Exploring Different Construction Stakeholders’ Perception of Human-Robot Collaboration

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Introduction
- Paradigm shift in robotic technology development
  - Emergence of on-site construction robots working with humans
- Need to understand how various stakeholders perceive development and deployment of construction robots for different tasks and situations to achieve successful robot adoption

Research Objective & Contribution
- To investigate how the contextual factors (individual, task-related, environmental) associated with different construction professions shape their perceptions of robots
- Findings can enable organization / developers to design future robots to promote effective HRI

Research Methodology
- Conducted a qualitative research using in-depth interviews

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
<th>Sub-group</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Contractor</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Subcon-Manager</td>
<td>14</td>
<td></td>
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<tr>
<td>Subcon-Worker</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Civil</td>
<td>1</td>
<td>Structural</td>
</tr>
<tr>
<td>Concrete</td>
<td>8</td>
<td>Structural</td>
</tr>
<tr>
<td>Structural steel</td>
<td>5</td>
<td>Structural</td>
</tr>
<tr>
<td>Facade/windows</td>
<td>1</td>
<td>Structural</td>
</tr>
<tr>
<td>Masonry/Stone/Tile</td>
<td>5</td>
<td>Arch Finishing</td>
</tr>
<tr>
<td>Plastering/Painting</td>
<td>2</td>
<td>Arch Finishing</td>
</tr>
<tr>
<td>Waterproofing</td>
<td>1</td>
<td>Arch Finishing</td>
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<tr>
<td>Structural</td>
<td>1</td>
<td>Arch Finishing</td>
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<tr>
<td>Tech Development</td>
<td>2</td>
<td></td>
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<tr>
<td>Intermediate (10 yr)</td>
<td>8</td>
<td></td>
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<tr>
<td>Advanced (11-20 yr)</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Expert (21+ yr)</td>
<td>11</td>
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Research Methodology (Con’t)
- Participants were asked to indirectly interact with robots based on the exemplary videos and photos and illustrated fictional collaborative scenarios in their own job environment
  - Independent vs. Collaborative robot
  - Assistive vs. Main task executing robot

Data Analysis
- Analyzed based on content analysis method
  - Attitude toward robots
    - Positive (improved productivity, improved work environment, improved quality)
    - Negative (job security, high cost, technical difficulties, lack of communication)
  - Robot Adoption Feasibility
    - Positive (technological trend, advanced technology development)
    - Negative (work environment dynamics, cost-benefit ratio, internal resistance)
  - Robot Autonomy
    - High (Trust in autonomy, improved efficiency, reduced workload)
    - Low (lack of trust in autonomy, lack of control, cost of robot error)

Result
- Different perceptions among stakeholders’ groups
  - Desired robot role and perceived robot capability
    - Structural workers
    - Arch finishing workers Managers
      - Assistive role
      - Main task role

- Desired robot autonomy and perceived benefits
  - Structural workers
  - Managers
  - Arch finishing workers

Discussion
- Technological anxiety was only apparent in the subcontractor worker group.
- The presence of robots in the workplace did not pose significant psychological safety threats to workers.
- Participants preferred to form social interaction with robots and showed propensity to anthropomorphism in robot appearance.

Limitation and Future Work
- Limitation: consider only one-to-one human robot interaction; scope of work covers only building project (excluding infrastructure project)
- Future work: extend the findings to multi interactions and further explores the contextual factors

Acknowledgements
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