

Flexibility structure design with human resource considerations

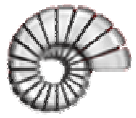
Zeynep Akşin

Koç University

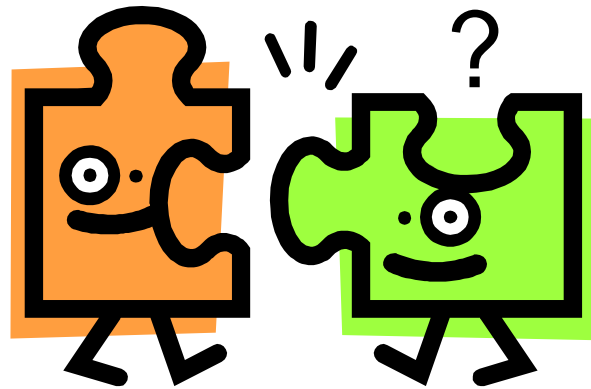
Joint work with

Nesrin Çakan, Georgia Institute of Technology

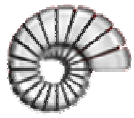
Fikri Karaesmen and Lerzan Örmeci, Koc University,



Why flexibility?

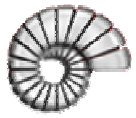


To better match supply to uncertain demand



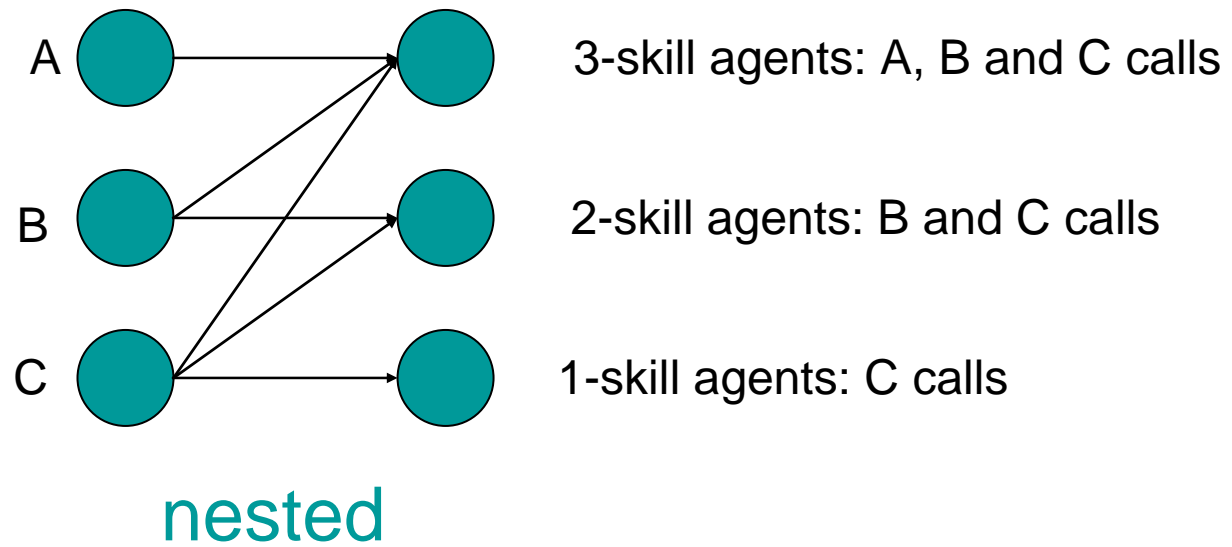
Designing a flexible call center

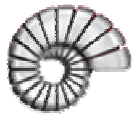
- Level 1: Define skills
- Level 2: Determine cross-train structure
 - Implies a certain career path
 - Implies groups of agents with different skill sets
- Level 3: Determine capacity for each skill set
- Level 4: Route incoming calls to appropriate agents: skills based routing



Flexibility structures in practice: a retail banking call center

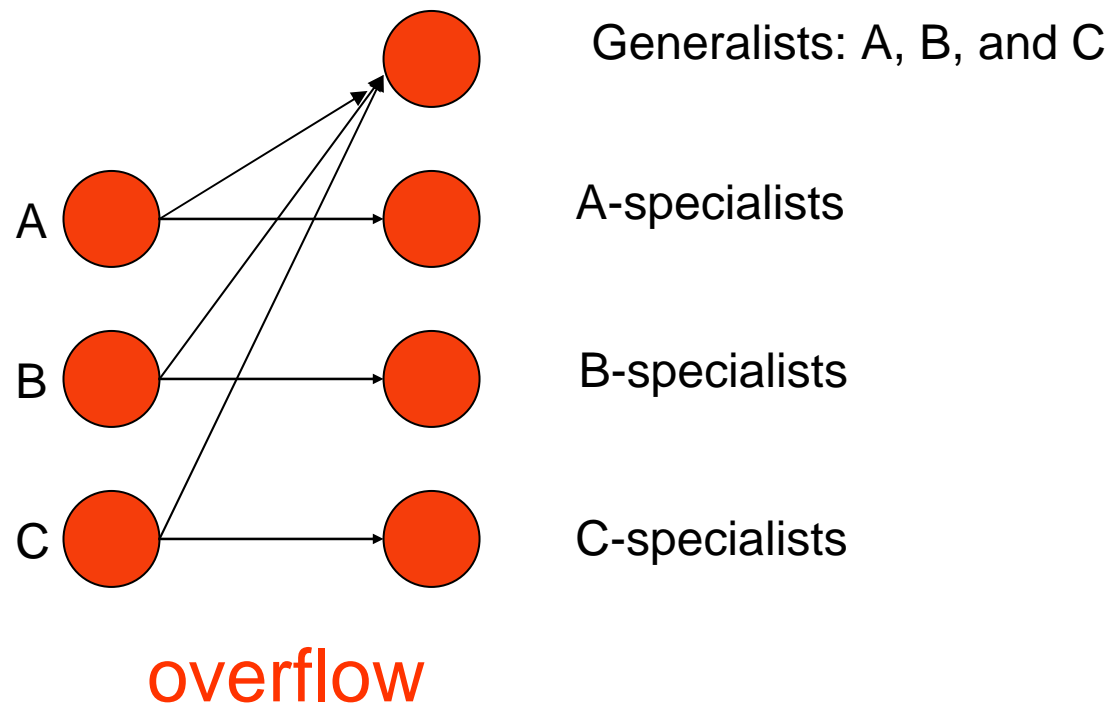
- Agents start as specialists in simple tasks
- As they become more experienced they are trained and obtain new skills

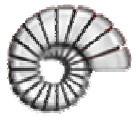




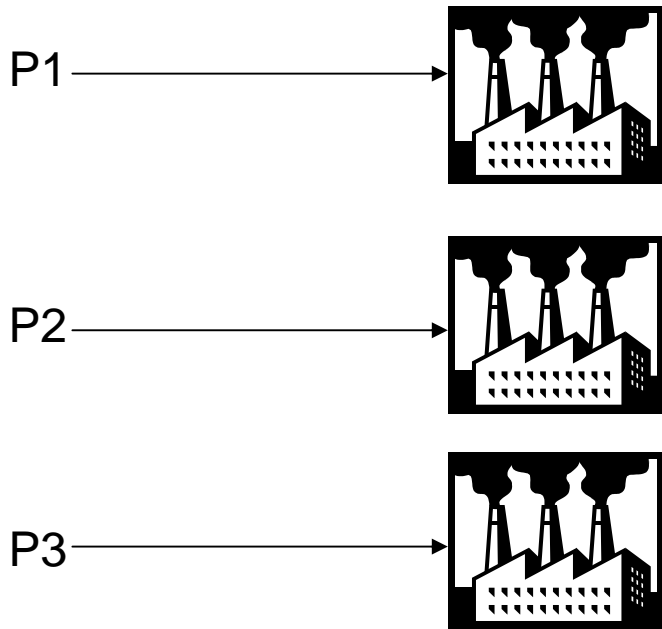
Flexibility structures in practice: a technical support center

- Most agents are specialized: gatekeepers
- Complex queries are escalated to generalist

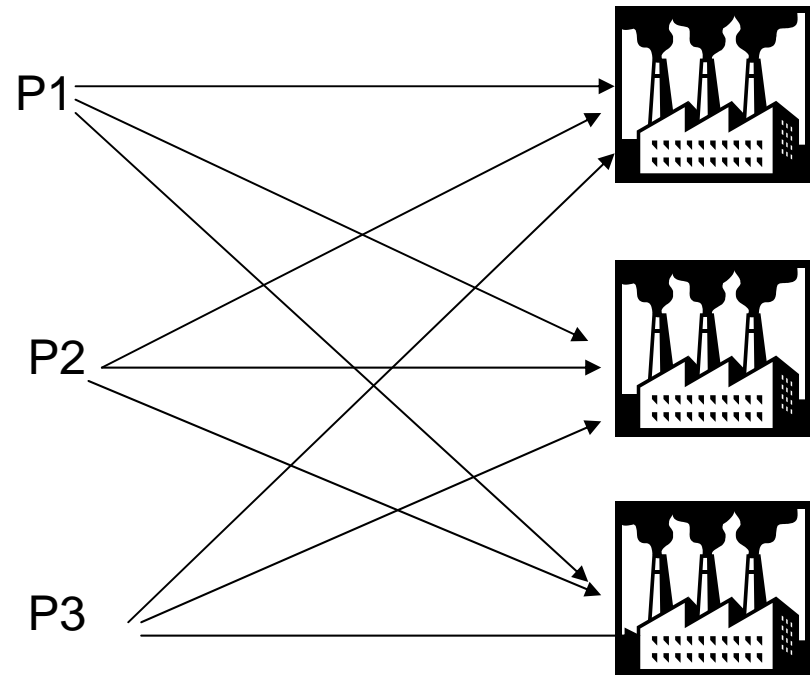




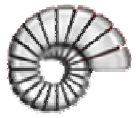
Process flexibility in manufacturing: *flexibility is desirable but comes at a cost*



Specialized: no flexibility



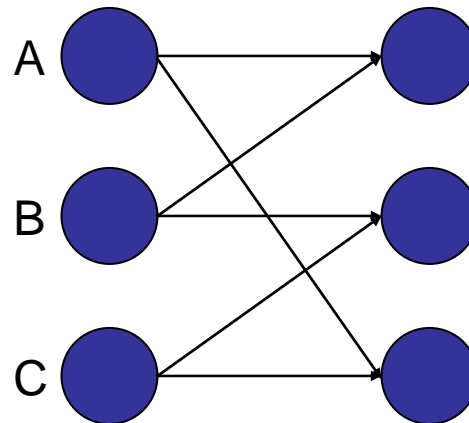
Full Flexibility



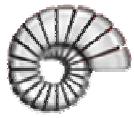
“Limited flexibility is almost as good as full flexibility” (Jordan and Graves, 1995)

From a throughput or revenue perspective:

- “Chain structures are good”
- “Longer chains are better”
- “Balanced flexibility is better”

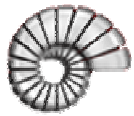


2-chain



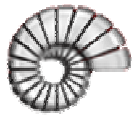
Some questions that come to mind

- Based on the process flexibility literature
 - A 2-chain structure seems superior to a nested structure from throughput perspective
 - A 2-chain structure seems superior to an overflow structure from throughput perspective
- Is this still true when staff costs are taken into account, i.e. when capacity is optimized?
- Is this still true when indirect human resource costs are taken into account?



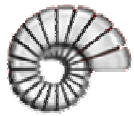
Capacity optimization

- The process flexibility literature assumes capacities are given and typically symmetric (Jordan and Graves 1995; Aksin and Karaesmen 2004; Iravani et al. 2005)
- The capacity optimization literature (Fine and Freund 1990; Van Mieghem, 1998; Netessine et al. 2002) assumes the flexibility structure is given
- We would like to explore prevalent flexibility structures under capacity optimization
 - Each handled call generates a revenue
 - Each server has a basic cost (salary and benefits)
 - Each additional skill has an additional cost (flexibility cost)



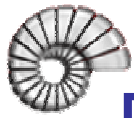
A two stage stochastic optimization problem

- Stage 1: maximize **expected** profits
 - Determine capacity levels under **uncertain demand** and given flexibility structure
- Stage 2: maximize profits
 - by allocating calls to appropriate agents
 - given flexibility structure and
 - capacity levels from stage 1 and
 - realized demand



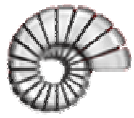
Numerical study comparing the three structures

- Different cost structures: revenues, basic costs, flexibility costs
- **Different demand volume assumptions**
- Different coefficient of variation for demand
- Correlated and uncorrelated demand



Demand volume assumptions have the most effect on the results

- Unbalanced-Pareto ordering $\mu_A < \mu_B < \mu_C < \dots$
 - Where μ_i with $i=A,B,C,\dots$ is the average call volume
 - In nested structure, type A calls are the ones that are learned last-most sophisticated
- Balanced ordering $\mu_A = \mu_B = \mu_C = \dots$
- Unbalanced ordering $\mu_A > \mu_B > \mu_C > \dots$

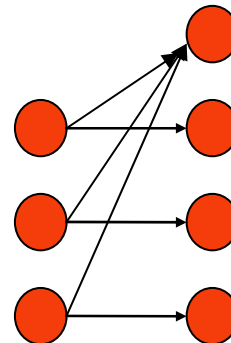


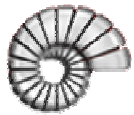
Level 1 design: If skills are being defined

- Define or determine skills such that demand volumes have the **balanced ordering**
- This results in the highest profits when combined with an overflow structure
- With capacities optimized
- Particularly in settings with high flexibility costs

$$\mu A = \mu B = \mu C = \dots$$

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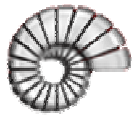


Level 2 design: Given skill definitions what cross-train structure to adopt?

	$\mu_A < \mu_B < \mu_C < \dots$	$\mu_A = \mu_B = \mu_C = \dots$	$\mu_A > \mu_B > \mu_C > \dots$
3-skills	Nested	Nested / overflow / 2-chain	2-chain
8-skills	Overflow	Overflow	Overflow

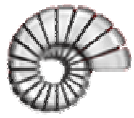
Ability to control direct costs in overflow

Ability to control direct costs in nested



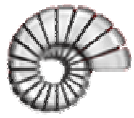
If we have a mismatch between demand ordering and flexibility structure

- If existing structure is nested
 - Hard to switch to different structure due to implied career path
 - Attempt regrouping skills
- If existing structure is overflow
 - Training for a shift to a 2-chain structure might be feasible
 - Shift to a nested structure may turn out to be very expensive



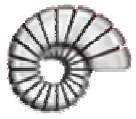
What about indirect costs?

- HR literature: relationship between job scope and performance an inverted U-shape
- This implies that as the number of skill increases
 - Overflow structure may become infeasible
 - Indirect costs will dominate direct ones and will revert back to 2-chain structure
- HR literature: inclusive versus segmented training programs
 - Overflow: segmented
 - 2-chain and nested: inclusive



Conclusions

- Incorporating direct costs in flexibility design illustrates important interaction
- What is best from throughput perspective may not be the best in profit terms
- Human resource considerations may impose constraints and limitations on the implementation of different structures
- Call volumes and number of skills are the most important determinants in flexibility structure choice
- Back to skills based routing: all of these results hold under the assumption that routing is done properly!



Questions?