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Monterey, California: Naval Postgraduate School.

The Art & Science of Service Conference, San Jose, California
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Exploring the Representation of Complex Processes in Information Intensive Services

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Agenda

- Introduction – Information Intensive Services (IIS)
- Examples of IIS – Two case studies
- Characteristics of IIS
- Methods of representation of processes in IIS – Six existing methods
- Evaluation of methods
- Conclusions

Structural Shifts in the U.S. Economy

- Two major trends in economic evolution
 - Evolution from agricultural to manufacturing to services
 - Evolution from material-based economy to information-based economy
- Services account for about 85% GNP and employment
- About 63% of GNP is generated in the information domain of the U.S. economy and about half of the workers are information workers (Apte et al. 2008)

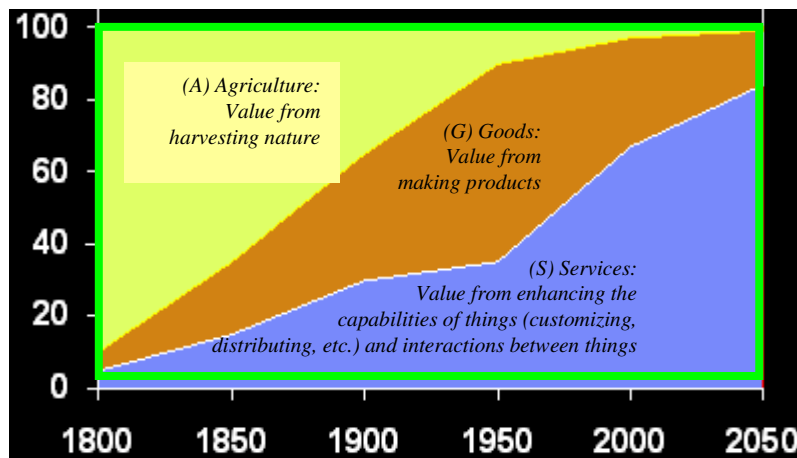
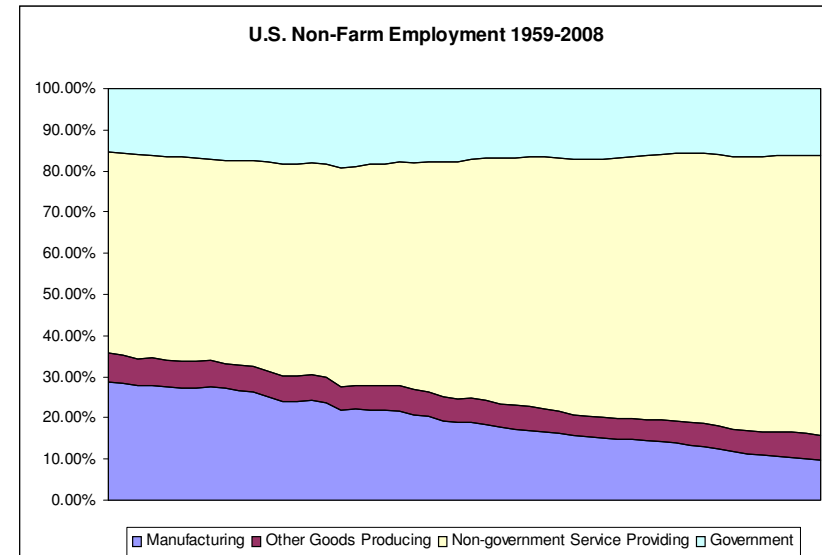


Figure 1. Transformation of US Economy





Information-Intensive Services (IIS)

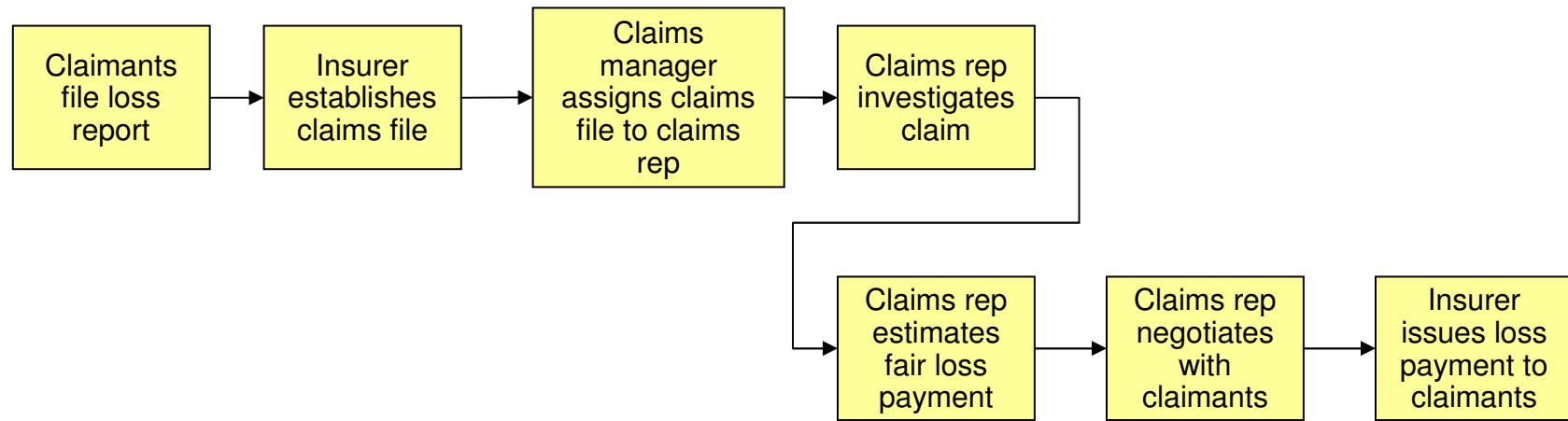
- A service activity has these components (Apte & Mason 1995)
 - Physical actions involving manipulation of physical objects
 - Informational actions involving collection, processing, & dissemination of symbols
 - Interpersonal actions
 - Other indirect actions
- Information-Intensive services are those with a large fraction of time spent on informational actions
- IIS appears in manufacturing, government, service sectors
- IIS has typical service characteristics
 - Intangible
 - Produced and consumed simultaneously
 - Co-production between provider and customer
 - Requires specialists } collaborative in nature
- Examples: consulting, legal services, financial services, IT services, insurance, healthcare, education
- Our objective: To understand IIS at a fundamental level so that they can be managed effectively
 - How does an IIS evolve over time
 - How does individual behavior impact the overall evolution of an IIS



Information-Intensive Services (cont'd)

- There are two fundamental challenges associated with information intensive services:
 - Lack of good scheme for description and categorization
 - Difficulties in quantification and measurement
- Most management concepts – such as demand/supply curves, productivity, quality, utility, cost, etc. – depend on quantification
- Hence, we believe that for managing IIS, some traditional concepts are indeed applicable and useful, but new concepts and techniques are needed
- The paucity of research in service operations in general and in IIS in particular are well documented (Roth and Menor 2003, Chase and Apte 2007, Karmarkar and Apte 2007, Apte et al. 2008)
- Hence, conducting research in information intensive services is critically important
- We focus on the first challenge
 - What is a good way to represent processes in IIS?

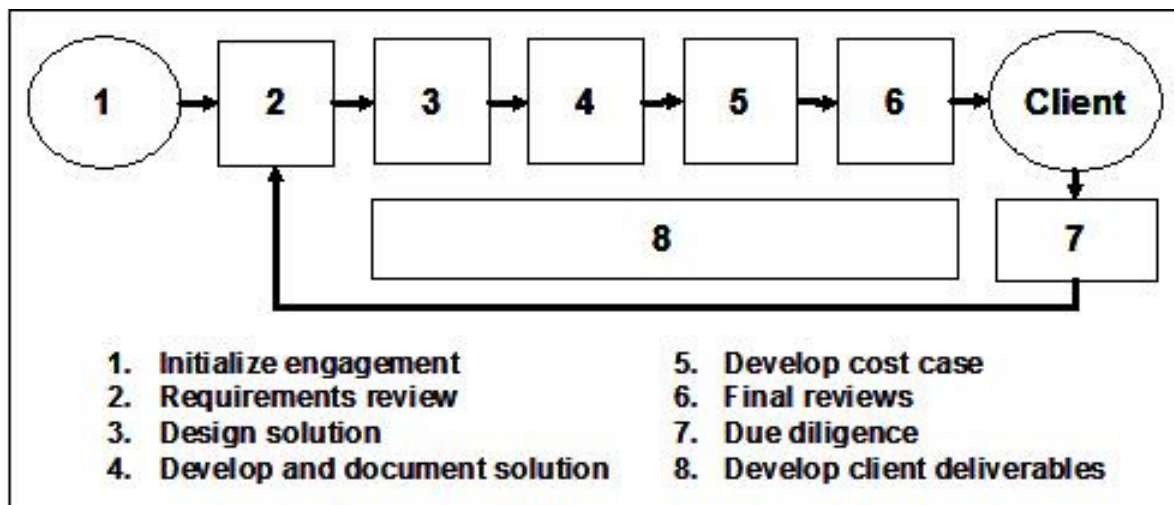
Example of a Process in IIS: Insurance Claims Handling



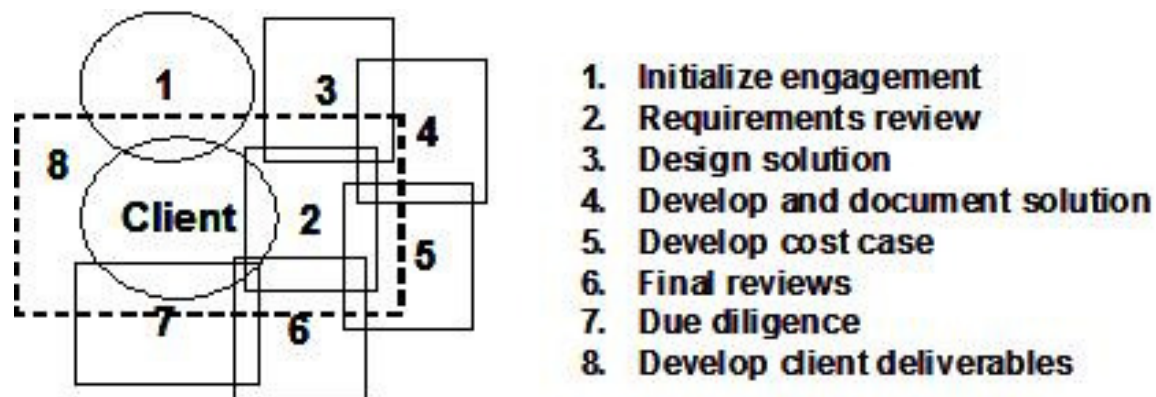
- Only a nominal path of the process is shown; process steps iterate depending on results of actions and behavior of actors
- A claims rep spent
 - 66% of time dealing with information
 - 30% of time dealing with customers
 - 24% overlap of above

Example of a Process in IIS: Response to Request for Proposal (RFP) in IT Outsourcing

Nominal process view:



Practice view:



Characteristics of Processes in Information-Intensive Service

- Influence of human behavior, perceptions & relationships
 - Process structure uncertain, depending on human decisions and interactions
- Multiple actors & decision makers
 - Multiple actors, each playing multiple roles in different steps are possible
 - Interaction of actors (cooperation, competition) leads to different dynamic behavior
- Joint production of output
 - The whole may be greater than the sum of its parts
- Multiple concurrent processes or multi-threading
 - Threads may diverge or converge
 - Threads may diverge after converging
 - Threads controlled by different actors
- Simultaneous use of multiple resources
 - A common path: simultaneous use of resources, resources separate in different threads, simultaneous use of resources, resources separate in different threads, ...
 - Unavailability of a resource changes rather than halts the process
- Large variance in individual activities & across activities
 - Information processing / decision making by humans are highly variable
 - Full range of activities from completely manual to completely automated

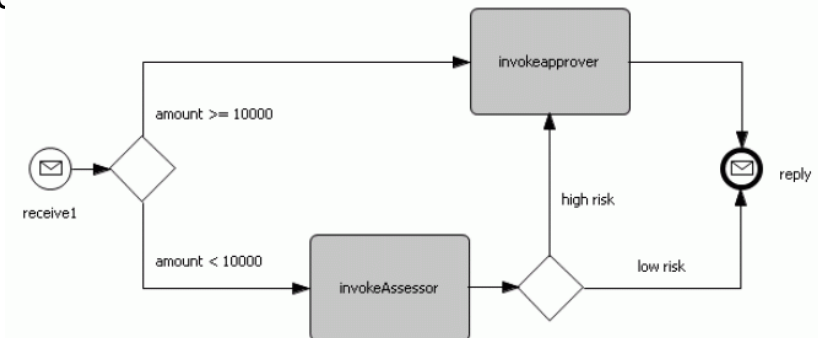


Existing Representation Methods for Processes in IIS

- Business process modeling
- Agent based modeling
- Service blueprinting
- Work practice diagrams
- An analysis framework for service process performance
- Game-theoretic modeling

Business Process Modeling

- Long history of 50 years in production process modeling & enterprise process modeling
- Surveys include Giaglis (2001), Kamath et al. (2003), Lu & Sadiq (2007)
- Production process modeling: Markov chains, queuing, discrete event simulation, algebraic modeling
 - Applicable and used in some service processes, e.g., call center operation (Gans et al. 2003)
- Enterprise process modeling: IDEF, EPC, DEM, UML Activity Diagrams, Petri nets
- Business Process Modeling Notation (BPMN)
 - Graph based technique, similar to flowcharting
 - Representative of many business process modeling “languages”
 - Adopted by OMG as a process modeling standard
 - Supported by many software vendors



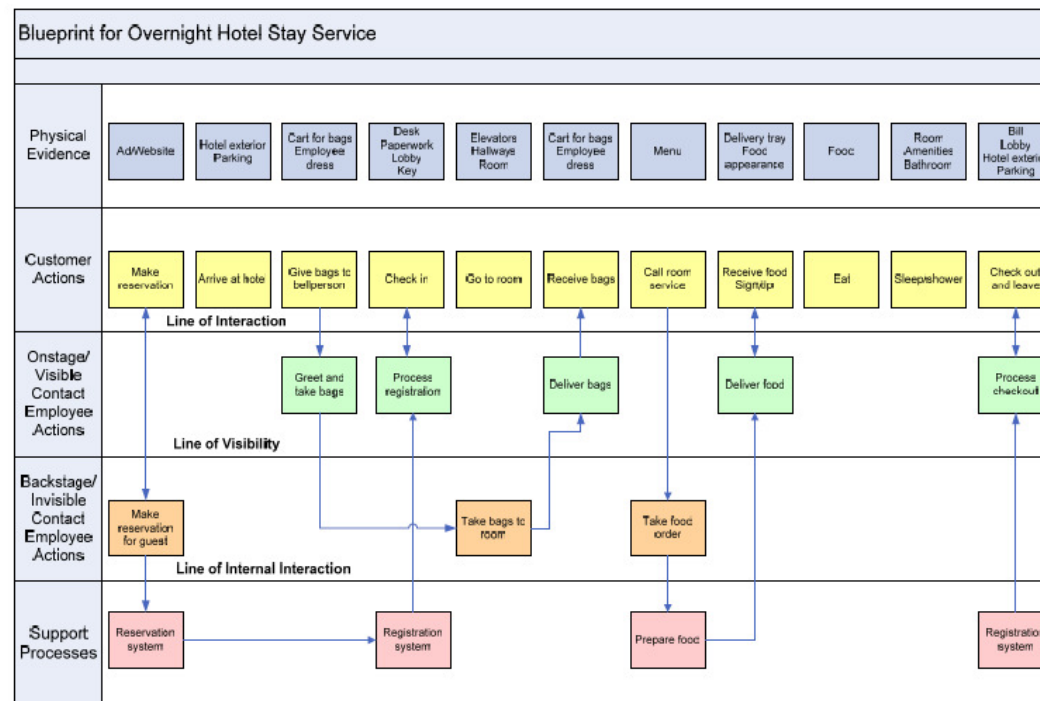
- Virtual Design Team (VDT, Jin & Levitt 1996)
 - Detailed simulation model of activities of a project team
 - Each team member operates independently on his own queue of work items
 - Covers production & non-production activities, communications, exception handling, management decision making
 - Extended to study different issues such as knowledge flow dynamics (Nissen & Levitt 2002)

Agent-Based Modeling

- Decentralized world view, in contrast to business process models
- Collection of agents with its own knowledge & decision making logic
- System behavior is not clear even though individual behavior is known
- Many application areas, e.g.,
 - Economics, especially non-steady-state economics (Arthur 2005)
 - Consumer behavior (Said et al. 2002)
 - Information economy utilizing software agents (Kephart et al. 2000)
 - Healthcare, e.g., disease outbreaks (Eubank et al. 2004), bio-attacks (Carley et al. 2006)
- Computational organization models (Carly & Gasser 1999, Carley 2002)
 - Agents are humans or information systems in an organization
 - Study organizational issues, e.g., how does an organizational structure evolve over time
 - Utilize existing agent-based modeling frameworks / tools
- Existing modeling frameworks & environments
 - MACE (Gasser et al. 1987)
 - SWARM (Minar et al. 1996)
- Specialized agent-based meta-model has been proposed for modeling enterprises (Jureta & Faulkner 2005)

Service Blueprinting

- Proposed specifically for service processes (Shostack 1984, Bitner et al. 2008)
- Similar to other business process modeling techniques
 - Graph based approach
 - Relatively simple with five key components
 - Takes a front stage / back stage view



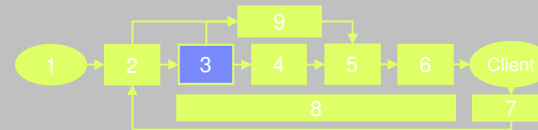
(From: Bitner, Ostrom, Morgan, "Service blueprinting A practical technique for service innovation," California Management Review, Spring 2008)

Work Practice Diagrams

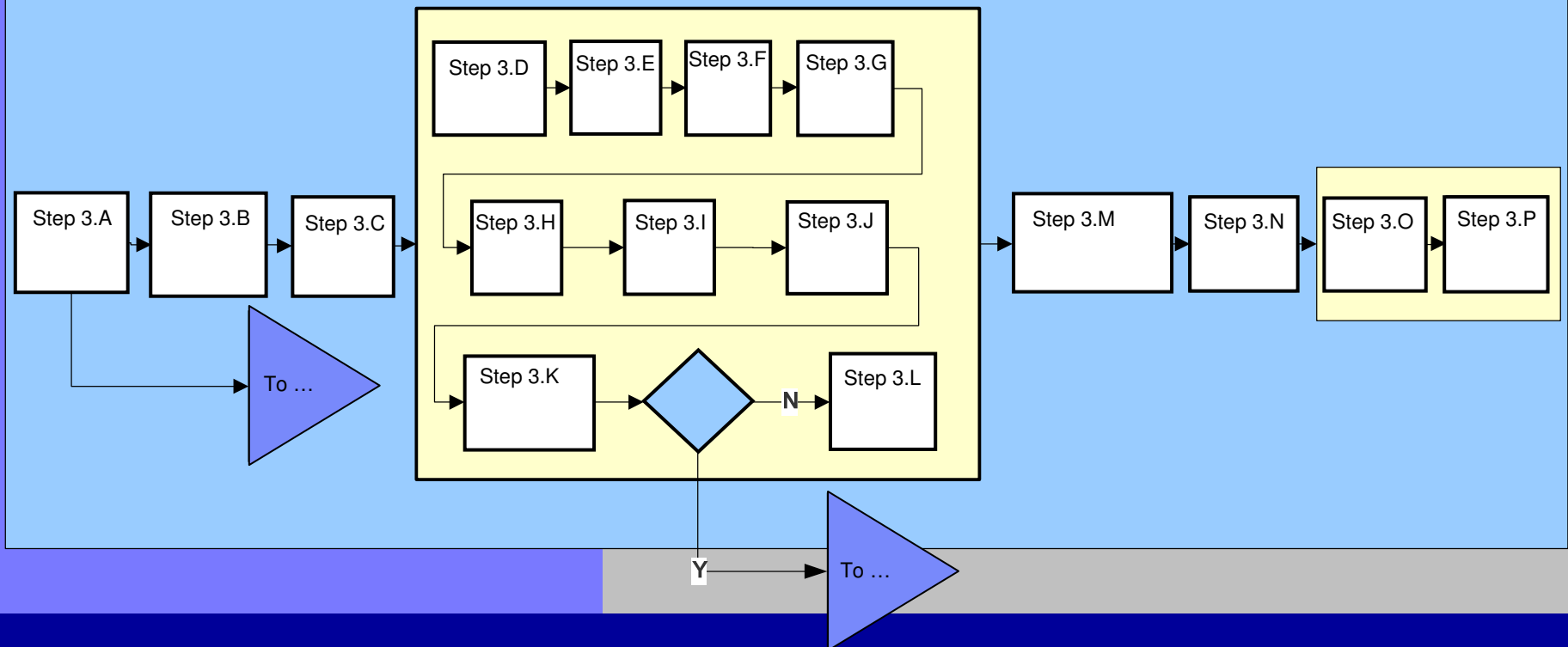
- Originally conceived for the communication of findings from ethnographic research of people engaged in information intensive work
- Useful to facilitate service design (Kieliszewski et al. 2007)
- Graph based approach

Process View	Work Practice View
Serialized, staged	Parallel, iterative
Process stages are central	Client deliverables are central
Work & information compartmentalized	Information flows back & forth freely; work is collaborative

Business Process View of SO Engagement

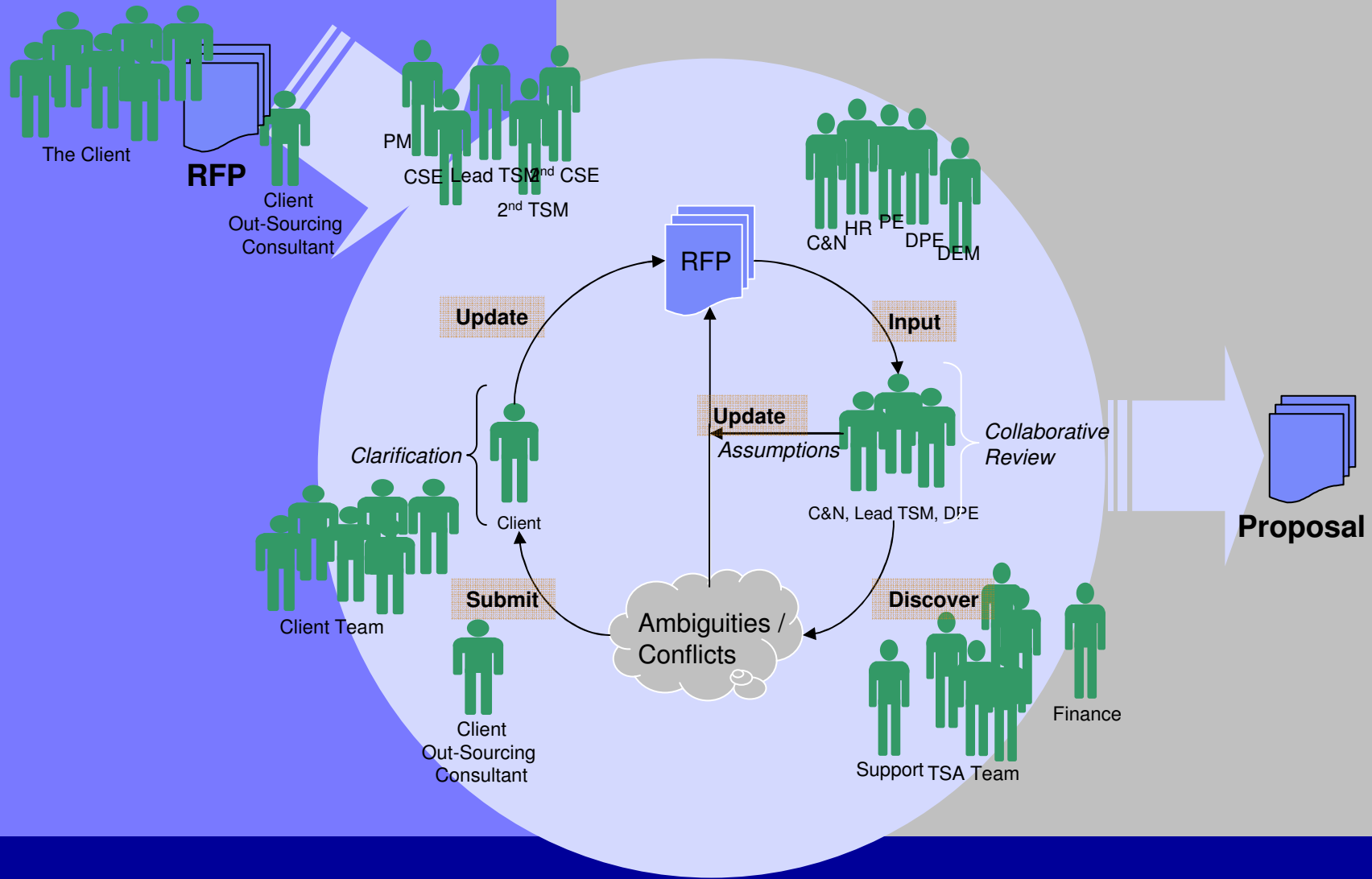


3. Solution Design



Work Practices View of Engagement

Investigative, collaborative, iterative, parallel and creative.

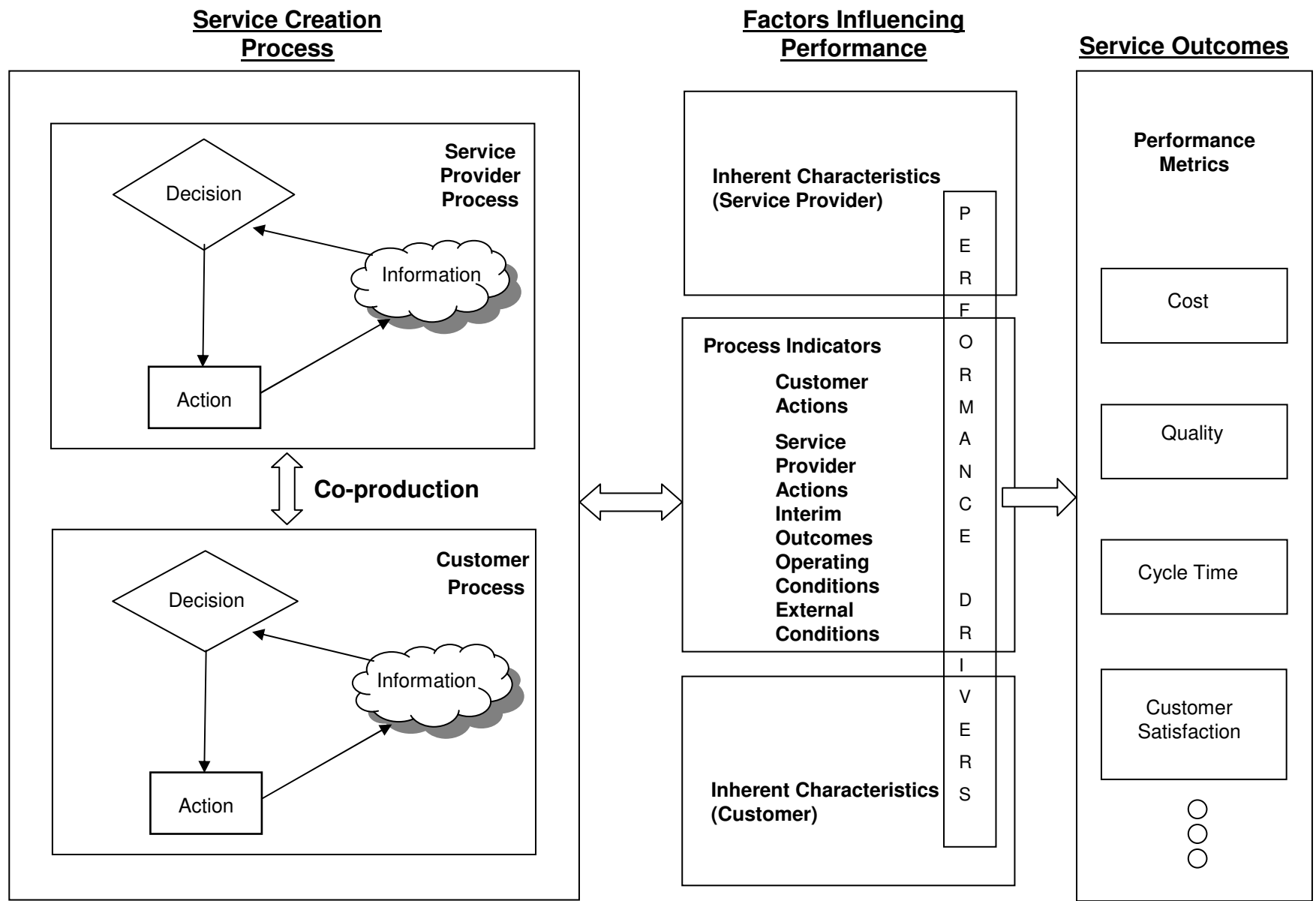




An Analysis Framework for Information & Customer Contact Intensive Services

- Insurance claims handling is an information and customer contact intensive service (ICCIS) process.
- ICCIS share characteristics and managerial challenges of both IIS and CCS:
 - Information gathering, quality of information
 - Managing employee-customer interaction and experience
- IIS are characterized by common repetitive structures in production processes of service providers and customers.
 - Information → Decision → Action → Information →
- Information exchange and interaction from co-production.
- Since direct measurement of inputs and outputs is difficult in IIS, indirect process measures need to be used. Hence, suitable process indicators that can convey if the process is functioning properly be identified.
 - Actions taken by service providers and customers
 - Interim process outcomes
 - Operating conditions
- Next a small number of critical process indicators influencing process performance be identified.
- If some of these performance drivers are adjustable then they can be beneficially used as management levers.

Analysis of Information Intensive Services: Conceptual Diagram



Game Theoretic Modeling

- Game theory models strategic situations, or games, in which an individual's success in making choices depends on the choices of others (Myerson 1991)
- Many application areas, e.g.,
 - Economics
 - Management
 - Biology
- Example of modeling a simplest process consisting of one process step
 - Service process properties:
 - Multiple decision makers (buyer-vendor, internal)
 - Joint production and collaboration
 - Stochastic process (outcomes)
 - Two players, possible strategies
 - Do nothing
 - Work alone
 - Request collaboration (both must request for collaboration to occur)
 - Costs and reward
 - Collaboration is more expensive
 - Reward for collaboration is higher (joint production)

Process Model Example: Results

- Several possibilities depending on costs and rewards
- Collaboration requires high rewards (joint production with high output) or high penalties (rules of the game) relative to costs of work
- Independent work can occur
- Can have indeterminate result (may add rules to resolve this)
- Related to games like “chicken”, “hawk-dove” and “free ridership”, “social loafing”
- Multi-period game requires further conditions to resolve indeterminate cases:
 - Rahmani et al (2011): multi-period, stochastic dynamic game. Two kinds of behavior can result
 - Collaboration tends to happen near deadline
 - Analysis of contracting (fixed fee, time & material)
- Multi-step service processes? Not yet tackled

Assessment of Methods for Representation of IIS

Evaluation based on the following criteria

- How well does the framework address each of the characteristics of IIS?
- How well developed is the means of representation:
 - Does the method provide a visual representation of IIS, or an algebraic representation, or both?
 - Does the method utilize formal logic?
 - Does the method provide a means of computation of dynamic or other behavior of IIS – is it a native means or is it being mapped to another computational framework?
 - Is the method amenable to, or does it directly support computer simulation of an IIS?
- For a practitioner, how far along is the framework developed for practical use:
 - What is the method's propensity to address realistic problems?
 - How well does the method support downstream implementation activities, such as an ability to generate code for work flow?
 - Is the method implemented in commercial or open-source software?
- How easy is a model developed using the method communicated to other people or systems:
 - Does the method support a machine readable format?
 - Is the method part of an industry standard?

Assessment rating

- 1: Excellent support
- 2: Moderate support
- 3: Little or no support

Assessment on Representation of IIS Characteristics

	Business process modeling	Service blueprinting	Agent-based modeling	Work practice diagrams	Service performance analysis framework	Game theoretic modeling
Human behavior & relationships	2	2	1	1	1	1
Multiple actors & decision makers	1	2	1	1	1	1
Joint, collaborative production	1	1	2	1	2	2
Multi-threading processes	1	1	1	1	2	2
Simultaneous use of multiple resources	1	1	2	1	2	2
Large variance in operations	2	2	2	2	2	2
Average rating	1.33	1.5	1.33	1.17	1.67	1.67

Assessment on Representation Means

	Business process modeling	Service blueprinting	Agent-based modeling	Work practice diagrams	Service performance analysis framework	Game theoretic modeling
Visual or algebraic representation	V+A	V	A	V	V+A	A
Use of formal logic	1	1	1	3	3	1
Means of computation	2	2	1	3	3	2
Support of simulation	1	2	1	3	2	2
Average rating (except visual / algebraic)	1.33	1.67	1	3	2.67	1.67

Assessment on Practice Considerations

	Business process modeling	Service blueprinting	Agent-based modeling	Work practice diagrams	Service performance analysis framework	Game theoretic modeling
Propensity to address realistic problems	1	1	1	1	1	3
Support for downstream process implementation	1	2	3	3	3	3
Available tools in the form of software	1	2	1	3	3	3
Average rating	1	1.67	1.67	2.33	2.33	3

Assessment on Information Exchange with Other Systems

	Business process modeling	Service blueprinting	Agent-based modeling	Work practice diagrams	Service performance analysis framework	Game theoretic modeling
Support for machine readable form	1	2	1	3	3	3
Part of industry standard	1	2	3	3	3	3
Average rating	1	2	2	3	3	3



Overall Assessment

	Business process modeling	Service blueprinting	Agent-based modeling	Work practice diagrams	Service performance analysis framework	Game theoretic modeling
Representation of IIS characteristics	1.33	1.5	1.33	1.17	1.67	1.67
Representation means	1.33	1.67	1	3	2.67	1.67
Practice considerations	1	1.67	1.67	2.33	2.33	3
Information exchange with other systems	1	2	2	3	3	3

Conclusions

- Relatively, no universally superior method
- Each method has its own weakness
 - Choice of method depends on the purpose of representation
 - Not very attractive for practitioners
- On an absolute basis, no single representation method is very satisfactory
- Development of a new method is perhaps necessary
- Use analytic hierarchy process based comparison method in Kaschek et al. (2006) with our criteria and rating



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