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Engineering the 21st Century Service Economy - The Human Side of Service Innovation and Transformation With AI/ML, Robotics, and Automation

Vittaldas Prabhu[1] and Jim Spohrer[2]

[1]Penn State University, University Park, PA 16802, USA
[2]The International Society for Service Innovation Professionals, San Jose, CA 95051, USA

ABSTRACT

The megatrend in automation driven by exponential increase in computing power and data is transforming diverse service industries and the service systems within them. During 2024 Penn State University (PSU) and the International Society of Service Innovation Professionals (ISSIP) collaborated to organize a series of panel discussions to explore the transformation underway across industry sectors as we engineer our 21st century service economy. Panels covered six service industries: healthcare, finance, education, retail & hospitality, and supply chain & logistics, energy & IT. Experts from industry, government, NGO, and academia served as panelists and discussed trends, tools, challenges, and ways to define and measure progress and excellence in the emerging service economy. This paper has two objectives: (1) to present a summary of the panel discussions regarding the human side of transformation and innovation; (2) apply AI systems to obtain this summary and querying the panel discussions. Additionally, the two AI systems used are compared based on their responses to identical prompts, any glaring errors, surprising findings, and complexity of the response. Specially, Notebook LM is provided richer, deeper information form the panel discussions whereas Chat GPT uses its underlying LLM trained on publicly available information.

Keywords: Service innovation, Human side of transformation, AI/ML, Robotics and automation

INTRODUCTION

The megatrend in automation driven by exponential increase in computing power and data is transforming diverse service industries and the service systems within them. Here a service system can be viewed as dynamic configurations of people, technology, organizations, and information interconnected by value propositions (Maglio et al., 2009). Service innovation can be viewed as advances integrating (i) technologies that amplify capabilities; (ii) business models that scale up benefits rapidly; and (iii) institutional arrangements that scale down potential harm to underserved populations, the planet, and future generations (Spohrer, 2024)

During 2024 Penn State University (PSU) and the International Society of Service Innovation Professionals (ISSIP) collaborated to organize a series of panel discussions to explore the transformation underway across industry sectors as we engineer our 21st century service economy. Panels covered six service industries: healthcare, finance, education, retail & hospitality, and supply chain & logistics, energy & IT. Experts from industry, government, NGO, and academia served as panelists and discussed trends, tools, challenges, and ways to define and measure progress and excellence in the emerging service economy.

This paper has two objectives: (1) to present a summary of the panel discussions; (2) apply AI tools to obtain this summary. First the key challenges related to the human side of service innovation and transformation are presented. After this experience with two AI systems in summarizing and querying the panel discussions is presented. Finally, the AI systems used are compared based on qualitative and quantitative metrics. Paper concludes with possible directions of future work.

CHALLENGES IN HUMAN SIDE OF SERVICE INNOVATION AND TRANSFORMATION

Through the panel discussions with experts in service industries, nine key challenges related to the human side of service innovation and transformation were identified, which are presented in detail next.

Resistance to Change: Implementing new technologies and processes can be difficult due to resistance from both employees and customers. A significant cultural shift is often needed for successful adoption, and if the culture is not ready, even the best ideas can fail. It's important to bring people along, explaining why changes are needed, and demonstrating how new technologies can improve accuracy and workflow.

The Need for New Skills: The digital transformation requires new skills, and companies are actively hiring for roles that didn't exist before. There's also a need for employees to upskill and reskill as technology changes, especially with the rapid advancement of AI. This includes not just technical skills but also soft skills like communication, teamwork, and listening, which are critical in team-based environments. Traditional education may not be adequately preparing individuals for these new roles.

Over-Reliance on Technology: There is concern that an over-reliance on technology, particularly among younger generations, may be hindering critical thinking and creativity. While AI can assist with many tasks, it cannot replace human skills like interpersonal communication or the ability to engage in nuanced thinking.

Bias and Fairness: AI systems are trained on human data, which can perpetuate existing biases and unfairness. It is important to build fairness and unbiased approaches into these systems, ensuring that the benefits of technology are shared across diverse populations.

Trust and Transparency: Trust is a major factor in the adoption of new technologies, especially in sectors like healthcare. People may be skeptical of

AI and other new technologies if they are perceived as being removed from human interaction. It's critical to establish clear governance structures and controls and prioritize transparency in how data is used and how decisions are made by AI systems.

Data Ownership and Privacy: There are complex questions around who owns the data generated by AI systems. For example, in the context of healthcare, there can be questions about whether data belongs to the patient, the healthcare system, or the company that developed the tool. There are also concerns about the security and privacy of data, and the need for regulations.

Balancing Automation and Augmentation: It is important to consider whether to use technology to automate processes or to augment human capabilities. The focus should be on creating human-technology synergies that empower people, rather than simply replacing them. In hospitality, for instance, the application of digital transformation is about augmenting the human experience by removing distractors, whereas automation is more central in the retail industry.

Change Management: Successfully implementing service innovation requires effective change management. This means bringing people along, helping them understand the changes, and making sure they have the support and training they need. It may also require re-evaluating the existing processes and infrastructure, and this can be hard when companies have existing roadmaps that are already littered with past, and ongoing, technology implementation efforts.

Human Empathy and Connection: Despite all the advances in technology, there remains a core need for human interaction and empathy. Service delivery should be about people taking care of people, and technology should be used to support those interactions, not replace them. It is important to maintain the focus on the human side of service. It may also be important to understand the differences in expectations, sophistication, or tolerance that different populations have regarding technology.

These challenges highlight the importance of taking a human-centered approach to service innovation and transformation. While technology is a powerful enabler, it must be deployed in a way that supports people, enhances their capabilities, and improves their experiences.

EXPERIENCE WITH AI SYSTEMS IN SUMMARIZING AND QUERYING

The six panel-discussions included experts from industry, government, NGO, and academia, and focused on discussed trends, tools, challenges, and ways to define and measure progress and excellence in the emerging service economy. These of these one-hour discussions were recorded over Zoom and are available as videos posted on YouTube covering healthcare (ISSIP 2024a), finance (ISSIP 2024b), education (ISSIP 2024c), retail & hospitality (ISSIP 2024d), and supply chain & logistics (ISSIP 2024e), energy & IT (ISSIP 2024f). In addition, 17 experts were interviewed for 30 minutes to get their perspectives and video recordings are also available on YouTube (ISSIP 2024g to 2024w).

In the past the workflow for analyzing such videos of groups and individuals would be largely manual. First step in the workflow would be transcribing, then qualitatively coding (possibly with the aid of Qualitative Data Analysis software), and finally analyzing for patterns/themes (Gill and Baillie, 2018). These manual workflows take a considerable amount of time and are usually expensive. For example, each hour of human time for transcription, coding and analysis can cost $50 to $200. However, involving humans to capture nuances such as visual and audio cues can have its advantages (Parameswaran et al., 2020). The 14.5 hours of videos from the panel discussions and interviews are used as sources in Google Notebook LM by proving URLs to the YouTube videos (Google, 2025). Within a few minutes Notebook LM can summarize and answer queries. This instance of Notebook LM can be accessed through a URL (Prabhu and Spohrer, 2024).

QUALITATIVE AND QUANTITATIVE COMPARISON OF AI SYSTEMS

AI systems based on Large Language Models (LLM) are having a transformative impact on many disciplines. There are few studies that have systematically compared AI systems (Mardikar et al., 2025, Mese and Kocak 2025). For this paper we are comparing the following:

A. Notebook LM with videos of six panel discussions as the source.
B. Notebook LM with videos of six panel discussions and 17 interviews as the source.
C. ChatGPT with openly available sources.

For each of the above three, the following queries were run using identical prompts:

- How will ai robotics automation transform service systems in the future?
- How will ai robotics automation transform healthcare service systems/ financial service systems/educational service systems/retail and hospitality service systems/energy and information technology service systems in the future?

Each of the responses were pasted into a Office 365 MS Word document and metrics were obtained using its built in features, which are summarised in Table 1. There were no glaring errors in any response for all three cases. Notebook LM responses are “crisper” compared to ChatGPT, which can be seen from the word count. However, ChatGPT provides references to sources that can be useful for exploratory research and sometimes drew upon examples from the broader service sector beyond the industries covered in the videos used as sources for Notebook LM. Case A and Case B responses were generally similar but Case B included specific points from the individual interviews as can be expected but surprisingly it does so with few words.

Table 1: Comparison of responses for three cases.

Criteria	Case A - Notebook LM With Six Videos	Case B - Notebook LM With 23 Videos	Case C - ChatGPT
Total Words	585	551	2,466
Flesch-Kincaid Grade Level	13.5	16	18.3
Passive sentences	27%	11.1%	15.7
MS Word Editor Score	95%	97%	95%

CONCLUSION AND FUTURE DIRECTIONS

The megatrend in automation driven by exponential increase in computing power and data is transforming diverse service industries and the service systems within them. It is important to recognize and understand the human side of this transformation and innovation. Opinions of experts industry, government, NGO, and academia drawn from six service industries identified nine challenges related to addressing the human side: resistance to change, need for new skills, over-reliance on technology, bias and fairness, trust and transparency, data ownership and privacy, balancing automation and augmentation, change management, and human empathy and connection. These challenges were synthesized using an AI system, Notebook LM. Moreover, comparing experience in using Notebook LM with six video sources (Case A), Notebook LM with 17 additional video sources (Case B), and ChatGPT (Case C) it is found that there were no glaring errors in any of the cases. ChatGPT LLM, trained using open source content, tends to provide more wordy responses and substantiates with references to the source. In Case B, Notebook LM is able to make sure of additional information to provide more pertinent information. One key conclusion from this experience in using AI systems based on LLMs is that they provide a much faster and far less expensive alternative to manual qualitative research that relies on transcribing and coding.

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