

Off-shoring, Interfaces, and Governance: the Case of Automotive Product Development

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What is service off-shoring?

- Involves doing some process steps in the US, then some steps off-shore, and then some in US
 - Doesn't include doing a whole process overseas (eg designing whole car in Europe)
- Keep steps here that involve
 - High skills, or high levels of interaction with steps involving high skill and/or
 - Physical interaction with US customers or US products
 - *E.g. X-raying US patient, developing treatment plan*
- Send steps abroad that can be de-coupled from steps above, and
 - Are labor-intensive and/or
 - Benefit from lead-time reduction available from working in different time zone
 - *Reading X-ray*

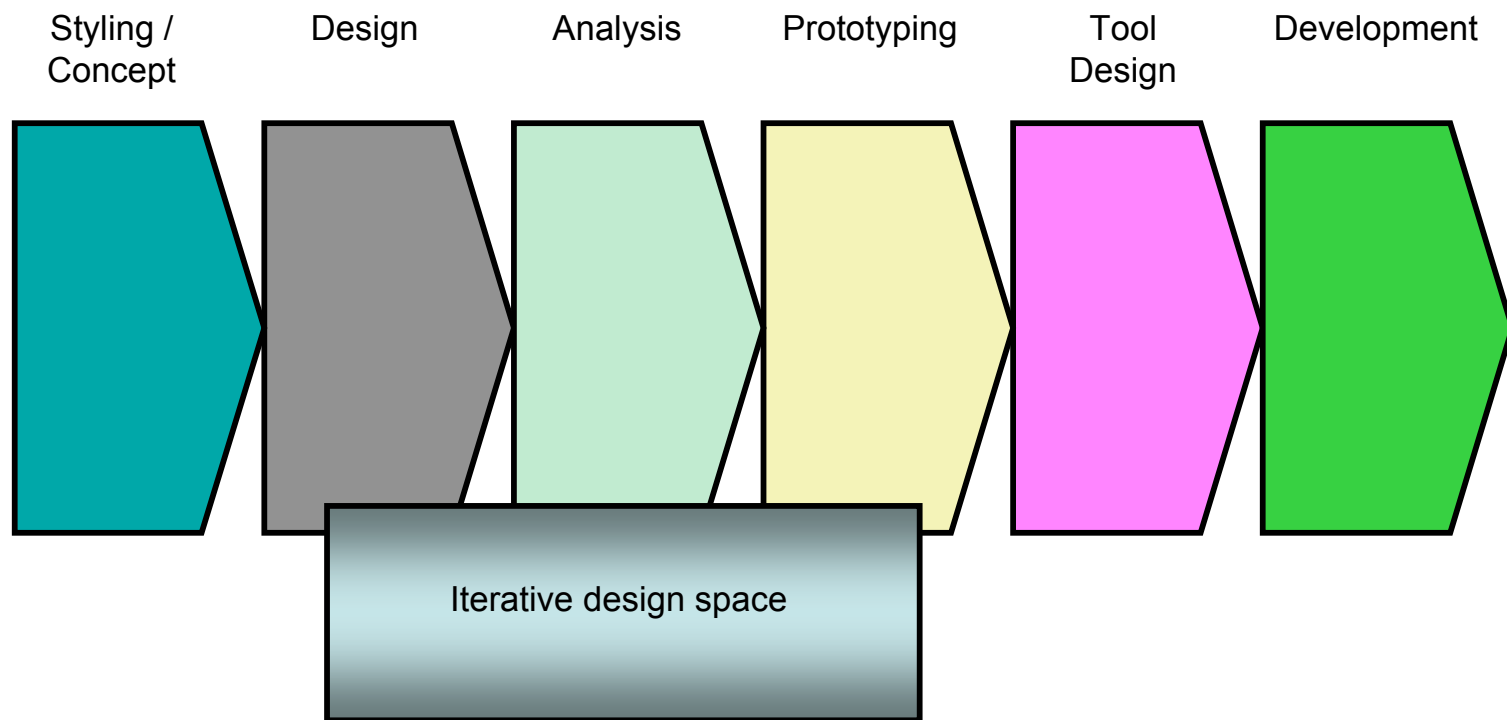
Our example: automotive product engineering and design

- Large
 - A \$2 billion sector in the US in 2004
 - Plus \$150-200 M of services provided from India to the US
- Fast-growing
 - GM alone plans to move \$48 million of work to India in 2004
- Heterogeneous
 - Tasks vary in degree of complexity and interactivity
 - Automakers organize product development differently

Research Approach

- How does offshoring work, in detail?
 - Key to understanding
 - Quality and quantity of jobs in the US and India
 - Quality and innovativeness of services provided
- Methods
 - Interviews
 - Participant observation

Steps in Automotive Product Development



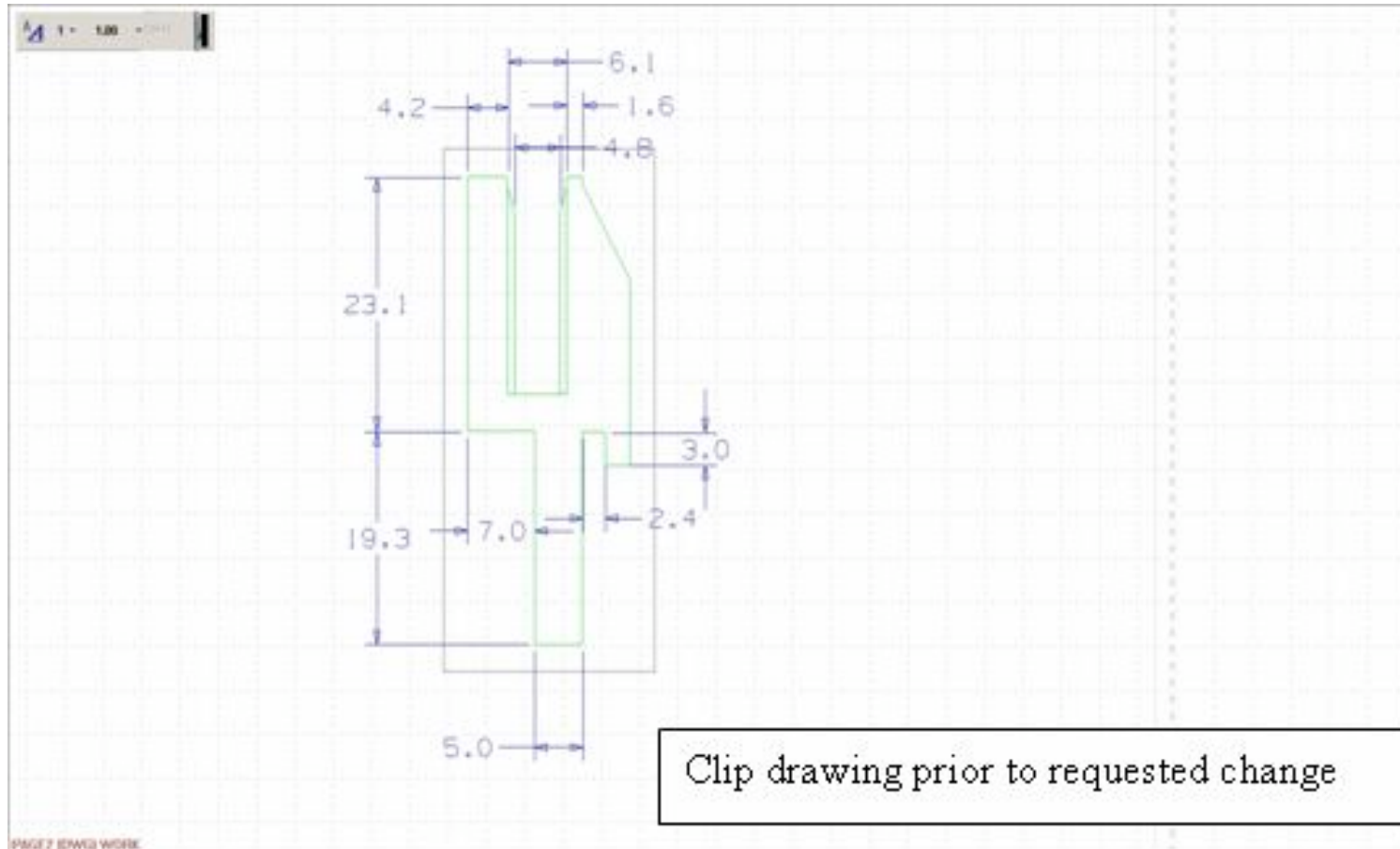
Product development in the US

- In the US, a sequential process
- We focus on stages of design and analysis
 - Engineers create parts with requisite functionality (strength, heat tolerance, etc.)
 - Designers draw these parts using CAD (computer-aided design) software
 - Note: by design, we mean “working on CAD work station”, not “styling” or “concept generation”
 - Division of labor not unlike 1980s manager/secretary

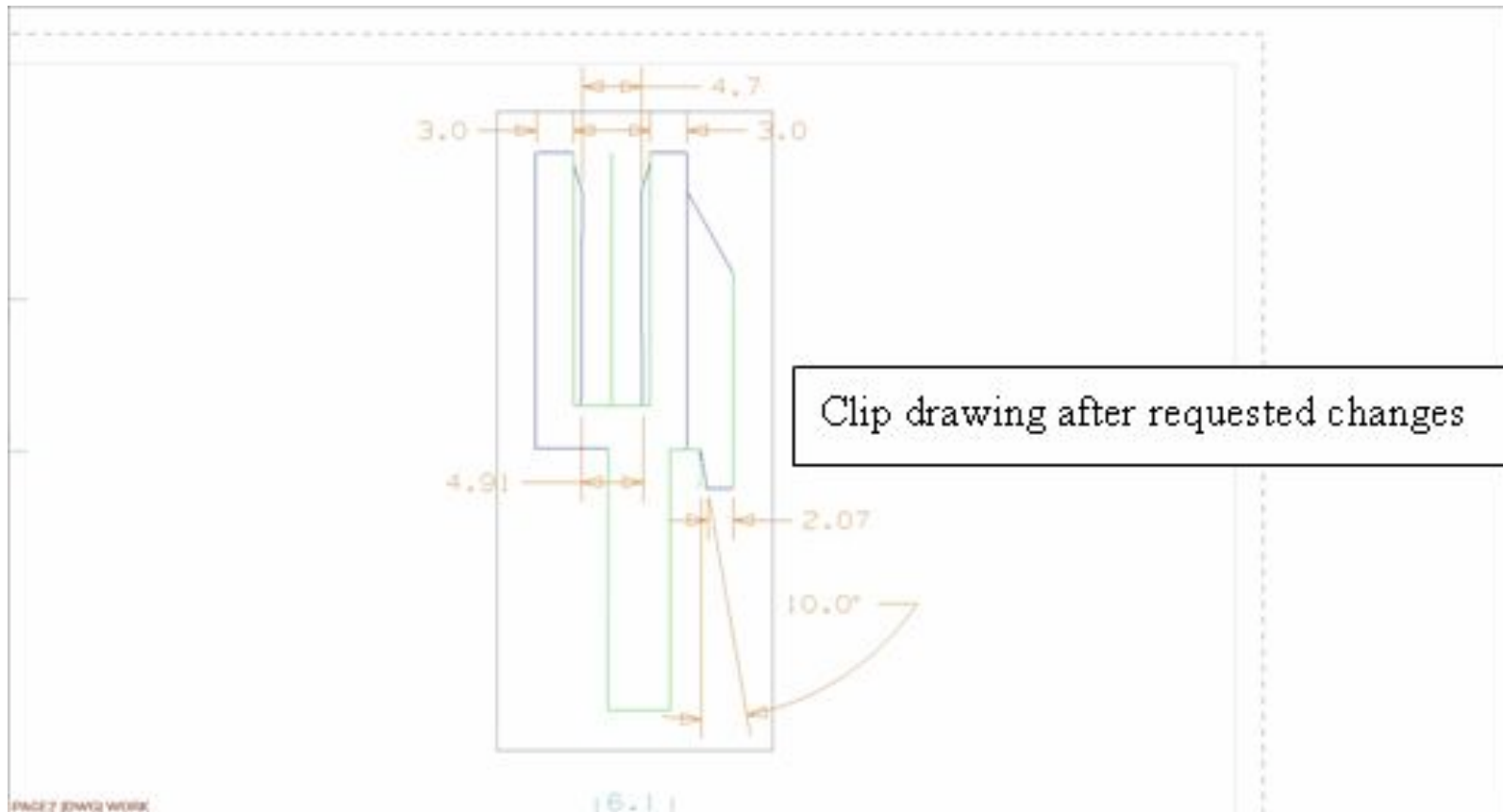
Our case

- Automotive glass design
- ESI: Engineering Services, Inc.
 - A small firm in Detroit that provides contract engineering to automakers and their suppliers

CAD before changes



CAD after changes



Primary Motivation for Off-shoring : COST SAVINGS

Category	Current Rate Including Tube Cost	Proposed Rate Including Tube Cost	Savings
CAD Product Design Phase 1: 1 designer Phase 2: 1 designer	\$ 40-55/hour	\$ 18-30/hour	\$ 22-25/hour

Average Cost Savings = \$ 24/hour

Early off-shoring efforts failed

- ESI had no mechanism to monitor work being done in India
- ESI could not establish a secure computer network
- Indian engineers did not understand US automaker conventions for CAD use (eg, storing data)
- Since design contracts were small, Indian engineers had little incentive to be responsive, meet deadlines
- US employees, fearing for their jobs, found excessive fault with work done in India

Another project did succeed

- Performance targets met
 - Cost savings achieved
 - No deadlines missed
- Business is expanding
 - From 1 program to 3
 - Interest from several other clients
- *Why did this project succeed (from management's perspective), where others failed?*

Comparing successful and unsuccessful cases

- Some factors did not change
 - Product development system
 - Separation of design and engineering
 - Arm's-length Supplier/OEM relations means attention to documentation
 - IT capability
 - A high level of information technology is necessary but not sufficient for off-shoring
 - Level of Out-sourcing
 - Vertical integration neither a barrier nor a pre-requisite to success

Three factors to predict location & governance of economic activity

- Interface complexity
 - Product (links between components)
 - Organizational (links between tasks)
- Distance
 - Geographic
 - Cultural
- Governance (arm's-length vs. collaborative)
 - Information sharing across organizational interfaces
 - How much back and forth?
 - How tacit?
 - How proprietary?
 - Incentive alignment
- *These three factors have a complementary effect on performance*

Each factor can be adjusted

- More complex interfaces → less arm's-length governance and/or less distance
- More arm's-length governance → less complex interface and/or less distance
- More distance → less complex interfaces and/or less arm's-length governance

Factors that did change

- Explicit attention paid to managing
 - Interface complexity
 - Governance
 - Distance

Managing interface complexity

- Product interfaces
 - Sent window design offshore, but not windshield
 - Windshield touches many more other parts
 - Need for fast turnaround of design
 - Windshield involved in styling
 - Tacit knowledge more important
- *More complex interface → less distance*

Managing distance

- Mixed communication methods mimic geographic proximity
 - Software
 - Structured method with accountability
 - Maintain US designer at automaker site
 - Automaker engineers often don't really understand what they want, even for simple part (clip)
 - Brought Indian designer to US for 3 months
 - Taught tacit knowledge/knowledge had not thought to make explicit
 - » eg how OE stores data within CAD program
 - Weekly conference call among all 4 parties
 - » Allows reminding/confirmation of deadlines
 - » Free-form discussion
 - » Fill in communication gap (quarter panel design due)
 - Informal calls as necessary
- *More governance allows both complex interfaces and long distance*

Supplier Inc – ESI

Open Issue List

Supplier Industries, Inc.
Product Development Team:

XYZ Program

Task Timing Chart

Sample Task		
Complete		
Due Within	32	Days
In Progress / Normal		
Last Updated	5/3/2004	
Current Completion Date		

Run Gant Chart

Chart Scale

#	Task	Dura-tion	Completion Date	Status	Assigned To	Comments
1	Update glass file to latest studio surf	2	31-Mar-04	Complete		
2	Sig-six	1	1-Apr-04	Complete	Jagdish	Result 17
3	Update T04A per mark-up	1	5-Apr-04	Complete	Jagdish	File ANA13723/001.0003
4	XYZ pin locations for sht mtl group	1	5-Apr-04	Complete	Jagdish	
5	Develop glass load for 888	1	8-Apr-04	Complete	Jagdish	11.16 to fender/modifying lower radius??
6	Verify glass load for 888,889, & 890	1	23-Apr-04	In Progress	Jagdish	Waiting on Schaffer for file #'s
7	Verify 22mm Ure rad for W/S and QTR	0.5	8-Apr-04	Complete	Jagdish	qtr 26mm rads, w/s has 35 and 40 rads
8	Re-design W/S locating pin	1	16-Apr-04	Complete	Jagdish	Base must maintain same surf area
9	Databank IA 1L112592 for CVER	5	16-Apr-04	Complete	Jim	Approved 4/23/04
10	Update IA 1L112592 with SVER data	1	16-Apr-04	Complete	Jim	CVER file needs to released first
11	Vin box size	0.5	8-Apr-04	Complete	Jagdish	5mm to each side for body variation.
12	Verify studiow/s & qtr glass common 888, 889, & 890	1	23-Jun-04	In Progress	Jagdish	Waiting on Schaffer for file #'s

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Off-shoring: local or global optimum?

- Off-shoring has benefits given current US automotive product development system (saves money)
- But, distance can drive interfaces (as well as vice versa)!
 - US vs Japan product design strategy
 - US OEM tolerates lower, slower interaction to achieve lower measured cost of off-shored design
 - Japanese emphasize understanding of context: employees need to understand not just their own job, but the context within which they do their job
 - Indian designer makes mistake because not continually reminded of the function of his design
 - Japanese OEMs have highly complex interfaces between design and engineering
 - both tasks are often done by the same person
 - Frequently there is simultaneous work on several stages & multiple feedback loops
 - Japanese may offshore design and production of a whole component
- Choice of organization will affect evolution of interfaces
 - Is off-shoring hindering evolution of US industry to a more efficient product development process?

Benefits of “industry studies” method

- Managers (esp. in US) don't always understand the process that employees actually use
 - If they underestimate interface complexity, may underinvest in proximity or governance
- Geographic proximity may be a result of producers' need to communicate with each other
 - Jensen/Kletzer method may overestimate returns to offshoring

Thoughts for other industries

- Autos is highly integral
- It's possible that in other industries, offshoring could lead in the US to:
 - More total jobs (retail?)
 - More skilled jobs (semiconductors)
- For US employment to increase, need
 - Little interaction (simple interfaces) between onshore and offshore steps
 - Cost reduction so large that demand increases dramatically
 - Some reason why some steps stay in the US

Conclusions for US policy

- Traditional view of offshoring
 - “low-skill” jobs are sent abroad, so “more education” will preserve US jobs, salaries
 - won’t affect nature of service provided
- Auto design is not low-skill
 - Requires 2-year college degree, pays \$60-80,000
- Complexity of interfaces as well as skill is important
 - More complex interfaces make jobs harder to move
 - Long distances make it hard to maintain complex interfaces

The End

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Interfaces evolve

- In successful collaborations, interfaces evolve over time—
 - They change location (where is delegation, FEA done?)
 - Interface governance may change (from design rule to pragmatic collaboration and back again)
 - This evolution is based on systematic evaluation of data collected via pragmatic mechanisms
 - Greater total distance may slow this process
 - Key idea of modularity: It is easier to innovate within the area bounded by inflexible interfaces than between such areas
 - So will sending design to India promote innovation within design and within engineering, while frustrating innovation that integrates design and engineering?

Conclusions for firms

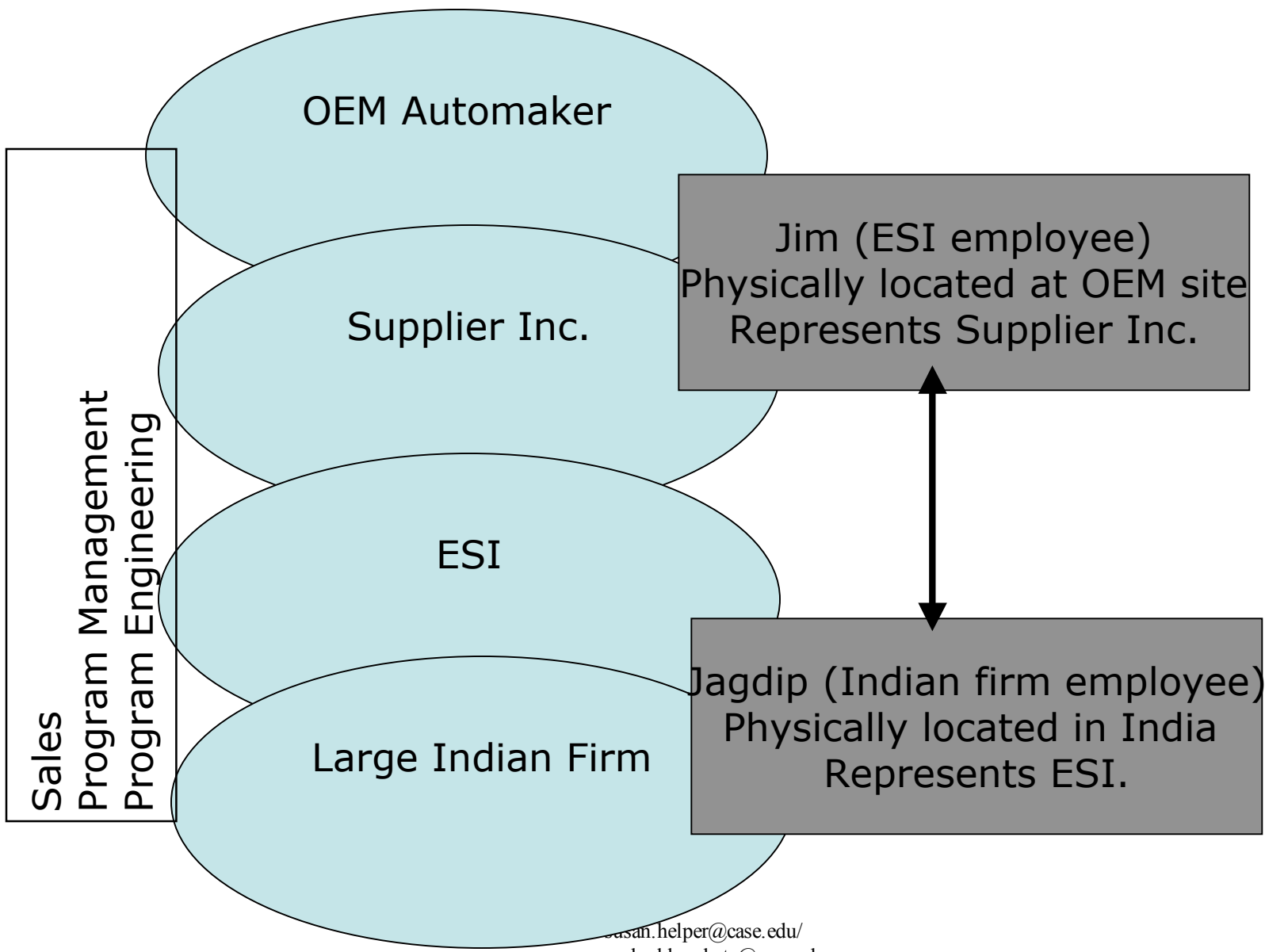
- Similar problems result from distance and from poorly-articulated governance
 - Goals may diverge
 - Bad motives may be assumed
 - Deadlines can slip by
- Moderately high-interface tasks can be coordinated across firm boundaries if geographic distance is low and other mechanisms are used to align incentives
 - Product design done with representatives of many firms sitting at automaker's site
 - US managers underestimate value of proximity
- If distance is increased, the project will not succeed without increased attention to managing incentive alignment and information transfer
 - ESI initial project lacked use of multiple methods of communication, pragmatic mechanisms, or incentives for their use
- Choice of organization will affect evolution of interfaces
 - Is off-shoring hindering evolution of US industry to a more efficient product development process?

Conclusions for Indian workers

- Indian designers have more formal education than US designers
 - 4-year engineering degree
 - Could do engineering analysis of designs (esp. if more auto experience)—but lack channels to communicate this expertise
- Purchasing power of salary is similar to US designer
- Is off-shoring of design tasks a better way to move up skill ladder than doing whole design of a simple part?

Methods

- Interviews with managers, designers at all firms involved
- Sat with US designer
- Listened in on several weekly conference calls
- Khambete was direct participant



Managing Governance

- The incentives of a few key parties must be aligned for the project to succeed. If not, there is little incentive to *use* the communication systems
 - Engineering experts at Engineering Services and Supplier
 - Off-shoring can help Supplier chief engineer meet his performance objectives
 - Therefore, conference calls discuss real issues, looks to solve problems rather than blame India
 - Designer in US and Designer in India
 - Indian's visit to US resulted in friendship
 - Bonus, job security

If incentives among key people are well aligned, the project can overcome imperfect incentive alignment among other parties

- The alliance can function despite imperfect incentive alignment between Engineering Services and Large Indian firm
 - Large Indian Firm would like to work directly with Supplier
 - Jagdip is not working fulltime on ESI projects, tho he's being paid by ESI for fulltime work

Impacts of off-shoring are complex

- Involves movements in three factors
 - Distance
 - Complexity of interfaces among process steps
 - Governance

How scalable is ESI's method?

- Goal:
 - have Jim be US interface for several projects
 - Have Jagdip supervise several Indian engineers (who have not been to the US)
- Potential problems
 - How much of the work can Jim delegate?
 - Extra layer of communication adds cost, decreases bandwidth
 - How successful with weaker personal relationship? (Jim and Jagdip's is strong)