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The future of tourism work: is technology a substitute for labour supply?

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ABSTRACT

The purpose of this paper is to explore the future of work by asking the question, 'is technology a substitute for labour supply?' Using New Zealand as a case study, a scenario planning methodology was adopted that engaged with leading tourism stakeholders, as part of an Industry Transformation Plan (ITP) process. Four scenarios were constructed, as follows. Scenario 1: *Robbie the Chef* represents a world without human chefs, where production robots run the kitchen. Scenario 2: *West World Holiday Park* portrays a popular tourist attraction, offering indulgent experiences shaped by advanced robots. Scenario 3: *Weekends Only* is a scenario about tourism businesses' constant struggle for labour, resulting in a smaller but more professional industry. Scenario 4: *The Day We Ran Out of Chefs* depicts the situation when tourism and hospitality become unsustainable because of labour shortages. The paper concludes with a conceptual framework, capturing the essences of the scenarios which advocates four modes of technological substitution for labour: replacement (full scale replacement occurs as machines are so advanced); experiences (technology creates new experiences); argumentation (applications of technology boost the productivity of workers); and redesign (the production of tourism is redesigned through technology to reduce costs).

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Introduction: accelerating trends

Prior to COVID-19, hospitality and tourism in New Zealand was the largest industry, representing 20.1% of all exports and generating NZ \$40.9 bn (MBIE, 2023c). COVID-19 changed all that when the borders closed. Overnight, international arrivals went to zero. However, as the sector recovers from COVID-19, tourism is once again taking a leading role in the country's economy. Notably, COVID-19 has accelerated a number of general work pattern trends, challenging the fundamentals of how we work, when we work and why we work, both within New Zealand and across the globe (Hargreaves et al., 2021). For example, working from home for at least part of the working week seems to be the norm for many of us now. However, tourism and hospitality is not a 'work from home' industry; it is a service industry that is about the provision of food, accommodation and activities. As such, one of the significant impacts of COVID-19 on the industry has been the scarcity of labour and the rise of robotics and automation as a solution (Green et al., 2020).

Several studies have addressed this issue and the changing nature of work *per se*. These have focused on the role of artificial intelligence and job insecurity (Koo et al., 2021; Li et al., 2019), the

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role of robots in food service (Hawksworth et al., 2018; Yu et al., 2022), perceptions of robots (Christ-Brendemühl, 2022; Parvez et al., 2022), service attributes and experiences of robots in food service (Song et al., 2022; Zhu & Chang, 2020) and hospitableness and robots (Qiu et al., 2022; Wen et al., 2022). However, many of these studies are perception studies about technologies of today, thus, they have a focus on presentism. They do not take a future literacy perspective which enables researchers to imagine future technologies and the interface of these with work. Hence, the need for a study that invents and imagines the future, rather than trying to predict the future based on presentism (Dator, 2019; Gupta, 2013; Parvez et al., 2022).

Working in hospitality and tourism has traditionally been perceived as a part-time job or temporary employment, rather than a long-term career choice (Reichenberger & Raymond, 2021). This is an industry that has always been associated with high turnover, high levels of casualisation, skills shortages and dependence on migrant workers (Williamson, 2020). As the tourism and hospitality industry is traditionally a major employer of those under 25 (Hemmington & Neill, 2022) and is labour intensive rather capital intensive, it is going to face intensive, ongoing competition for this cohort from other labour-intensive industries, particularly health, agricultural and retail (Poot, 2018). To compound the issue, as Spoonley (2020, p. 190) points out, New Zealand is heading towards 'very low fertility, and to where we have more elderly people than young people' (p. 190). So, the future for labour supply in New Zealand doesn't look so bright, like many other countries.

However, a recent announcement by Dyson (Wang et al., 2023), at the *IEEE International Conference on Robotics and Automation*, signalled that within ten years humanoid robots will be doing household chores and servicing hotel bedrooms, thus, making the room attendant job redundant. Is this reality or fiction? Humanoid Robotics are well documented in the literature (Mende et al., 2019) and comparisons can be made with the science fiction film *I, Robot* (Asimov, 2004) in which every house has a service robot. Right at the core of humanoid robots is the concept of technological singularity which is a hypothetical future point in time when super intelligent machines outperform and outthink humans. So, could advancements in technology and robotics be a potential solution to the problem of the scarcity of labour?

Determining the future using scenario planning

Scenario planning studies invent the future, rather than predict the future, as they are the process of imagination, discussion, conceptualisation and learning (Ball et al., 2017). One notable study that addressed the future of labour markets in New Zealand was Petersen and Smith (2022, p. 1) who note that 'labour markets are notoriously difficult to determine and both micro- and macro-environmental drivers of change will ultimately affect the shape, quality and quantity of a workforce'. Indeed, the debate on the future of work is demanding increased attention internationally (Malone, 2004; Organization, 2017), not just in New Zealand (Commission, 2020). A number of studies have looked at the future of work in a tourism context (Baum et al., 2016), with Petersen and Smith (2022) creating a series of scenarios about the New Zealand tourism workforce in 2035. This study deployed a useful scenario planning methodology, given the complexity of the topic, the number of variables and different outcomes. Scenario planning deals with multiple futures and is the most commonly deployed methodology in future studies (Anderson, 2007). Scenarios are illustrations of possible alternative futures. The key purpose of scenario planning is to change/alter mental models through dialogue, conversation and decision-making as a participatory group process, thereby contributing to learning and an increased capacity to think in innovative and challenging ways (Bradfield, 2008; Wright & Cairns, 2011).

Research methodology: a scenario planning process

Labour scarcity in the hospitality and tourism industry in New Zealand was identified as having political and strategic importance (Roberts, 2022). Indeed, it had become an important priority

for the government to plan for and respond to even before COVID-19 (Boston, 2017). The New Zealand government uses Industry Transformation Plans (ITPs) to address the critical issues or developments which will have a significant impact on the future of the country's economy. ITPs are a high-intensity, high-engagement approach to industry policy, with the purpose of setting a transformative vision and action plan for key sectors in the New Zealand economy through the Ministry of Business, Innovation and Employment (MBIE). Tourism has an ITP because of its significance to the New Zealand economy. The ITP for the tourism industry commissioned a research study about the future of employment in the industry. Its purpose was to enable better work and opportunities for those in the tourism and hospitality industry, which is a key part of creating a regenerative tourism system.

One of ITP's objectives was to consider the future of work and what is 'better' work. Thus, based upon the expertise of the authors and the MBIE requiring a futures focus, the authors were invited to create a set of scenarios about the future of work for New Zealand's tourism industry, resulting in the following objectives and research question being established.

Scenario question

To shape the future of work, a focused question was used, namely:

Is technology a substitute for labour supply?

This question was addressed by constructing four scenarios about technology and labour supply in 2035. Each scenario represented an alternative future incorporating a scenario summary, signals of the scenarios presently occurring and examples of policy decisions and implications as if the scenario was taking place in the present. The purpose of the scenarios was to paint a picture about the future and for users to work with the scenarios to find answers and actions. They are not a forecast of what 'will' happen but a picture of the future of what 'could' happen. It's about inventing and imaging the future (Ball et al., 2017; Sardar, 2010).

Scenario planning as a learning and action system

Scenario planning is a framework for learning which changes mental models through participation in workshops, group discussions and interactions (Postma et al., 2025). Within workshops, importance is placed on comparative learning, through scenarios and visual learning, which helps participants to see the impact of potential decisions, the connectivity of issues and solutions and the whole picture (Gangwer, 2009). Workshop activity allows participants to break down complex issues, layer issues and understand the parts of the problems, rather than being overwhelmed with complexity. Participants go through the process known as 'the zone of proximal development' or 'scaffolding' to breakdown, structure and learn about problems (Holton & Clarke, 2006). Scenario planning as a learning and influencing system is very important in policy decision making, as it helps frame the problem for decision makers rather than impose a solution, hence, the focus on participation and changing mental models in a collective manner (Freeth & Drimie, 2016).

Scenario planning and case studies

Scenario planning studies or interventions fundamentally can be deemed as case studies, since they usually represent studies of a particular problem set in a business context. These interventions involve groups or stakeholders with different levels of power and authority. Stakeholders bring different viewpoints in which the outcome is converged into one group consensus. As the interventions are about the future, concepts must be imagined and they are complex. The future is usually portrayed as a story and many interventions seeking a satisfactory outcome, rather than an optimal

outcome as they are constrained by time. Hence, for this case study, the study adhered Woodside's (2010) rules of case studies of multiple viewpoints, collective perspectives and interactions, human behaviour, a work-based problem, a complex phenomenon, a satisfying outcome, time constrained and story based. In addition, Woodside (2010) argues that case studies can be used as theory builders as they describe a rich and thick narrative of problems in society and business, in which observations and interpretations can be made to describe why something is happening.

Scenario planning as theory builder

In the scenario planning literature, Chermack (2022) adopts an epistemology perspective focusing on the forms of knowledge associated with methods, validity and scope, in order to bridge the gap between beliefs and opinion to fact and truth, thereby bridging theory and practice (Yeoman & McMahon-Beatte, 2018). Thomas J Chermack (2004) has advocated constructivism as a scenario planning paradigm, based upon the importance of social process and creating mental models. This constructivist approach to scenario planning has been acknowledged as important in many other studies, especially the use of workshops to create a sense of ownership and calls for action (Postma et al., 2013).

As noted above, scenario planning theory places an emphasis on revealing and reconstructing mental models. Theorising is based on the assumption that organisations are systems of feedback loops that spread the dominant mental models and cultural artefacts (Huff & Jenkins, 2002). In tourism research, Pearce (2012) advocated theory building through conceptual and theoretical frameworks and highlighted scenario planning as an appropriate framework. At the heart of the scenario planning framework is the 2×2 matrix, allowing researchers to conceptualise a particular phenomenon related to the future. Chermack and Walton (2006) also argue that scenario planning can be considered as a mode of theory building. This argument is based upon the fact that scenario construction and theory building share several similar key characteristics in terms of purpose, process and outcomes. Bergman et al. (2010) used an ontological approach to classify scenarios as theory builders, focusing on truthfulness and explanatory claims. Such an approach has similarities with Professor Doug Pearce's (2012) research within which frameworks are used to classify tourism research on a conceptual or higher order level to convey the essence and philosophy of the research. Wilkinson et al. (2013) acknowledge the limitations of scenario planning as being too focused on logic. In particular, the 2×2 matrix tends to produce scenarios focused on logic and rationality. To address this, at an ontological level, a plurality overlay can be applied to the 2×2 matrix (Yeoman & McMahon-Beatte, 2018). In this vein, one such approach is the application of James Dator's (2009) *Alternative Futures* model in which the future cannot be predicted but can be discussed and pondered upon. Hence, its *futures* studies not *future* studies. Dator achieves this concept of plurality by clearly identifying different futures, which are:

- continuation (business as usual, more of the *status quo* growth);
- discipline (behaviours to adapt to growing internal or environmental limits);
- collapse (system degradation or failure modes as crisis emerges); and
- transformation (new technology, business, or social factors that change the game).

Thus, Dator's (2009) *Alternative Future* model ensures scenarios range from a continuation of the present, hence, rational and logic to transformational, hence, utopian or skeptical. A scenario matrix that adopts this approach aligns with the laws of futures studies (Bergman et al., 2010; Dator, 2019), giving diversity and plurality.

For a more comprehensive understanding of how to make sense of the future of tourism using scenario planning, readers are referred to *Scenario Planning and Tourism Futures: Theory Building*,

Methodologies and Case Studies (Postma et al., 2025), which provides a step-by-step guide of how to build scenarios whether for theoretical studies or consultancy style interventions.

Methodological process

The scenario planning research methodology for this New Zealand case study adopted the following process.

Step 1: formulating a research brief

Initially, the scenario planning team (consisting of a scenario planner, research assistant and two experts) was commissioned by the MBIE to undertake the project. In consultation with the MBIE Tourism Strategy secretariat and the co-chairs of the ITP panel, a research question (including sub-questions) was established which was '*Is technology a substitute for labour supply?*'. The ITP wanted to explore the role of technology from a productivity and feasibility perspective along with the issues of demography trends and immigration policies.

Step 2: scenario sets workshop

Scenarios were constructed using Pierre Wack's *Shell Method* (Chermack & Coons, 2015) which is fundamentally a secondary research process, or kitchen table method, based upon gathering evidence from a range of different sources, both academic and government publications. Technical data about New Zealand's labour force and demography was provided by the MBIE statisticians. Drivers of change were gathered and structured using a STEEP framework (social, technological, environmental, economic and political). These drivers were evaluated using Van der Heijden's (2005) 2 × 2 matrix which considers the variables of uncertainty and impact. Once a series of drivers had been established, four scenario sets were constructed. These scenario sets were presented to the ITP panel of leading stakeholders through a two hour online workshop, using Miro boards (Lee, 2019) and the merits of each scenario set were discussed. Consensus was reached on which scenario set would create the most insight and be of value, given the research question. The ITP panel composition is detailed in [Table 1](#) below and the scenario set selected for the workshops is shown in [Figure 1](#).

Table 1. ITP panel members.

| Position | Sector |
|---|---------------------|
| Chair, Tourism Association | Association |
| Trade Union Leader | Trade Union |
| General Manager, Government Department | Government |
| Trade Union Leader | Trade Union |
| Chief Executive, Tourism Company | Industry |
| Chief Executive, Tourism Education Provider | Education |
| Chief Economist, Government Department | Government |
| Treaty Negotiator, Iwi | Association (Maori) |
| CEO, Hotel Company | Industry |
| CEO, Tourism Company | Industry |
| Chief Executive, Tourism Association | Association (Maori) |
| Trade Unionist | Trade Union |
| Chief Executive, Consultancy Company | Consultancy |
| Chief Executive, Hospitality Association | Association |
| Human Resources Manager, Tourism Company | Industry |
| Chief Executive, Tourism Association | Association (Maori) |
| Managing Director, Consultancy Company | Consultancy |
| Chief Executive, Tourism Association | Association |
| Trade Union Leader | Trade Union |
| CEO, Tourism Company | Industry |

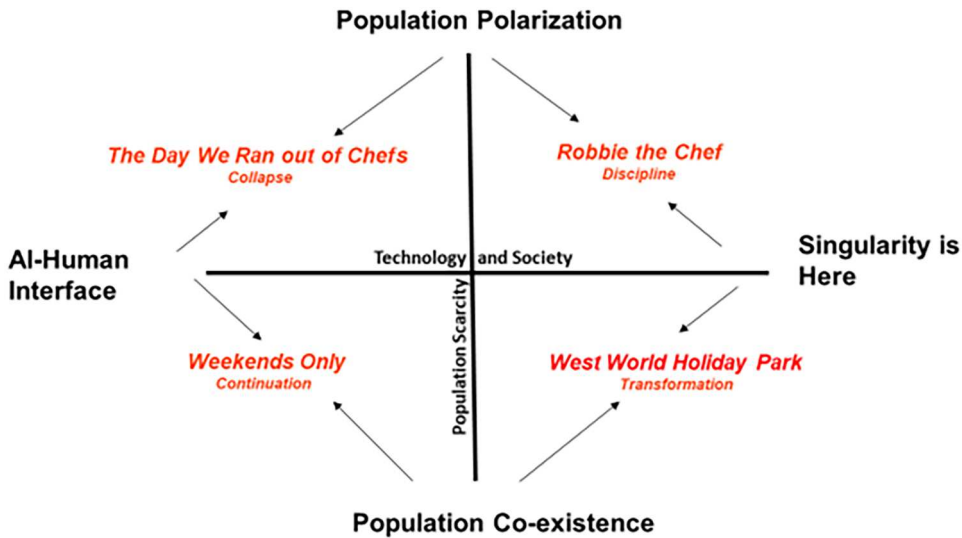


Figure 1. Future of work scenario matrix.

Step 3: scenario matrix workshop

The scenario below (Figure 1) depicts the interface of demography and technology. On the vertical axis, population scarcity is shaped by *Population Polarisation* derived from falling birth rates and an ageing population (Spoonley, 2020) and *Population Co-existence* is driven by immigration policies and the growth of a multi-cultural society (Ward & Masgoret, 2008). The horizontal axis is shaped by the relationship and uses of technology in society (Johnson & Wetmore, 2021). *Singularity is Here* represents the point in the future where machines match the capabilities of humans (Callaghan et al., 2017), whereas, *AI-Human Interface* is the integration of technology in society in everyday roles, with technology taking a passive role (Factory, 2022b).

Once the scenario matrix was finalised, the scenario planning team ‘fleshed out’ the scenario set, identifying the essence of each scenario with a storyline and its signals (Wade, 2012). Two, three-hour, online workshops were organised with the ITP panel using Miro boards (Lee, 2019). In these workshops, discussion set out to surface the assumptions associated with each scenario plus positive and negative aspects of each scenario. Discussions then moved to identifying implications and decisions associated with each scenario, based upon reaching a conclusion that was satisfactory rather than optimal given the time constraints of the scenarios. Next there needed to be an understanding that each scenario required participants to conceptualise content of the scenario. For example, Scenario 3: *Weekends Only* is a continuation of the present, thus, the ITP panellists could easily conceptualise and understand it, given the focus on presentism, whereas the other scenarios were plausible but required explanation, interaction, reflections and listening in the group activities in the workshops.

There was a high level of consensus within the ITP about the identifying signals and discussing implications. This was attributed to the conceptual and fictional nature of the scenarios and a workshop atmosphere of creating a dialogue for reflection. The ITP members, overall, were very engaged with the process, given the importance of the topic of exploration.

In conclusion, the ITP was asked to consider the scenarios overall, to surface a series of questions which would be taken forward for further analysis, in order to shape a policy report for the ITP (MBIE, 2023b).

A full description of each scenario with outcomes is described in the Table 2.

Table 2. Scenarios comparisons and workshop outputs.

| | Scenario 1: Robbie the Chef (Discipline) | Scenario 2: West World Holiday Park (Transformation) | Scenario 3: Weekend Only (Continuation) | Scenario 4: The Day We Ran Out of Chefs (Collapse) |
|-------------------------|---|---|--|---|
| Essence of the scenario | Robbie the Chef represents a world without human chefs, with production robots running the kitchen. This is a fully automated world and is an example of the dramatic rise of robotics, automation, the advancement of science and rapid changes in technology. It is also a world with a new leisure society. These changes addressed the massive labour shortages brought about because of an ageing population and competition between industry sectors. In the workshops we told the story of <i>Robbie the Chef</i> [®] , New Zealand's 3-star Michelin Chef. | <i>West World Holiday Park</i> is a popular tourist attraction which offers indulgent experiences delivered by advanced robots and avatars. The park was designed by Beta Workshops in Dunedin, a technology startup of Eastern European immigrants who came to New Zealand in 2020. In the workshops we told the story of Igor Sikorsky and New Zealand's thriving technology sector and how tourism became an automated and contactless industry. | <i>Weekends Only</i> is a scenario about tourism businesses' constant struggle for labour which results in a smaller but more professional industry. In the workshops we told the story of hospitality graduate Faizan Ali who moved to New Zealand in 2022 and subsequently started his own award-winning restaurant. | <i>The Day We Ran Out of Chefs</i> represents how the tourism and hospitality industry became unsustainable as it couldn't compete with other industries which offered better terms and conditions. In the workshops we told the story of a conversation between Catherine and Sheila. Catherine manages the Lodge in Milford Sound. The Lodge offers minimum service with no frills. Where possible, labour-saving technologies are used. Sheila is a visitor who recalls her experience of the Great Walk and how she used personal technologies to enhance her experience, that is, the Department of Conservation (DOC) Extended Reality apps. |
| Story | Dining out at Robotique New Zealand is a nation of technological innovation and advanced manufacturing. Two of the country's universities are ranked in the top ten by https://www.topuniversities.com/ . Science is cutting edge and the country is often described as the New Finland of the Southern Hemisphere. Professor Michael Zhang of Auckland University of Science (AUS) won the Nobel Prize for Technology and Science in 2035 with his pioneering robotic research on technological singularity. His research and its associated patents addressed many of the issues of the day relating to how to use robots in the service sector from hospitals to hotels. In a burgeoning economy, there simply aren't enough people to be nurses, | Beta Machines: The Future of AI Dunedin based technology company Beta Machines has raised US\$ 2.0bn as demand for humanoid robot experiences grows globally. The company will use the new funding to expand research in technology and science and establish a new manufacturing plant at Tiwai Point in Invercargill which services West World Parks in Queenstown and Auckland. The company recently won a contract to provide an Adventure Theme Park in Shanghai and California for the Disney Corporation and a Pleasure Resort for Marriott in Fiji. Beta Machines employs 400 scientists at Otago University Science Park and collaborates with other universities and research centres across the globe. | Faizan Ali's: Restaurant Entrepreneur Faizan Ali immigrated to New Zealand in 2022 at the age of 5. He is a refugee from Afghanistan whose family fled the country because of the Taliban. Faizan loves Afghan traditional food with a passion, such as Kabuli palaw, a meat dish with fried raisins, carrots and pistachios. His family have been in the restaurant business since arriving in New Zealand with their first family restaurant located in South Auckland. Since graduating with a Bachelor of Culinary Technology from AUT, Faizan now has four ethnic food restaurants across Auckland, all specialising in Silk Route food. His restaurants are award-winning, not just for food but for hospitality, management practices and sustainability. | Catherine and Sheila – The Milford Lodge Sheila: Tell me Catherine, what was tourism like in 2025? Catherine: Those were the days when we employed people, real people. Over the years it just became more difficult. We just couldn't attract the right people to work in remote locations. So, in the end we decided, 'to hell with this'. We needed to redesign the service delivery system. We hired this guy who used to work for Amazon and was a specialist in service design and labour scheduling. Fundamentally, we had to become capital rather than labour intensive. There basically wasn't any other choice. Sheila: What does this mean for the tourist who is staying at the lodge? Catherine: Just think about your stay. The |

(Continued)



Table 2. Continued.

| Scenario 1: Robbie the Chef (Discipline) | Scenario 2: West World Holiday Park (Transformation) | Scenario 3: Weekend Only (Continuation) | Scenario 4: The Day We Ran Out of Chefs (Collapse) |
|--|---|--|--|
| <p>cleaners and chefs. Investment in science and technology has led to the creation of <i>Robbie the Chef</i>, who is the head chef at the restaurant <i>Robotique</i>. The kitchen brigade are advanced robots whose culinary skills have resulted in New Zealand's first 3-star Michelin restaurant.</p> | <p>The new advanced manufacturing plant will be a state-of-the-art facility, drawing upon the latest patented techniques in stereolithography (SLA) 3D printing, synthetic skin manufacture, image recognition systems, robotic hydraulics, claytronics and other advances in artificial intelligence (AI). Beta Machines was founded in 2030 by Dr Igor Sikorsky who came to New Zealand from Bulgaria to study towards a PhD in AI. However, he fell in love with the country, its people and landscapes. In 2034, he won a Nobel Prize for Technology for his Beta Robot which, based upon a technological conversion platform allowing a multitude of technologies to come together, resulted in the most advanced humanoid robots in the world. His Beta Robot has many applications in the service economy from hospitals to restaurants.</p> | <p>However, over the last five years Faizan has noticed a lot of changes happening in the restaurant sector in Auckland. In particular, it is a constant issue to recruit professionally qualified staff. Many friends in the Restaurant Association have decided enough is enough. They were tired of the long hours, the pressure of managing a small business with minimal return, the aggravation of always trying to find staff, rising labour costs and heavy regulation. In addition, the retail and healthcare sector pay better. He decides to stay in the restaurant business. However, to do this he has to change his business model. No longer are his restaurants open 7 days a week. Two of his restaurants are just open Thursday to Sunday, as the focus is the leisure weekend customer. Faizan has had to adopt new management practises. Since TripAdvisor changed their review system to include employees' reviews, there is nowhere to hide as a bad employer. His company offers an apprentice scheme which has been successful in recruiting quality staff. The scheme allows aspiring over 55s to train as a chef on a part time basis. Faizan works closely with the local prison and college, offering a course in ethnic food to the prisoners. Some of the graduates now work for him in various roles. As labour is scarce, Faizan has had to adopt new technologies in the kitchen to alter the production process. Excellence in customer service is at the forefront of his approach and, given his background, a Manaakitanga (care for</p> | <p>hotel design is modular. Basically, it is containers fixed together. The ensuite toilet and bathrooms are self-cleaning using nano technology. The bed is a futon and duvet. Reception is staffed by Alison, a virtual assistant made by Soul Machines. All of our food is prepared using a cook chill operator in Queenstown who flies in all of our supplies by cargo drone. <i>Sheila</i>: What's your opinion of the tourism industry today? <i>Catherine</i>: What industry? There are a number of operators in iconic locations, such as us in Milford South. Others in Rotorua and Northland, etc, but they do the same as me. Minimalism is the new buzz word. <i>Catherine</i>: For your trip tomorrow on Milford Sound, we have booked you on the autonomous self-guided motorboat and submarine experience. The experience takes about three hours. Don't forget to download the app for the stories you want to hear. <i>Sheila</i>: What if I want any food? I remember the café in the harbour on my last visit. <i>Catherine</i>: The café closed ten years ago. Couldn't get a decent chef. We can provide you with a packed lunch. Use the app on your phone to order something.</p> |



| | | | |
|--|---|--|---|
| <p>Signals</p> <p>Experts envision three waves of automation. We are currently experiencing the first wave of automation: an algorithmic wave in which computational tasks are becoming automated, impacting data-driven sectors most strongly. The second wave of automation, an augmentation wave, is expected to last through the 2020s, transforming clerical support and decision-making. Automation is expected to take over more routinised physical labour, such as moving objects in warehouses (already, such machines are being deployed in some areas). The third wave, known as the autonomous wave, is predicted to last until the mid-2030s and will result in the automation of dynamic physical labour (Hawksworth et al., 2018).</p> <p>Miso Robotics (https://misorobotics.com/) makes autonomous kitchen assistants, which are currently being trialed by Chipotle (Wolfe, 2022) and set to be introduced in a California location in 2022.</p> <p>Boston Dynamics (https://www.bostondynamics.com/) produce the world's most advanced robots with mobility, dexterity and intelligence. Initially designed as rescue agents to recover injured soldiers from the battlefield, they are now considered the nearest to a human in the terms of manual and complex tasks (Paudel & Mross, 2022).</p> | <p>Countries that are successful adopters of technology tend to have the most favourable attitudes to technology in population surveys according to a New Zealand Productivity Commission (Heatley, 2020).</p> <p>According to research by the Foresight Factory (2022b), 59% of global consumers mention 'having unique experiences' as something they look for in a holiday.</p> <p>Westworld is an HBO TV series of technologically advanced android hosts in a themed amusement park. The park caters to high-paying guests who may indulge their wildest fantasies within the park without fear of retaliation from the hosts. The android hosts are prevented by their programming from harming humans. Westworld is considered an example of the potential for automation to disrupt one of the few services traditionally assumed to be impervious to automation: human interaction (Gurevitch, 2021).</p> <p>The advanced technologies associated with Westworld include stereolithography (SLA), lifelike robots, intelligent machines with speech recognition capabilities and image recognition, infinite knowledge, and the ability to improvise like humans founded on quantum computing (Lösel, 2018).</p> | <p>another's wellbeing) is very important to him. Faizan was one of the first restaurants in New Zealand to adopt Apple Glass. The technology allowed Faizan employees to anticipate customers' needs.</p> <p>45% of employees that work in the tourism sector are under the age of 34, whereas 7% are aged over 65%; 55% of employees in the tourism industry are female; and 20% of employees in the accommodation and food service sector identify themselves as <i>Māori</i> (Page, 2022a).</p> <p>Tourism employs 230,000 people at the height of the tourism season, averaging 200,000 over the year (Page, 2022b). The hourly wage is relatively low with over a third of the tourism workforce earning less than NZ\$500 a week since 2019 (Page, 2022b).</p> <p>Prior to COVID-19 and New Zealand border closure, working holiday visa holders made up nearly a quarter of the tourism's migrant workforce (Page, 2022b).</p> <p>According to Statistics New Zealand's (2022) median scenario of population growth in 2040, the population will have grown from 5,093,500 in 2020 to 5,950,300 – an extra 856,800 people, an increase of 16.8%. At the same time, the demographic cohort aged between 15 and 34 will grow from 1,414,300 to 1,467,000, an extra 52,700 people, an increase of 3.7%. For the 65 + age group, the cohort in 2020 is 792,500, which grows to 1,336,800, an extra 544,300 in 2040. An increase of 68.6%.</p> <p>What this represents is a combination of falling birth rates and an ageing population. The significance of this for</p> | <p>Productivity in New Zealand is similar to Greece and Mexico, rather than Finland and the Netherlands. New Zealanders tend to work longer hours for low outputs, meaning its productivity is one of the lowest in the OECD. In the accommodation and food service sector, productivity growth has been less than 1% between 2008 and 2020. The Productivity Commission for New Zealand recognises productivity growth will only come from technology and innovation (Commission, 2021)</p> <p>The New Zealand labour market is constraining businesses. Employment is at a record high and as a result, hiring more people is the hardest it has been on record. There is record demand for goods and services, but they can't be delivered because of a lack of labour and materials. There aren't enough people who aren't in a job and looking or available for work, and often there are mismatches in skills and location (Partners, 2022).</p> <p>According to the MBE's (2023a) employment outlook, 60% of chef graduates are no longer chefs or working in the hospitality sector five years after graduating.</p> <p>The global shortages of professionally qualified chefs have created a scarcity of labour. A very significant challenge for employers in the hospitality sector is the gap between their need for skills and the availability of employees who</p> |
|--|---|--|---|

(Continued)



Table 2. Continued.

| Scenario 1: Robbie the Chef (Discipline) | Scenario 2: West World Holiday Park (Transformation) | Scenario 3: Weekend Only (Continuation) | Scenario 4: The Day We Ran Out of Chefs (Collapse) |
|--|---|---|--|
| <p>The World Economic Forum's (2020) <i>Future of Jobs 2020</i> report found that by 2025, the average estimated time spent by humans and machines at work will be on par based on today's tasks. Further, 43% of businesses surveyed indicated that they will reduce their workforce because of technological integration.</p> <p>The risk will be unevenly spread across industries and skill levels. Low-skilled workers are at greater risk of losing their jobs to automation than high-skilled workers. A PwC report (Hawksworth & Audino, 2017) suggests that 44% of workers with a low education level will be replaced by automation by 2030, compared with only 11% of workers with graduate degrees.</p> <p>The Henn-na Hotel (https://www.h-n-h.jp/en) is a robotic hotel in Japan, but it has culled half its robotic workforce as many of the robots were not advanced enough to perform numerous tasks that humans could do and there were constant complaints from guests about technology issues (Shead, 2019)</p> <p>From a psychological perspective, the human relationship with robots is captured by the uncanny valley theory. Research suggests that a human appearance or behaviour can make an artificial figure seem more familiar but only up to a point. The sense of familiarity drops sharply into the uncanny valley once the artificial figure tries but fails to mimic a realistic human (Zhang et al., 2020).</p> | <p>the hospitality and tourism industry is that the vast majority of those employed in the tourism industry are aged between 15-34, but this cohort will be scarcer in the future. On the other hand, the 65+ age will be burgeoning.</p> <p>In a competitive labour market where scarcity is prevalent, tourism and hospitality businesses have to compete with construction, retail, healthcare and agriculture and other industries for semi-skilled labour which means many businesses are running at reduced capacity (Leaver, 2021).</p> <p>The restaurant industry in New Zealand is dominated by Small Medium Enterprises (SMEs) which are driven by entrepreneurs who relish creativity, enterprise and innovation as business start-ups (Omisakin & Adegoke, 2022).</p> <p>The scarcity of labour means hospitality operators are seeking employees that are socially disadvantaged and championing social enterprise (Crouth et al., 2021).</p> <p>Automation and machine learning can bring exponential benefits to your organisation, but this doesn't mean your workers have to lose out. AI can do tasks that free up human staff to focus on what they do best, like customer relationships – providing a real basis for your explicit 'human-powered' branding, which should buy consumer goodwill (Factory, 2022a).</p> <p>Expect growing admiration and imitation of the German system, where attending a technical college and working in trades are respected choices (Young, 2019).</p> | <p>possess those skills. The shortage is compounded by a number of factors including perception by young people of career pathways, high labour turnover, high levels of casualisation, cost of living, housing costs and dependency on migrant workers (Anand, 2022).</p> <p>Hospitality businesses are being forced to close due to the lack of chefs is a frequent newspaper headline (Te Ora, 2021).</p> <p>Hotels have traditionally relied on labour intensive operations. Adoption of technological innovations offers a path to new markets and reduced costs, for example, the move to automated self-service check-in, cook-chill kitchen operations or redesigning service functions (Mercan et al., 2020)</p> | |



| | | |
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| <p>With Apple about to launch a new augmented reality glass (Perry, 2020), similar to Google Glass (Cranmer et al., 2020), expect in the future food service operators being able to anticipate your thoughts and desire. For example, when this technology uses the Realeyes (https://www.realeyesit.com/) or Nordic Ninja (https://nordicninja.vc/portfolio/realeyes/) customer faces are scanned to determine their emotional engagement.</p> | <p>The future typical employee for tourism will not be 15–34 years old but 65+ given demographic trends. As such, structured pathways for apprenticeships will enable a part-time route for seniors to technical education degrees.</p> <p>In general, apprenticeships will be seen as an opportunity for 'home cooks' to learn more advanced skills. Novices will appreciate advice on basic culinary skills, while professional home cooks will jump at the chance to learn more advanced techniques, such as haute plating (Denni's Catering, 2016). In addition, A pathway from apprenticeship to degree should be established for high achievers.</p> <p>Social enterprises will attract and retain employees.</p> <p>If tourism and hospitality do not address the issue of scarcity of labour, any growth strategy will be constrained. There is a realisation that New Zealanders do not want to work in the industry given the competition for labour. So, a recruitment model should be based on focused immigration policies.</p> <p>As it becomes harder to recruit</p> | <p>Scarcity of labour will further result in the redesign of the service delivery system to minimise human contact.</p> <p>The industry will be a smaller but a more productive one through technology.</p> <p>Training and education of a tourism workforce will no longer be an issue as nobody will want to work in the industry.</p> |
| <p>We need a labour force that welcomes, is willing and can adopt and adapt to technological change.</p> <p>Innovation and technological entrepreneurship are driven through small-medium enterprises.</p> <p>Science, technology and advanced manufacturing needs to be an integral part of tourism.</p> <p>The development of a science and technology investment strategy is needed which asks 'what if' to develop high risk and innovative products and experiences for the industry.</p> <p>A science, technology, engineering and mathematics model of education and training creates a new workforce with tourism as one of the main beneficiaries.</p> <p>In this respect a tourism career is no longer about being a tour guide, a chef, or a room attendant but offers new career opportunities, such as AI Ethics Advisor, Avatar Relationship Manager, Human-Machine Engineer, Hotel Robotic Controller, Restaurant Vertical Farmer-Chef and Augmented Reality Journey Planner.</p> <p>Artificial Intelligence (AI) provides the ability to develop New Zealand tourism activity datasets to design more</p> | <p>We need a labour force that welcomes, is willing and can adopt and adapt to technological change.</p> <p>Innovation and technological entrepreneurship are driven through small-medium enterprises.</p> <p>Science, technology and advanced manufacturing needs to be an integral part of tourism.</p> <p>The development of a science and technology investment strategy is needed which asks 'what if' to develop high risk and innovative products and experiences for the industry.</p> <p>A science, technology, engineering and mathematics model of education and training creates a new workforce with tourism as one of the main beneficiaries.</p> <p>In this respect a tourism career is no longer about being a tour guide, a chef, or a room attendant but offers new career opportunities, such as AI Ethics Advisor, Avatar Relationship Manager, Human-Machine Engineer, Hotel Robotic Controller, Restaurant Vertical Farmer-Chef and Augmented Reality Journey Planner.</p> <p>Artificial Intelligence (AI) provides the ability to develop New Zealand tourism activity datasets to design more</p> | <p>Artificial Intelligence (AI) provides the ability to develop New Zealand tourism activity datasets to design more</p> |
| <p>A 'robot' co-worker in many contexts won't even be thought of as such, and the long-term benefits will be evident.</p> <p>The huge analytical capability of machine learning means that, deployed effectively, it will be able to innovate solutions to problems that humans thought impossible.</p> <p>The tourism, accommodation and food services sectors are manually intensive. Processes will benefit from AI's increased insights and contextual intelligence. Considerable profitability gains will be realised through labour productivity improvements alone.</p> <p>The issue of advanced robotics raises a series of ethical dilemmas and questions who is at fault if something goes wrong. Take the example of an autonomous taxi transporting tourists from the airport to the hotel and being involved in an accident? Who is accountable here and what is liability? If the future of work is automated, what infrastructure and investment is required for this scenario?</p> <p>This scenario highlights a massive change in the provision of tourism and hospitality education. We will no longer require culinary training for chefs. What</p> | <p>We need a labour force that welcomes, is willing and can adopt and adapt to technological change.</p> <p>Innovation and technological entrepreneurship are driven through small-medium enterprises.</p> <p>Science, technology and advanced manufacturing needs to be an integral part of tourism.</p> <p>The development of a science and technology investment strategy is needed which asks 'what if' to develop high risk and innovative products and experiences for the industry.</p> <p>A science, technology, engineering and mathematics model of education and training creates a new workforce with tourism as one of the main beneficiaries.</p> <p>In this respect a tourism career is no longer about being a tour guide, a chef, or a room attendant but offers new career opportunities, such as AI Ethics Advisor, Avatar Relationship Manager, Human-Machine Engineer, Hotel Robotic Controller, Restaurant Vertical Farmer-Chef and Augmented Reality Journey Planner.</p> <p>Artificial Intelligence (AI) provides the ability to develop New Zealand tourism activity datasets to design more</p> | <p>Artificial Intelligence (AI) provides the ability to develop New Zealand tourism activity datasets to design more</p> |

(Continued)



Table 2. Continued.

| Scenario 1: Robbie the Chef (Discipline) | Scenario 2: West World Holiday Park (Transformation) | Scenario 3: Weekend Only (Continuation) | Scenario 4: The Day We Ran Out of Chefs (Collapse) |
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| <p>we will need are highly educated software engineers</p> | <p>personalised visitor experiences. Advanced robotic AI systems or Personal Robotic Assistants are not expected to become mainstream for quite some time. Living with a robot will require a significant social license gained through other successful AI deployments before the average tourist will be comfortable with it.</p> | <p>professional and skilled personnel, the industry will have to become creative and reposition its attractiveness. It needs to be an advocate about local food, sustainability and communities. This can be achieved through storytelling and a new focus on value systems and social responsibility thus matching the values of consumers with the values of the industry, thereby highlighting its values as a reason for a career in the industry.</p> | |

The development of a conceptual framework: is technology a substitute for labour supply?

Figure 2 represents a conceptual framework driven by the ontological of each scenario and evidence presented in the scenario (Table 2). Ontology captures the fundamental philosophy of what is being studied, thus, at a high level it captures the essences and purpose of each scenario (Bergman et al., 2010). From a theory building perspective, it allows generalisation through reasoning of what has been observed in scenario planning intervention, which could be used in further studies as a theoretical and empirical framework (Pearce, 2012; Smith & Lee, 2010).

Mode 1: Replacement is derived from Scenario 1 *Robbie the Robot* which is shaped by technological singularity and population polarisation in which labour is scarce. Here, full scale labour replacement occurs as machines are so advanced. *Replacement* is derived from the scenario in the following way:

- *Robbie the Chef* represents a world without human chefs, with production robots running the kitchen.
- Massive labour shortages brought about because of an ageing population and competition between industry sectors.
- New Zealand is a nation of technological innovation and advanced manufacturing.
- The scenario represents the third autonomous wave, which is predicted to last until the mid-2030s and will result in the automation of dynamic physical labour (Hawksworth et al., 2018).
- This scenario highlights a massive change in the provision of tourism and hospitality education. We will no longer require culinary training for chefs. What we will need are highly educated software engineers.

Mode 2: Experiences is derived from Scenario 2: *West World Holiday Park* which is shaped by technological singularity and population co-existence. Here, because labour is optimal the mode focuses on the opportunity of technology through new experiences. The scenario discusses the application of technology creating new experiences and high-tech jobs. *Experiences* is derived from the scenario in the following way:

- *West World Holiday Park* is a popular tourist attraction which offers indulgent experiences delivered by advanced robots and avatars.
- In 2034, Dr Igor Sikorsky won a Nobel Prize for Technology for his Beta Robot which, based upon a technological conversion platform allowing a multitude of technologies to come together, resulted in the most advanced humanoid robots in the world. His Beta Robot has many applications in the service economy from hospitals to restaurants.
- The advanced technologies associated with Westworld include stereolithography (SLA), lifelike robots, intelligent machines with speech recognition capabilities and image recognition, infinite knowledge and the ability to improvise like humans founded on quantum computing (Lösel, 2018).
- Innovation and technological entrepreneurship are driven through small-medium enterprises.
- The development of a science and technology investment strategy is needed which asks 'what if' to develop high risk and innovative products and experiences for the industry.

Mode 3: Argumentation is derived from Scenario 3: *Weekend's Only* which is shaped by integration of technology and population co-existence. *Argumentation* focuses on technology to enhance labour through productivity gain. *Argumentation* is derived from the scenario in the following way:

- *Weekends Only* is a scenario about tourism businesses' constant struggle for labour which results in a smaller but more professional industry.

- Faizan has noticed a lot of changes happening in the restaurant sector in Auckland. In particular, it is a constant issue to recruit professionally qualified staff. Many friends in the Restaurant Association have decided enough is enough. They were tired of the long hours, the pressure of managing a small business with minimal return, the aggravation of always trying to find staff, rising labour costs and heavy regulation. In addition, the retail and healthcare sectors pay better.
- In a competitive labour market where scarcity is prevalent, tourism and hospitality businesses have to compete with construction, retail, healthcare and agriculture and other industries for semi-skilled labour which means many businesses are running at reduced capacity (Leaver, 2021)
- As it becomes harder to recruit professional and skilled personnel, the industry will have to become creative and reposition its attractiveness. It needs to be an advocate about local food, sustainability and communities. This can be achieved through storytelling and a new focus on value systems and social responsibility, thus, matching the values of consumers with the values of the industry, thereby highlighting its values as a reason for a career in the industry.

Mode 4: Redesign is derived from scenario 4, *The Day We Ran Out of Chefs'* which is shaped by population polarisation and AI-Interface. Due to severe labour shortages, the process of production of goods and services has to be redesigned to reduce costs. *Redesign* is derived from the scenario in the following way:

- *The Day We Ran Out of Chefs* represents how the tourism and hospitality industry became unsustainable as it couldn't compete with other industries which offered better terms and conditions.
- Quote from scenario: 'We just couldn't attract the right people to work in remote locations. So, in the end we decided, "to hell with this". We needed to redesign the service delivery system'.
- Productivity in New Zealand is similar to Greece and Mexico, rather than Finland and the Netherlands. New Zealanders tend to work longer hours for low outputs, meaning its productivity is one of the lowest in the OECD. In the accommodation and food service sector, productivity growth has been less than 1% between 2008 and 2020.
- According to the MBIE's employment outlook, 60% of chef graduates are no longer chefs or working in the hospitality sector five years after graduating.
- Training and education of a tourism workforce will no longer be an issue as nobody will want to work in the industry.

Overall, [Figure 2](#) summarises the outcomes of the scenario planning intervention. This conceptual framework is a means to discuss and formulate the future work based upon the interfaces between technology and labour supply. Given that the future of tourism will operate in a VUCA context (Baran & Woznyj, 2020), the value of the framework allows us to negotiate and make sense of the future. As James Dator (2014) claims, no one can predict the future but only ponder a series of futures, hence why we use the term futures studies, not future studies.

Concluding contributions

In the following sections we identify firstly, the contribution of the study to hospitality and tourism in New Zealand, secondly, the contribution to academia more generally through the development of a conceptual framework which summaries what the scenario planning intervention achieved.

Contribution to New Zealand tourism

New Zealand demographics are startling. Any growth in tourism is going to be constrained by issues of labour capacity. Ultimately, we will run out of young people under present population forecasts (Page, 2022a). The key issues that are raised in the scenarios included the need for innovation, higher productivity, increased use of technology and the impact of a changing demography. The ITP panel

was asked to consider the scenarios as a complete set, highlighting the key questions for further research and analysis. These questions were:

- Does New Zealand want technology as a substitute for real people or will we have no choice?
- What is the added value of a career in tourism beyond the traditional roles, such as chefs, tour guides or casual work?
- How can we use technology to improve productivity, without affecting the personal experience?
- At what point in the future does New Zealand's tourism industry become unsustainable, because of the scarcity of labour?
- Is the only valid alternative to encouraging New Zealanders to think about a career in tourism a policy of immigration?
- How do you communicate that tourism is the most entrepreneurial industry in New Zealand?
- New careers will be established as technology creates new experiences and products, thus, how do we communicate and educate New Zealanders about these opportunities?
- Technology has revolutionised gaming. What can it do for tourism?

These questions were then further developed by the MBIE (2023b) in the report *He Mahere Tiaki Kaimahi – draft Better Work Action Plan* as outcomes which was published as a consultation document.

From a practical perspective, the workshops and this paper should be viewed as a 'living or thinking document' that may be considered when thinking about the future of work in the tourism industry. The four scenarios have been discussed to demonstrate the importance of considering several outcomes to support preparedness for future changes and in designing anticipatory decision making and policy formulation. Thus, the real value of this paper demonstrate of how academic research can influence policy through stakeholder engagement as the key to scenario planning is not the outcomes but scenarios thinking (Wright & Cairns, 2011).

Contribution to academia

First, this paper acknowledges the importance of intertwining practice and theory, demonstrating how theory shapes practice and *visa versa* (Feldman & Orlikowski, 2011; Feldman & Worline, 2016). Hence, from the case study of the scenario planning intervention a conceptual framework has been developed to address the question '*Is Technology a Substitute for Labour Supply?*' Second, the paper highlights scenario planning as a theory builder and learning framework, when dealing with policy interventions and action research. This reinforces the value of scenario planning from a scenario thinking perspective (Wright & Cairns, 2011). Third, as no one can predict an exact future (Dator, 2019), the scenario 2 × 2 matrix and the conceptual framework highlight the importance of plurality in providing multiple perspective about the future and theoretical outcomes (see Figure 2).

Research limitations and further studies

The limitations of the paper include the following. First, under normal circumstances, scenario planning studies conclude that using in-person workshops rather than an online approach using MIRO (Biggs et al., 2010; Lyons et al., 2021; Postma et al., 2025; Raford, 2015) produces a richer dialogue and better group participation. Creativity and interaction is bounded by the complexity of using online platforms rather than open dialogue through in-person workshops. This was the case for this study as it occurred during COVID-19 restrictions. Second, there are many unknowns associated with technology futures, its acceptance and the point in the future when technological singularity (Callaghan et al., 2017) will be reached. Singularity is important, as this is the point in the future when no distinction can be made between what is in human and what is artificial. The

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| Mode 4: Redesign | Mode 1: Replacement |
| Better technologies permit existing goods or services to be produced at a lower cost, through redesigning the operational interface between human and service provider. | Labour-replacing applications of technology are those that allow jobs or tasks that were once carried out by people to be undertaken by machines, computers or other assets. |
| Mode 3: Argumentation | Mode 2: Experiences |
| Labour-augmenting applications of technology are those that directly boost the productivity of workers and, thus, increase the demand for labour that are able to use the new technology. | Technology creates new goods, experiences and services and, thus, demands new types of skills, opportunities and jobs. |

Figure 2. Modes of technological substitution for labour.

journey to singularity raises the issue of uncanny valley theory (Zhang et al., 2020), where humans reject artificial humanoid robotics as they are perceived as ugly and unworkable. This was the case with the Henn na Hotel, which had to abandon the idea of a 100% serviced robotic hotel as the robots broke down and humans found it a frustrating experience (Osawa et al., 2017; Reis et al., 2020; Wang et al., 2022). Third, this is a case study of New Zealand and it could be argued that a different case study location could produce different results, thus, challenging the generalisations of the conceptual framework (Figure 2).

To address the limitations of this paper, will require further studies, including a different country and in-person workshops. The conceptual framework (Figure 2) could be used to develop further scenarios and analysis, as they are an ontological foundation to test with different groups to provide different insights.

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