries)

Phase (Length)	#1 (12 mo)	#2 (6 mo)	#3 (4 mo)	#4 (5 mo)	#5 (4 mo)	#6 (3 mo)	Totals (Summaries)
Focus	Roadmapping - high-level alignment of technology standards and milestones	Agreement - craft written agreement about basic structure of collaboration	Assessment - evaluating technologies, platform, products, and collaborative process to date	Technology Development - research and development activities aimed at developing new solutions to existing technical problems	Product Development - using new technologies to improve or create new products that can be sold to customers	Marketing - creating interest in new technologies, platforms, and products that were developed jointly	6 Phases (34 Months)
Decisions	(M)acbeth unilateral	M	M&F,M&F	M&F,M&F,M&F	M&F	M&F	(No Alternation) 0 Alternations
	(F)alstaff mutual	M&F	M&F,M&F,M&F	M&F,M&F,M&F	M&F	M&F	
Changes in Objectives	Initial Objectives: Develop wireless local area network technologies that are embedded in F's routers and use M's communications technologies	1. Pursue multiple projects focused on wireless chips for enterprise customers and prototypes for military customers.	3. Change priorities to focus on wireless chips	4. Reduce wireless chip feature set.	5. Conduct multi-platform hardware compatibility testing		(Moderate Zig-Zagging) 5 Objectives Changed
	Participation						
Activation Cascades	M Lab Manager → F Alliance Manager & F Alliance Director → M VP Platforms Unit & F VP Wireless Unit → F Tech-Partners Manager & M VP Wireless Management Group → M Lab Senior Manager & M Lab Bus. Dev. Manager → Various M Technical Leads; F VP Wireless Unit → F CEO; M Lab Manager → M CTO	M Lab Bus. Dev. Manager, M Lab Senior Manager & F Alliance Manager → F Tech-Partners Manager & M VP Wireless Technical Lead → F Technical Lead; M Lab Senior Manager, F Alliance Manager & F Alliance Director → M & F Legal Teams	M Lab Bus. Dev. Manager, M Lab Senior Manager & F Alliance Manager → M VP Wireless Management Group & F VP Wireless Unit → F CTO & M CTO, F Technical Lead, Various M Technical Leads	F CTO → F Alliance Director, F Alliance Manager & M Lab Bus. Dev. Manager → M VP Wireless Unit, F Technical Lead, Various M Technical Leads	F CTO → F Alliance Director, F Alliance Manager & M Lab Bus. Dev. Manager → M VP Wireless Unit, M VP Wireless Management Group → M VP Wireless Testing Group	F CTO → F Alliance Director, F Alliance Manager & M Lab Bus. Dev. Manager → M VP Wireless Management Group → M VP Wireless Testing Group & Wireless Testing Group → F Marketing Group	(Moderate Fluctuation)
Different from Prior Phase		44%	56%	29%	29%	25%	38% Different Participants (Weighted Average) 20% New Participants (Weighted Average)
New to Collaboration		44%	11%	0%	14%	25%	
Technological Outcomes		Agreement Signed		Wireless Chips Completed and Tested	Wireless Chips Integrated into Circuit System	Limited Joint Marketing	Innovation Performance: 9 Patent Apps, 5 Subjective Evaluation New router and transceiver technologies with some bandwidth improvements.

Case #7: Web Services - (L)ear & (O)phelia (Dominating Leadership)

Totals (Summaries)

Phase (Length)	#1 (3 mo)	#2 (3 mo)	#3 (2 mo)	#4 (3 mo)	#5 (2 mo)	#6 (5 mo)	6 Phases (18 Months)
Focus	Agreement - craft written agreement about basic structure of collaboration	Roadmapping - high-level alignment of technology standards and milestones	Platform Development - creating set of technologies that can be reused across multiple products	Product Development - using new technologies to improve or create new products that can be sold to customers	Assessment - evaluating technologies, platform, products, and collaborative process to date	Marketing - creating interest in new technologies, platforms, and products that were developed jointly	(No Alternation) 0 Alternations
Decisions	(L)ear unilateral	L,L	L	L,L	L	L,L,L,L	(Limited Zig-Zagging) 2 Objectives Changed
	(O)phelia mutual	L&O		L&O			
Changes in Objectives	Initial Objectives: Use O's web services technologies to enable L's application suite to access complex websites seamlessly			1. Limit web services product offering to one application in L's product suite	2. Change the primary customer segment of new application functionalities		(Moderate Fluctuation)
	Participation Activation Cascades	L Product Director & L Product Head → L Program Manager & L Alliance Manager → O Technology Manager → O VP Web Products & O Technology Lead	L Program Manager & L Alliance Manager → L Product Team & O Technology Manager → O Technology Lead → O Web Technology Team; O Technology Manager → O VP Web Products	L Program Manager & L Alliance Manager → L Product Team & O Technology Manager → O Technology Lead → O Web Technology Team; O Technology Manager → O VP Web Products	L Program Manager & L Alliance Manager → L Product Team & O Technology Manager → O Technology Lead → O Web Technology Team; L Program Manager & L Alliances Manager → Other L Product Teams	L Program Manager & L Alliance Manager → L Product Director & O Technology Manager → O VP Web Products & O VP Marketing	O VP Web Products & O VP Marketing → O Technology Manager → L Program Manager & L Alliance Manager → L VP Marketing Teams
Different from Prior Phase		29%	0%	14%	50%	29%	<div style="border: 1px solid black; padding: 5px;"> Innovation Performance: 5 Patent Apps, 5 Subjective Evaluation Document application linkages to e-commerce database. </div>
New to Collaboration		29%	0%	14%	17%	29%	
Technological Outcomes				Limited Web Services Client Interfaces	Web Services Client Application	L markets it alone	

Case #8: VOIP Phone – (M)acbeth & (F)alstaff (Consensus Leadership)

Totals (Summaries)

Phase (Length)	#1 (10 mo)	#2 (2 mo)	#3 (2 mo)	#4 (3 mo)	#5 (4 mo)	6 Phases (21 Months)
Focus	Roadmapping - high-level alignment of technology standards and milestones	Project Scoping - deciding what tasks and activities are occurring in the project and which are not	Technology Development - research and development activities aimed at developing new solutions to existing technical problems	Agreement - craft written agreement about basic structure of collaboration	Assessment - evaluating technologies, platform, products, and collaborative process to date	(No Alternation) 0 Alternations
Decisions	(M)acbeth unilateral		M			(Limited Zig-Zagging) 1 Objective Changed
	(F)alstaff mutual	M&F,M&F	M&F	M&F		
Changes in Objectives	Initial Objectives: Develop a digital phone with VOIP capabilities for enterprises using M's communications technologies and F's hardware systems expertise		1. Develop phone that operates on multiple networks			(Moderate Fluctuation)
	Participation Activation Cascades	M Manager & F Manager → M CTO & F SVP Wireless Unit; M Manager & F Alliance Manager → M & F Marketing and Managers, M & F Wireless Internet Development Teams	M Manager & F Manager → M Technical Manager, M & F Alliance Managers, M & F Marketing and Legal Reps, M & F Wireless Internet Development Teams	M Manager & F Manager → M Technical Manager, M & F Alliance Managers, M & F Marketing and Legal Reps, M & F Wireless Internet Development Teams	M Manager & F Manager → M Technical Manager, M & F Alliance Managers, M & F Marketing and Legal Reps, M & F Wireless Internet Development Teams	M Manager & F Manager → M Technical Manager, M & F Alliance Managers, M & F Marketing and Legal Reps, M & F Wireless Internet Development Teams; M Manager & F CTO & F SVP Wireless Unit
Different from Prior Phase		33%	0%	0%	18%	<div style="border: 1px solid black; padding: 5px;"> Innovation Performance: 4 Patent Apps, 2 Subjective Evaluation No new technologies or products. </div>
New to Collaboration		33%	0%	0%	0%	
Technological Outcomes			Improved M Communication Architecture			