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Is the Internet of Things a helpful employee? An exploratory study of discourses of Canadian farmers

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ABSTRACT

The increasing global population and the growing demand for high-quality products have called for the modernization of agriculture. "Internet of Things" is one of the technologies that is predicted to offer many solutions. We conducted a discourse analysis of 19 interviews with farmers in Ontario, Canada, asking them to describe their experience of working with IoT and related technologies. One main discourse with two opposing tendencies was identified: farmers recognize their relationship with IoT and related technology and view technology as a kind of "employee", but some tend to emphasize (1) an optimistic view which is discourse of technology is a "Helpful Employee"; while others tend to emphasize (2) a pessimistic view which is a discourse of technology is an "Untrustworthy Employee". We examine these tendencies in the light of the literature on organizational behavior and identify potential outcomes of these beliefs. The results suggest that a farmer's style of approaching technology can be assessed on a similar scale as managers' view of their employees and provide a framework for further research.

1. Introduction

As agriculture and farming practices evolve from labour-intensive to technologically intense and data-driven agriculture, the role of the quickly advancing adoption of the Internet of Things (IoT) is becoming more important [1]. Digital tools connected to the Internet could help facilitate farming knowledge to advance sustainable agriculture [2]. Advocates of data-driven farming posit that information systems, and the data they generate, will enable farmers to adopt more sustainable farming practices and improve their competitiveness. As participants in farming increasingly recognize the value of connectivity and data analytics, the need to understand how farmers view IoT and its role in farming become more pertinent. Whilst there is a growing interest in how farmers view technology, there is a shortage of empirical studies on the developing discourse [3, 4, 1]. This deficiency is surprising because farmers' intentions are influenced by their perceptions of how technology is viewed. Studies demonstrate that farmers' perceptions of technology significantly influence their perceived usefulness, perceived ease of use and intention to use the technology [5]. Studies investigating farmer perceptions of IoT call for further research on narratives regarding trust in agricultural technology providers, perceived value, and adoption risk [4].

We aim to expand on these prior works to further establish the tensions and discourses around IoT and farming technology to respond to this call. Discourse analysis serves as the theoretical and methodological approach to understanding how farmers use IoT in

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their day-to-day farming practices. This approach is guided by the assumption that discourses enable and constrain an individual's interpretations and influence their experience and how they act in the real world [6, 7]. How individuals think, speak, and act has implications for practices and interactions within organizations [8]. Discourses then shape meaning systems and dominate how we define and organize ourselves and our social world [9]. Through discourses, people make sense of the world, which then generate particular experiences and practices [10, 11]. Examining the discourses of farmers allows us to view their reality in how they make sense of IoT, which is dependant on what they know and believe [6]. In understanding the farmer's point of view, we better understand the adoption influences of the discourse in structuring practices and influencing farmers' decisions [12]. If we do not understand these views, we risk misidentifying the problems and hindering efforts to remedy them [12]. Therefore, our study contributes to the literature by clarifying the landscape to align future works with farming discourses.

This paper aims to contribute to the discursive study of information systems (IS) to better understand the discourses around adopting IoT. Based on the analysis of 19 semi-structured interviews of farmers, this paper contributes to our understanding of IoT in several ways. In this paper we analyze how farmers view IoT, illustrate how the farmers' view of data and connectivity shape the extent to which IoT is framed as an employee, how their IoT discourses reflect existing farming practices, and how they reaffirm or challenge those practices. We offer a discursive perspective and framework of IoT in agriculture within which the subsequent contributions can be located and contextualized. To this end, this paper is structured as follows: first, we outline the theoretical framework and relevant literature. Second, we explain the methods for data collection and analysis. Third and fourth, we present and discuss our findings, limitations, and areas for future research. We conclude by documenting our contribution to IS literature.

2. Background and conceptual model

Digital agriculture has been described as a method of using "computer and communication technologies to increase profitability and sustainability in agriculture" [13]. Stemming from the concept of a digital world and precision agriculture, it highlights the information intensive nature of the agricultural production process [14]. This digitization refers to managing tasks on and off the farm that focus on collecting data using sensors, drones, machines, and satellites [13] and harnessing the data collected by these technologies to make decisions [15]. The digital transformation of farming includes cloud computing, big data, artificial intelligence, distributed ledger technology (including blockchain), Electronic Data Interchange (EDI), platforms, sensors, and the IoT. IoT objects manage and store data while interconnecting vast quantities of information. The IoT ecosystem's interconnectedness has the potential to change every aspect of farming.

The literature recognizes the global utilization of IoT has the potential to convert skill-based agriculture into technology- and knowledge-driven digital agriculture [16]. IoT has the potential to combine different devices from various vendors to independently interact in a single integrated platform [17]. IoT has multiple definitions, including "a global infrastructure for the Information Society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies" [18]. Other definitions have centred around the things connected in the IoT, the Internet-related facets of the IoT (Internet protocols and network technology), and the semantic issues in the IoT regarding the storage, search, and organization of large volumes of information [19]. These definitions indicate that IoT may serve as a platform to be configured for collaboration and innovation by users.

The users' role in utilizing the potentials of an innovation is often defined as passive [20]. This is problematic because innovations often compete against incumbent practices, which means diffusion depends on users playing a part in adaptation, reconfiguration, and intermediation [21]. Therefore, exploring the roles of users in innovation and diffusion is a key research priority [22]. The literature on the adoption of innovations provides useful insights into factors that impact users decision to adopt [23]. As individuals use digital technologies for learning, socializing, and performance improvements, adopting these tools is motivated by characteristics such as cost, familiarity, and immediacy [24]. In addition, the users' decision to adopt is dependent on the perceived characteristics of the innovation and the degree to which technology performance produces perceptions consistent with prior beliefs [25]. For example, the expectation-confirmation theory [26] posits that users satisfaction with technology is dependant on expectations, perceived performance, and disconfirmation of beliefs. In the context of the diffusion of IoT in farming and how farmers utilize the potential of this technology for collaboration and innovation, it is important to understand the psychological and behavioural perception of farmers after their use of IoT platforms.

Discourse analysis provides the theoretical and methodological approach to understand how farmers use IoT in their day-to-day farming practice and to understand the concerns surrounding farming and IoT. Discourse refers to a relatively coherent system of meanings that are constructed through language use [27]. We thus focus on the analysis of the ordinary use of linguistic terms by farmers in the interviews in the context of IoT use in agriculture. We adopt a view of discourse as socially constructive as well as socially conditioned [28]. In other words, we explore the discourses that bring IoT use discursively into being [29]. Through uncovering how farmers perceive IoT, this discourse analysis reveals the normalized and dynamic assumptions that influence behaviour. Discourse analysis challenges the fundamental framing of ideas and the entire social system to improve progress in the 'problem' of adoption [30]. By recognizing the discourses present, we can better understand how farmers, specifically and users in general, approach the potentials of technology.

Rural studies have accepted discourse analysis to understand the social relations present in rural settings [31]. Studies documenting IoT in agriculture also focused on technology-driven issues. Technology-focused issues included availability, reliability, data mobility, scalability, and data privacy [32]. In addition, studies have reviewed farmers' perceptions, including finding that there was a positive perception towards mobile phone use and that many preferred to obtain agricultural information and logistics [33]. However, despite these positive perceptions, farmers face challenges around IoT acceptance due to uncertainty regarding costs, affordability [34], and trust concerning perceived risk [4].

Previous studies of discourse analysis regarding agricultural power have shown how the dominant discourses do not reflect gender equality, describing women as spouses, homemakers, and farmhands [35]. The discourses regarding masculinity in agriculture reflect a myth that agricultural labour needs men's strength and skills [31]. Recent studies in this area show the discourse has altered to show more detraditionalization and diversity, documenting that although men are predominantly the principal operators in farming, women were not described merely as helpers [36]. Other studies of discourse analysis that are prominent in the area include reviewing regulations impacting farmers [37], adult agricultural education to understand the impact of tensions between industrialized and alternative agri-food discourses [38]. Other studies of information technology in farming identify workplace culture, gendered interactions, and communications as critical factors regarding interactions with technology [39]. However, little research has explored the relationships between farmers' discourses and agricultural technology (exceptions include research by Fleming and colleagues' [30]). As technology contains assumptions of how people work and think, more practical information is necessary to understand how farmers collaboratively solve these issues and the social organizations that support or constrain their ambitions [39].

3. Material and methods

This study is explorative and contextual as it aims to investigate participants discourses of IoT. Our research adheres to a naturistic approach led by a social construction approach to focus on how participants perceive and interpret their experiences [28]. Our view is that participants construct their realities based on these experiences. Discourse analysis is therefore used to understand the farmer's versions of reality through an examination of language. Discourse analysis can expose how language reflects perceptions. This study analyses the interview data by applying Cukier and colleagues' [40] empirical method to identify aspects of IoT that farmers felt carried significant meaning or value. This method aims to operationalize discourse analysis for information technology [40], and we apply this method to further expand on the discourses regarding IoT. This approach has a specific focus on identifying statements involving the advantages and disadvantages of IoT, unique language or terminology, and terms, metaphors, and adjectives used to describe activities [40].

3.1. Interviews

From November 2019 to November 2020, we interviewed 19 Canadian farmers to discover their experiences and views of IoT in agriculture. These farmers were from various farming sectors, including cash crop, tender fruit, dairy, beef, swine, poultry, and sheep (Table 1). This scope allowed data to be collected from a wide range of related farming sectors. For discourse analysis (being socially constructed) to reach saturation, it was important to ensure sectors were related. These were sourced from referrals from government experts and other farmers. Interviews lasted between 29 min to 3 h 39 min in duration. One interview was conducted face-to-face in February 2020, and the other eighteen were completed via the telephone. The interviews contained open-ended questions regarding the participants' experiences with farm life, collaboration with partners, and perceptions of technology. The interviews were semi-structured to have flexibility in probing.

Samples of semi-structured interview questions included:

- Can you please tell me about your organization/farm?
- Can you please tell me about your role in the organization?
- Can you please tell me about your experiences working with IoT and IoT providers?

Table 1
Research participants.

Code	Farmer domain	Interview length
#1	Dairy and cash crop	53 min
#2	Tender fruit	2 h 40 min
#3	Cash crop and poultry	58 min
#4	Tender fruit	47 min
#5	Cash crop and swine	29 min
#6	Bison	58 min
#7	Dairy and cash crop	45 min
#8	Tender fruit	36 min
#9	Sheep	46 min
#10	Dairy and cash crop	1 hour 7 min
#11	Cash crop	1 h
#12	Cash crop and poultry	1 hour and 6 min
#13	Cash crop and poultry	1 hour and 6 min
#14	Cash crop and poultry	1 hour and 6 min
#15	Bison	57 min
#16	Cash crop and poultry	1 hour and 21 min
#17	Sheep and poultry	1 hour and 52 min
#18	Sheep and poultry	3 h and 39 min
#19	Cash crop	1 hour and 23 min

- Why did you decide to work with these IoT providers?
- What are your general feelings about technology on farms?
- What are the general trends you see around the Internet of Things?
- Is data privacy a concern? Or data ownership?

3.2. Analysis

The interviews were digitally recorded and transcribed. The interview data was grouped into a hierarchical structure of themes and sub-themes through multiple rounds of coding (Table 2). Data were analyzed through Cukier and colleagues' [40] empirical method in the IS discipline founded on the principles of Habermasian discourse analysis. Habermasian discourse analysis aims to detect taken-for-granted assumptions in a research domain to broaden the domain's perspectives [41]. Habermasian's call for empirical research is utilized through Cukier and colleagues' four-step method [40]. We use these steps to guide our analysis.

Step 1 – Defining the corpus to be analyzed

The first step is to identify the necessary materials to explain the context and immediate communicative exchange [40]. We conducted a review of the academic and grey literature based on a specific set of criteria that demonstrated a need for continued study [41]. These articles aided in the creation of questions for the farmers considered subject matter experts. Once transcribed, the interview data consisted of 434 pages. These multiple data sources allowed for a wide range of evidence.

Step 2 – Content analysis and coding procedure

Next, a content analysis was conducted on the articles to identify the empirical claims and determine the frequency of specific arguments [40]. This stage also uncovered the rhetorical repetition of opinions that many accept as facts [40]. We followed a two-step procedure. In the first cycle of coding, we applied content analysis, descriptive coding, and in vivo coding. Descriptive coding assigns words or phases to summarize passages for categorizing qualitative data, and in vivo coding uses stages from the participants own language as code. As our focus is on the discourses surrounding IoT technology, we examined the perceived value and determinants. Even though interviewees used different terminology to highlight elements of discourses, we were looking for elements in the statements that were compatible within specific equivalent systems of meaning. Echoing Cukier and colleagues' [40], our data was coded twice for (1) *Statements involving the advantages and disadvantages of IoT*, (2) *Unique language or terminology,* and (3) *Terms, metaphors, and adjectives used to describe activities.*

We used NVivo12 to assist in coding the participant's language. In this stage of the first cycle coding, we reviewed the interviews and tagged the passages relating to the three categories mentioned above with a general description. Fig. 1 below shows an example of the tags used to summarize participants' statements. The vertical bars "data ownership and misuse" and "measurement for better decisions" dictate the sections in which that code is being discussed. These are two examples of descriptive coding as these phases were assigned to summarize passages for categorizing the qualitative data. Fig. 2 shows a quote that was tagged as the code "frustration". This statement is an example of in vivo coding as the phrase "frustration" was used from the participants own language as code. Table 2 displays all the first cycle codes.

Step 3 – Reading and interpreting the empirical observations

After these statements are identified, the meaning of the text and the implications are explored. In the second cycle of coding, pattern coding was applied to reconcile emerging trends from the data. Pattern codes summarize the codes in cycle one into meaningful themes and constructs [42]. The number of times the terms appear do not provide insight into the meaning of the texts, but it does show which themes dominate the discourse [40]. Steps 2 and 3 undergo an iterative process. For example, Fig. 3 shows the codes "time savings" and "labour savings". When compared, there was an underlying theme of efficiency. Therefore, the second level code was named "efficiency".

In the second cycle of coding, the codes found in cycle one were re-examined and grouped into the optimistic themes of decision making (which comprised of measurement for better decisions, no going back, information exchange, and remote monitoring), efficiency (which comprised of let the computer do it, more efficient, tech is another employee, time savings and labour savings), gaining momentum (which included increasingly available to farmers, out of interest, technology is future growth, and not a target), and social good (which included animal welfare and environmental impact). Additionally, the codes in the first cycle of coding were also grouped

Table 2
First cycle codes.

Animal wellbeing	Remote monitoring
Environmental impact	Tech is another employee
Increasingly available to farmers	Technology is future growth
Information exchange	Time savings
Labour savings	Data ownership and misuse
Let the computer do it	Don't share everything
Measurement for better decisions	Expensive
More efficient	Fear of data loss
No going back	Frustration
Not a target	Internet connection
Out of interest	Mistrust
Not normal to them	

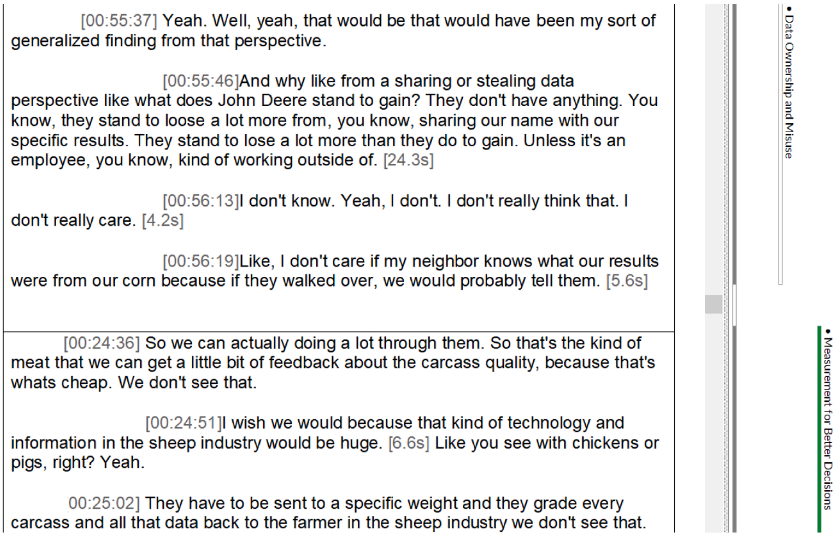

Fig. 1. Example of descriptive first cycle coding using NVivo 12 12 to show the codes "Data Ownership and Misuse" and "Measurement for Better Decisions" with associated quotes.

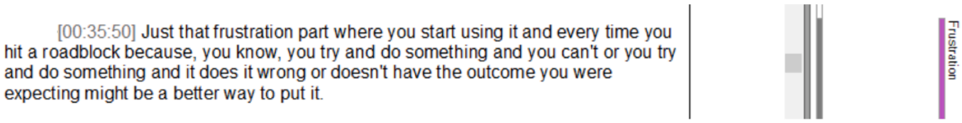

Fig. 2. Example of in vivo first cycle coding for "Frustration" using NVivo 12 with associated quote.

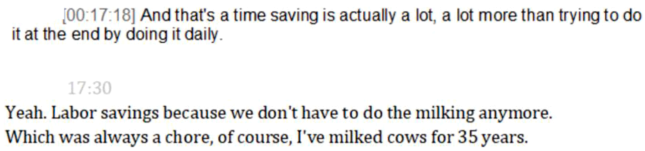

Fig. 3. Examples of second cycle coding grouping quotes of different farmers using NVivo 12.

into the pessimistic themes of lifestyle changes (which included not normal to them, frustration, internet connection, and expensive) and fears (which included don't share everything, fear of data loss, mistrust, and data ownership and misuse). These groupings are shown in Table 3.

Step 4 – Explaining the findings

The findings are explained by drawing on the broader context. They are described in detail below.

4. Results

The farmers we interviewed expressed widespread agreement about the impact of implementing IoT. Despite concerns and reluctance of participants, there was agreement that IoT and related technology is changing farming. For example one farmer stated,"There is so much information. You can get so much without even having to go out in the orchard and take a look at things, you can get it right from your chair! … There's no way we could go back, you know? We are really dependent on it." As Table 3 demonstrates, our first-level analysis identified several subjectively interpreted elements of outcomes of implementing IoT by farmers. The second level analysis explored how these discrete themes were articulated within broader discourses of advantages or concerns related to using IoT, and in what ways they served to enable or hinder the adoption of technology. On closer inspection, in the third level of analysis, these different signifiers supported one key discourse referencing IoT as a kind of employee along two opposing dimensions that we labelled "Optimistic" and "Pessimistic" views.

4.1. Language - Technology is a helpful employee

Regarding language and descriptions, IoT is a helpful employee discourse likened the technology to another employee. This meta-

Table 3
Coding hierarchy.

Optimistic discourse in pattern codes	
Second cycle code	First cycle code
Decision making	Measurement for better decisions
	No going back
	Information exchange
	Remote monitoring
Efficiency	Let the computer do it
	More efficient
	Tech is another employee
	Time savings
	Labour savings
Gaining momentum	Increasingly available to farmers
	Out of interest
	Technology is future growth
	Not a target
Social good	Animal wellbeing
	Environmental impact
Pessimistic discourse in pattern codes	
Second cycle code	First cycle code
Lifestyle changes	Not normal to them
	Frustration
	Internet connection
	Expensive
Fears	Don't share everything
	Fear of data loss
	Mistrust
	Data ownership and misuse

talk about technology's role was typical in farmers describing their interactions depicting technology as a solution to the tensions of modern farming. The participant's comment below highlights that technology can be viewed as a dependable employee. Additionally, other farmers frequently cited that the technology itself can "help us" and as something with which they have a long-term relationship. This statement further personifies the technology as a worker that is helpful and efficient. These views were expressed through many examples, including times that technology successfully saved the farmers' time.

"And there's data floating around everywhere. And in order these days, to be successful in farming, you have to sort of have a certain size and in order to manage that size with fewer people working on the farm. **Technology is like almost a second, another employee**."

In the following section, we focus our presentation on the tensions farmers experience along this continuum. This analysis reflects how farmers view the role of technology and the experiences that shaped this position.

4.2. Optimistic - Technology is a helpful employee

The "Optimistic" role comprises the themes reflecting support that IoT offers decision-making, efficiency, gaining momentum, and social good. This position promoted the broader discourse of technology contributing to the success of their farming business. In addition, there was an emphasis placed on the possibility of a long-term relationship with IoT, both the present and future benefits, with users citing it as a valuable and vital resource. Below are the statements from farmers describing how they view the advantages of IoT.

4.2.1. Advantage - decision making

The decision-making discourse emphasized the short- and long-term benefits of IoT's impact on their decision-making abilities. They discussed how the increased amount of data allows them not to "guess" and that if the data is not used currently, it will be valuable in the future. Show below, farmers with experience with this technology could not imagine living without it.

> **"**I don't know how I would. I can't even imagine trying to do what I do without it because I wouldn't have the data and I wouldn't be making the decisions that I am making… They would be guesses, most likely wrong guesses."

4.2.2. Advantage – efficiency

The efficiency discourse described how this technology supported farmers to make their businesses more efficient. This discourse highlighted a desire to continue to implement this technology. As shown below, this drive for increased efficiency was often compared to past procedures.

> "So it would do a little things like that. Like, you start doing those little things to update just everyday chores and then it just kind of builds from there. Because anything you can do to make it easier, it's better. Right. And I don't think the generations

before us, they were just there's always work, work, work. For me, if I can implement any kind of technology that's going to make my job take half as long, I can spend that time doing more important things. And it's more efficient."

4.2.3. Advantage - gaining momentum

The gaining momentum discourse viewed IoT as an emerging technology that was gaining momentum in the farming industry. These participants acknowledged that the future of farming is embedded in technology and that the current climate displays these alterations.

> **"**So, precision agriculture is actually extremely high tech. And it's quite new from a farming perspective, I mean, it's been around for a few years. But I think it's becoming really available now to the farmers."

4.2.4. Advantage - social good

In the social good discourse, the farmers described pride for being "responsible farmers", and how the wellbeing of their livestock directly impacts them. IoT was viewed as a benefit for the environment, animals, and the farmer.

> **"**So the cows are milked by what is called a voluntary milk system or robotic milkers. So they get milked whenever they feel like it. You don't tell them when they have to get milked. They just go there when they think its time to get milked. This is really nice for the cows… Nobody chases them around or forces them to do anything its all their choice. So they can sleep on the compost bag… Happy cows make a happy farmer."

4.3. Pessimistic - Technology is an untrustworthy employee

The "Pessimistic" view of IoT, comprised of lifestyle changes and fears, discouraged the broader acceptance of this technology. There was an emphasis placed on the unknown future challenges and the inability to trust the technology.

4.3.1. Disadvantage - fears

As cited in the following account, the fears discourse references experience where they have lost their information in the past and now feel the need to keep physical copies of the information. This meta-talk expresses the fears behind relying fully on technology due to the disastrous effects of information loss. This view can be likened to an untrustworthy employee, where the manager must keep a close eye on their work. Other farmers expressed their concerns about the technology recording the data too well and potentially getting them into legal trouble.

"Technology is scary when it loses information. I've seen that. And I've seen that happen, right? So when you lose all your information, you are sitting there thinking `why didn't I write it down? **Right, like even when we do a spray, I write down, I've written it out on paper, and I've handed that physical piece of paper** to myself or the operator."

The view that data recorded by the technology could potentially harm the farmer reflects that farmers do not trust that their data stays in their hands, as the recorded human mistakes could become accessible from the system and tarnish their reputation. This lack of safety is shown below.

"So that mistake happens. So how do you record that mistake? Do you put it in? Do you put it in where it is going to get reported? Or do you put it in your little notebook off to the side saying, Okay, I'm not 100% sure what I did with this tank… But if you recorded that it that it's going to look really bad to somebody who doesn't realize what the action was all about so that is where I take everything **when we do data collection and we start putting it into programs it gets scary for everybody**."

4.3.2. Competing descriptive terms – "It's nice, until"

While the discourse tended towards either optimistic or pessimistic observations regarding IoT, it contained both views. The discourse referenced farmers' thinking highly of IoT, but negative adjectives emerged when directed to speak on their experiences. Participants expressed distress when discussing the periodic failures of the technology and the lack of autonomy in not fixing the problems themselves.

4.3.3. Language - lifestyle changes

The lifestyle changes discourse described the farmers' experience of their lifestyle. It described the IoT positively, but at the same time, as "trouble". This pessimistic language to complement the description of positive experiences reveals an overarching struggle regarding IoT that even those who profit daily from IoT have their prolonging negative experiences.

> "We're actually not even allowed to go in and try to diagnose through the computers of what's going on, we have to call in and try to get help remotely. So that's been a really big issue lately… we don't know what to do… So we call them and then they have to call the (Company) and try to go through with them so it's, it's really painful."

> "At its core, I'm completely annoyed that cloud computing from the rural perspective. Its actually a deterrent. My software used to be connected to the Internet. You got to fix that problem for me. That was my feedback to the industry."

5. Discussion

This study aimed to explore and contextualize participants discourses of IoT. To this end, we conducted and analyzed 19 semi-structured interviews of Canadian farmers. By applying Cukier and colleagues' four-step method [40] for coding, we noted that farmers we interviewed expressed widespread agreement about the impact of implementing IoT. Despite concerns and reluctance of participants, there was agreement that IoT and related technology is changing farming and that they have a long-term relationship with this technology. They explicitly used words such as "employee" (in contrast to "worker") to describe this relationship. In their day-to-day practice of farming, farmers tend to have both optimistic and pessimistic views towards the technology, but one view is often dominant. We noted that the ways these views were discussed differ, with optimistic viewpoints concerning the consequences as decision making, efficiency, gaining momentum, and social good. These consequences were present in the farmers' examples describing how this technology supported them and altered their business and quality of life, from allowing their job to be less manual to bettering their long-term decisions. The pessimistic viewpoints discussed the consequences of major lifestyle changes and fears. The examples of these pessimistic views were prevalent when discussing frustrations using the technology and the lack of trust in the performance and security of the data. Fig. 4 presents these results.

As farming evolves from traditional intuitive and labor-intensive to automated and evidence-based decision-making, the role of IoT to gather, distribute, and analyze data becomes more critical. Our results demonstrate how farmers' beliefs impact their approach to utilizing the technology in their farming business. This finding is novel and contributes to studies that examine how information technologies are framed as useful within management practices [43]. While the study of human perceptions in attributing human-like qualities toward computing technology has been termed one of the most common metaphors in computing discourse, our findings suggest how farmers view their technology "employee" impacts their behaviors and reflect their personal beliefs about how much control they should exert over this technology. Specifically, our results expand on Agarwal and Karahanna's [44] statement that deep involvement with software is in part exhibited in the user's perception of being in control of the interaction.

The results suggest that farmers in their day-to-day practice of farming approach technology either with an optimistic or pessimistic view. In other words, they adopt a managerial style consistent with their views when dealing with IoT and related technology. There is a similarity here with how managers approach their human employees based on their view of them. McGregor's Theory X and Theory Y of human work motivation have been considered one of the most influential theories in organizational behavior [45], with his work proposing three main ideas. The first is that managers possess a theory of human work motivation and that managerial practices reflect the managers' assumptions of people [46]. Second, there are two different assumptions of human behavior categorized as a pessimistic Theory X mindset or an optimistic Theory Y mindset [47]. Theory X assumes that workers are lazy and aim to avoid work, are irresponsible, need to be closely monitored, and have little to contribute to the organization's success [46].

On the other hand, theory Y assumes that workers can find work enjoyable and fulfilling, are capable of self-direction and self-control, and make intellectual contributions to the organization [46]. Third, that the managers' expectations of their employees are self-fulfilling [45]. When managers fail to achieve their desired results, they tend to blame the employee instead of blaming inappropriate control methods [47]. Thus, a Theory X manager would perceive their workers to have little interest or motivation in their work and further decrease their employee's motivation through these complaints [46]. A Theory Y manager would perceive their workers to take pride in their work and trust their employees to perform effectively by themselves.

The data indicates that a similar practice is occurring here, with the discourse emphasizing both a pessimistic viewpoint like Theory X and an optimistic mindset like Theory Y. For example, as shown in the pessimistic fear discourse, farmers with such a mindset showed to be less inclined to trust the technology to keep a record of their mistakes. These farmers described their needs to exhibit a higher need for control and assumed that technology could not be trusted and needed to be closely monitored [46].

In contrast, as shown in the optimistic discourses, farmers with an optimistic view perceived their technology "employee" as useful and self-sustaining. As displayed in the decision making and efficiency discourses, farmers with this view described exhibiting a lower need for control and relying more on technology to complete their tasks. Throughout the optimistic discourses, farmers expressed that technology is capable of taking over some of their tasks and control and that technology can make contributions to their business [46].

Our results suggest that even when a farm is construed as having adopted IoT, it is still possible that the farmer will try to avoid it and limit its potential. As a result, they may continue their day-to-day practices without getting the full potential of the available

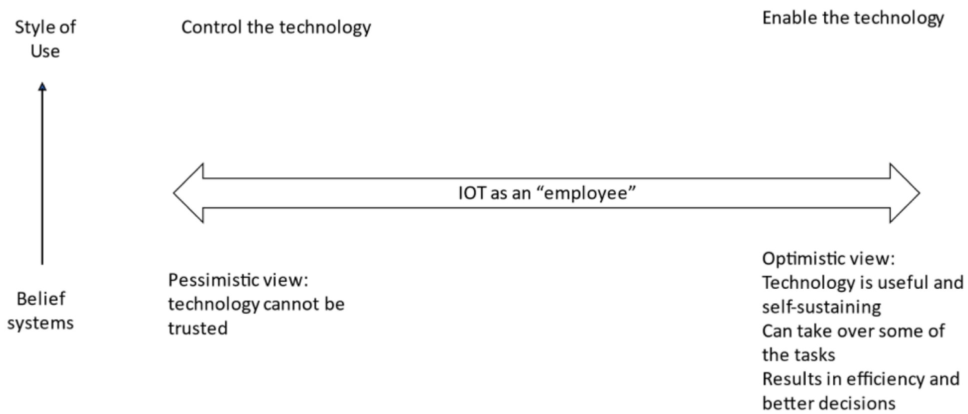

Fig. 4. The impact of IoT viewpoints on style of use of technology.

technology. This view can create a gap in the use of available resources and negatively impact the farm's performance.

Building on this insight, our study calls to further expand on these perceptions through additional studies and examine the impact of these tendencies. As artificial intelligence is being integrated in the IoT platforms and systems become more and more autonomous [48], understanding users' perception of their relationship with technology and what style they use to approach this technology becomes more important. There is a longstanding need to conceptualize technology users on a continuum with various styles of approaching technology that can shift over time [49]. The term *continuums of technology* have been applied to demonstrate the participant's experiences using and not using technology [50]. Traditional continuums of technology segment their participants from laggards to innovators [51]. Our results provide a framework for further studies that categorize how uses adopt specific styles for using and managing technology.

5.1. Implications for policy and practitioners

Validated assessments in the organizational behavior literature have been created to measure a manager's position on a scale to assess Theory X and Theory Y attitudes towards employees, provoking introspection of a manager's assumptions [45]. A scale can provide opportunities for personal use through self-reflection and industry use through training and policy development. For introspection purposes, utilizing the scale with technology as the employee could help farmers question their tech assumptions [45]. Farmers could gain a better understanding of their level of trust and need for control. If a scale is developed in the industry, it can be used for training purposes to help farmers understand why they view technology in certain ways. The results of this study would provide a model for developing assessments that are useful for organizational development and intervention [45].

6. Conclusion

The discourse analysis revealed one main discourse along a continuum of two opposing dimensions to display how farmers perceive IoT in Canada - (1) Internet of Things technology is an optimistic force which is a helpful employee - Technology is a Helpful Employee— and conversely, (2) Internet of Things technology is an unpredictable employee—Technology is an Untrustworthy Employee. We suggest that these perceptions can be classified with organizational behavior theory to further identify these optimistic and pessimistic discourses. As IoT continues to expand through agriculture, these discourses must be recognized for the IoT development industry to make suitable changes to technology to meet the demand of various styles of approaching IoT by farmers.

Aspects of our research limit the transferability of our discoveries. First, this study examined farmers from a variety of fields. While the fields were related, and interviewing farmers in multiple farming fields was used to see overarching themes, we recognize that certain fields are further in adopting technology. More research is needed with a focus on specific fields. Second, most of these farmers operated in Ontario, which is known for its agriculture and related technologies. More research is needed with participants from other locations where agriculture is less developed. Options for future research include a survey of farmers to develop a better classification of their views of IoT and related technologies, a longitudinal study where participants can be re-assessed in the future to understand if the discourses alter over time, examining other outcomes of these optimistic and pessimistic behaviours, and considering participants from other industries outside of farming, and different technologies.

Declarations

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Declaration of Competing Interest

None.

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