Commercializing University Innovations

Commercializing University Innovations: A Sense-Making Perspective to Communicate Between Academics and Industry

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Abstract—Technology transfer offices (TTOs) play a key role in helping universities commercialize research and distribute knowledge. Nonetheless, there remains an incomplete understanding of the communication, which takes place between academics, industry partners, and TTO staff. The aim of this article is to examine, with the use of sense-making theory, strategies used by TTO employees as they work with academics and industry partners to commercialize intellectual property. In order to achieve this aim, an ethnographic exploratory case study was undertaken at a university TTO. The collected information then became the basis for qualitative interviews with TTO staff from 13 universities in Scotland. The study contributes to the sense-making theory by explaining how, during the commercialization conversations, TTO employees can deliberately interrupt the sense-making process through "dumbing down." Our research introduces the TTO employee as a mediator and examines the role of the TTO staff in facilitating the sense-making process. The findings illustrate how someone who is not an expert in the field can add to the sense-making process. The study suggests that TTO employees intentionally engage in a "dumbing down process" to make complicated conversations easy to understand.

Index Terms—Collaborations in technology management, communication, knowledge management, management of intellectual capital, technology commercialization, technology transfer.

I. INTRODUCTION

ALONGSIDE teaching and research, commercialization of technology is a key priority for contemporary universities [1], [2]. Funding arrangements with private and public bodies allow universities to cultivate and harvest research outcomes, reinvest into research and development (R&D) structures and propel regional and national innovation [3]. Commercialization of technology is also a key priority for many national and local governments [4], [5] with government agencies providing support and significant amount of funding for universities [6]. Universities implement strategic changes and investments to become more entrepreneurial [7]. One of the common practices is to form technology transfer offices (TTOs) to promote and facilitate the commercialization of academic research [8]. TTOs are a relatively new phenomenon. While over the last two decades there have been a growing number of papers dedicated to TTOs and the wider process of technology transfer, there remains a "paucity of knowledge on research commercialization" [9].

TTOs are seen by academic scholars as dual agents [10], acting as an intermediary between university staff members and industry and generating a wealth of commercial knowledge in order to build and increase the reputation of the university [11]. The role of the TTOs and their staff members is typically to act as the commercialization center for all university-based projects. This includes governmental funding, research output (such as publications), licensing, patenting, and the creation of spin-out companies. Therefore, because of their job role, TTOs and their employees are in constant contact with both academics and industry partners. Furthermore, because of the complex nature of the university technology transfer environment and the considerable number of people TTO employees need to communicate with on a regular basis, a rather unique opportunity is provided to research how TTO employees communicate with different groups.

The literature has examined the following.
1) What role TTOs play in the commercialization process [9].
2) What are the mission statements of TTOs [12].
3) TTO business models [13].

Relevant studies have summarized the literature on TTOs [14]. However, there remains a theoretical and empirical gap in our understanding of the communication between academics and industry partners. To help address this omission, the article presents a study of how employees in TTOs can help facilitate the communication between these individuals, thereby fostering mutual understanding and leading to a successful commercial output. Specifically, the aim of the study was to explore, with the use of sense-making theory, the field of technology transfer and to examine the strategies that TTOs use to communicate between academics and industrial partners.

The results of the investigation show that TTO staff members may not know answers to all questions, especially those related to technical details of a particular technology. However, they do have experience in regulating and catalyzing the form and pace of communication between parties involved, in order to help them reach mutual understanding. The article expands our knowledge in the context of technology transfer by identifying and explaining how during the commercialization conversations TTO employees can deliberately interrupt the sense-making process through "dumbing down." We define dumbing down as a way to make complicated communication or information easier to understand. This is carried out by mediators as part of the sense-making process. In the context of this article, it is usually performed by TTO employees who will structure the conversation in such a way that actors will not move forward in the commercialization process until everyone in the group has a mutual understanding of the communication. The practice of dumbing down broadens the sense-making framework introduced by Weick *et al.* [15] by introducing an example of a strategy where a party temporarily breaks down (disrupts) sense-making in order to produce a simplistic meaning that all involved parties can understand (dumbing down). This deliberate practice, identified in our research, usually occurs after the initial "noticing and bracketing" [15]. The article also extends our understanding of mediated sense-making developed by Strike and Rerup [16]. Strike and Rerup [16] explain how mediators by regulating and catalyzing particular cues change the pace at which meaning is created. Our article identifies a specific strategy that can be used by mediators (here TTO employees) facilitating a communication between main different parties (here academics and industry partners).

The rest of the article is organized as follows. Section II provides the background about TTOs and technology transfer environment in Scotland, where this study was based. Section III then introduces the theoretical framework of sense-making and mediated sense-making. Section IV introduces the research methods and explains the two-phase structure of the data collection. Section V showcases the study's findings focusing on three themes: TTO staff noticing and bracketing, the dumbing down process, and mediated sense-making. Section VI presents a discussion of findings and Section VII presents a summary highlighting practical implications of the research. Finally, Section VIII concludes this article.

II. RESEARCH CONTEXT

A. Technology Transfer Offices

The primary duty of many universities is to engage in research and facilitate knowledge and information to both academic and student populations. The importance of this task on behalf of the university is well-documented [17]. Universities can also help in technology transfer activities by providing R&D projects [18], [19], by assisting in patenting and licensing innovations along with establishing spin-outs and start-up companies, all of which can provide staff and students with the tools needed to become highly skilled individuals [20], [21].

TTOs are a specialized group of individuals based within a university to help commercialize and manage all aspects of intellectual property (IP) such as patenting, creating licensing agreements and spin-out companies along with performing market analysis and economic assessments of various industries. According to Bennetzen and Moller [22], a TTO can provide research for a solution to theoretical or existing problems along with providing insights into products that the marketplace does not yet know it needs. Furthermore, Bennetzen and Moller argue that TTOs also perform the following:

1) investigate the novelty and patentability of IP (typically done by external patent attorneys);
2) perform market research (understanding customer needs, mapping competitors, stakeholders, etc.);
3) gather competitive intelligence (the assessment of emerging technologies and alternative solutions that might compete with those being pursued by other universities and industries).

TTOs help facilitate commercial knowledge transfers of IP created from university research by licensing them to existing firms or start-up companies. The activities of TTOs have important economic and policy implications because the combination of creating licensing and patenting agreements while also generating university-based start-ups (spinoffs) can result in additional income for the university [10]. Furthermore, increasing additional R&D for the universities helps to create employment opportunities for university-based researchers and graduate students. Thus, generating a spillover effect both economically and technologically into the surrounding geographic location from the university. TTOs activities also make a broader contribution to gross domestic product (GDP), particularly in the case where university funding comes from governments.

Traditionally, TTOs have placed an emphasis on licensing and patenting. However, in more recent years, TTOs and their employees have increased efforts into creating spin-off firms [23]. According to Siegel *et al.* [10], much of the information pertaining to TTOs have focused on the exploration of TTOs performance, specifically by examining elements of technology commercialization (such as licensing and patenting) and entrepreneurship (creating spin-out companies). For example, Siegel *et al.* [10] state that authors like Thursby and Thursby [23] studied university faculty involvement in technology commercialization, such as the inclination of academics to create patents, disclose inventions, coauthor with industry scientists, and form university-based start-ups. Furthermore, Thursby and Thursby [23] and Siegel *et al.* [10] discovered that academics are rarely trained in these activities, let alone trained in the ability to perform a market analysis or foster business development since these are not generally seen as key aspects of the researcher's training. Thus, Bennetzen and Moller [22, p. 12] argue "this points toward a pivotal role for TTO units, they are dedicated to facilitating and managing the process of making academic research have a direct impact on society."

Having a specialized unit such as a TTO can be beneficial for both the university and individual academic researchers [24]. Not only can this office help facilitate the growth of university-developed technology, it can also act as a mediator between the goals and expectations of the university administration and the needs of academic researchers. There are several different rationales for the growth of TTOs within universities.

First, TTOs help bring knowledge created by academics together within the institution. Thus, by bringing together these inventions it creates a wealth of potential commercial knowledge in order to build and increase the reputation of the university [11]. The university administration has the ability to influence and provide incentives to both the TTO and faculty members by establishing university-wide policies for the sharing of licensing income and/or sponsored research [10]. Second, those employed in TTO roles act as intermediaries between university academic staff and industry. Jensen *et al.* [25] describe the process of academic disclosure and university licensing as a game, in which the goal for the university administration, the academic researchers, and TTOs is to commercialize as much IP as possible. In this process, individuals who specialize in technology transfer treat the office as a dual agent, representative of both research staff and the university [10].

When a university researcher develops a potential technology, service, product, or other forms of innovation, the TTO decides whether to search for a potential business to license the technology and then negotiates the terms of the licensing agreement with the prospective firm. The quality of a product and the invention's potential to be commercialized are two of the most significant determinants of whether an invention becomes a licensed or patented technology. Siegel *et al.* [10, p. 644] state that "TTOs engage in a short 'balancing act,' in the sense that they can influence the rate of invention disclosures, evaluate the inventions once they are disclosed, and negotiate licensing agreements with firms on behalf of the university administration and faculty members."

Hellmann [26] proposes that a further advantage of creating a TTO is that the TTO comprises a team of individuals who specialize in commercialization activities, thus accounting for the fact that individual scientists (who primarily act as teachers or researchers) do not have specialist knowledge in establishing businesses or commercial activities. Additionally, TTOs are generally better equipped and trained toward searching for potential buyers who might be interested in licensed university technology. Hellmann [26] further argues that university researchers are more likely to delegate their search for potential buyers to TTOs when patent protection is implemented. Similarly, Hoppe and Ozdenoren [27] explore the idea that TTOs act as innovation intermediaries in order to reduce any uncertainty problems. They suggest that firms seek to capitalize inventions; however, they cannot estimate the value of the technology with any form of certainty. Intermediaries like TTOs are able to make the investment less risky for the university. They do this by acquiring the expertise to locate new creations by inventors, sort the level of profitability or lack thereof and assess the efficiency level of potential commercialization activities.

TTOs are needed in order to make decisions about the commercialization process of IP because the university administration or research staff members are generally not able to focus their entire attention toward commercialization activities. Siegel and Phan [28] state that TTOs are constantly deciding how to strategically commercialize the IP created by university researchers; specifically, concerning whether emphasis should be focused on licensing or creating spinoff companies. These choices are mostly determined by the TTOs' perceptions of the relative financial returns and the universities' desire to generate economic/knowledge spillover to the local community. Lockett *et al.* [29] argue that TTOs have expertise in both identifying opportunities for commercialization and developing spinoff companies because of their commercial networking and business development expertise. Academic researchers can play a pivotal role in the technology transfer process, especially if their experience and knowledge are necessary for the further development of the technology. Additionally, they can share their preference between creating a spinoff company and a licensing agreement [29].

However, the other literature from Nelsen [30] suggests that TTOs, mainly in the USA, may not be as efficient as previously alleged. Simply having and employing a TTO does not ensure that the office will succeed in securing a positive net income from their IP. According to Macho-Stadler *et al.* [11], the size of a given TTO has a direct effect on licensing activity and licensing revenue. TTO's productivity is also associated with the university's royalty and equity distribution schemes combined with the quality of the TTO staff members. Friedman and Silberman [31] argue that TTO outputs are related to how many years the TTO has been operational, the regional location of the university, whether the university possesses a clear mission to support technological transfer, and the size of rewards for faculty involvement. Weckowska [32] argues that transitioning into "entrepreneurial universities" can be challenging. While opening a TTO can be relatively straightforward, it can be difficult to successfully engage in technology transfer without commercialization practice focusing on building relations and without strategic input from TTO directors. Hidalgo and Albors [33, p. 218] found that in the process of technology transfer regulatory issues, technological cooperation and technological risks can be major barriers for industry partners and partly for universities.

B. Technology Transfer Environment in Scotland

Scotland has had a long-established regional development agency called Scottish Enterprise, which was established in 1991. The idea was to create support mechanisms combined with the best research/researchers in the world [34]. Scotland was the first region in the U.K. to develop a regional science policy. The regional science policy model in Scotland, later coupled with the Scottish Funding Council (SFC), helps to promote new strategies for universities that include knowledge exchange activities and a strategic approach to research funding and resources in an attempt to compete in a global knowledge-based economy [35]. SFC was established in 2005 and it became "the national, strategic body that is responsible for funding teaching and learning provision, research and other activities in Scotland's 25 colleges and 19 universities and higher education institutions" [36].

A report titled "A Smart, Successful Scotland" [37] identifies three key themes that were deemed important by the government: growing businesses; ensuring global connections; and enhancing the learning and skillset of Scots. Another report

titled a "Global Connections Strategy" [38] explains Scotland's strategic direction for commercializing on the opportunities surrounding the knowledge-based economy and putting in place the necessary mechanisms to ensure Scotland is a globally integrated economy. In January 2001, the Minister of Science published a report called "A Science Strategy for Scotland" [39], which expresses the need to maintain a strong science base and calls for an increase in the effective utilization of scientific research created in Scotland. This resulted in enlarged funds for Scottish university science departments as well as bigger subsidies for knowledge exploitation initiatives such as the Proof of Concept Program (PoCP) and the Royal Society of Edinburgh (RSE) and Enterprise Fellowships [40]. PoCP is an initiative managed by Scottish Enterprise, which aims to support and improve the quality of commercialization within Scottish Universities by funding awards to individual research projects [41]. RSE Enterprise Fellowship is a premier business development and training program, which provides a salary, mentoring, and formal business training for promising researchers who want to develop into successful entrepreneurs [42].

In addition, the Scottish Government sees university education as one of the seven key sectors of the Scottish economy, thus there has been an increasing commitment to knowledge and technology exchange from the academic sector, which has been promoted by the SFC. Furthermore, the Scottish Government has stated that knowledge and technology exchange can improve Scotland's social and economic well-being [43].

Scotland has 19 universities, all of which are funded by the SFC. The total income of Scottish universities in 2017–2018 was £3.8bn, out of which £1.1 was funded by SFC [44] and £477 million came from technology transfer [43]. In 2017/2018, this income included external research grants and contracts (49.5%), continuing professional development (13.5%), licensing (1.7%), consultancy (21.0%), enterprise schemes (1.9%), translational awards (4.7%), venturing (5.9%), and outreach (1.8%). Between the academic year 2015/2016 and 2017/2018, the composition of Scottish technology transfer in academia has been relatively consistent, with venturing being the most significant change, which has shown a +1.6 increase between 2015/2016 and 2017/2018 relative to the total sector income for each year [43].

In the 2017–2018 academic year, the highest knowledge transfer income was received by the University of Edinburgh (£86M), followed by the University of (£86M). The University of Glasgow had by far the highest income from external research grants and contracts (£57M), whereas University of Edinburgh had significantly higher income from licensing (£3M) and consultancy (£28M) than other Scottish Universities. The University of Aberdeen has excelled in income from venturing (£24M) [43].

III. THEORETICAL BACKGROUND

A. Sense-Making

Karl Weick is considered as the father of sense-making. Weick [45, p. 4] suggests that the term simply means "the making of sense." This deceptively simple observation suggests that we as individuals are compelled to engage in a process of "structuring the unknown" [46, p. 41] by "placing stimuli into some kind of framework" that enables us "to comprehend, understand,

explain, attribute, extrapolate, and predict" [47, p. 51]. Sense-making enables people to examine the complexity of the world into a situation that is explicitly comprehended in words and that allows one to take action [15].

Sense-making is the belief that "reality is an on-going accomplishment that emerges from efforts to create order and make retrospective sense of what occurs" [48, p. 635]. Individuals (otherwise known as actors) involved in sense-making, work through a process of social construction. The actors interpret and explain the information that they received to produce credible reconstruction of their world view based on their perception. Therefore, sense-making becomes the basis for understanding the individual accounts involved in the process and it is a never-ending process that these actors make in real time [49]. In addition, sense-making is needed when our understanding of the world and how it works becomes confusing [50]. This occurs when the actor's environment is under constant change or duress, therefore presenting the actors with situations for which they were unprepared for and must adapt toward [51].

People involved in the sense-making process (actors) develop their opinions on the basis of many different factors. Some of these factors may be a person's own unique individual contexts, including organizational positions, histories, and personal backgrounds, which position their sense-making toward the development of different representations [45]. Weick [45, p. 18] has described several properties of sense-making of which three directly relate to actors' contexts. First, sense-making is imbued with identity construction, which means the identities of people involved in a specific context shapes how those individuals view the world [52], [53]. Second, sense-making is retrospective, this means it is based on significant lived events [54, p. 567], with actors relying on their experiences to make sense of their current situation [55]. Third, sense-making is a social process, which is simultaneously an individual and shared experience. It captures an emerging product of conversations that we may have with others or ourselves [53].

Weick [45], [56] explains that sense-making is both an ongoing and retrospective process toward the development of plausible imaginations that help us to rationalize what people are doing. Gephart *et al.* [57] also agree that sense-making is an ongoing process, which through verbal and nonverbal behavior, creates an intersubjective sense of shared meanings. More specifically, in the activity of sense-making actors seek to produce, negotiate, and maintain a shared sense of meaning. It is viewed as an important process of organizing. Sense-making can be described as an arrangement of circumstances during which the actors engage in continuous experiences from which they extract information and try and make sense of the scenario in an ongoing and/or retrospective manner. Taylor and Van Every [58] compare sense-making to a way-station on the road, where experiences are turned into explicitly comprehensive words leading to coordinating systems of action.

In organizational life, we can identify three key factors pertaining to sense-making. First, sense-making occurs when a movement of organizational events is spoken into words and placed into categories. Second, organizing the sense-making process is placed into either written or spoken texts, or both. Third, reading, writing, conversing, and editing are all crucial actions that serve as a way to shape the sense-making process

[59]. The sense-making process can be examined at the individual as well as level organizational [48]. In particular, this study offers an opportunity to examine the triggers for sense-making and the role(s) of those directly involved in commercializing university IP and shaping the transition from a series of organizational events to an order and shared account of those experiences. The research focuses specifically on the sense-making of conversations that are held between TTO staff, academics, and industry partners. Thus, the project explores sense-making at the individual level.

Sense-making is a theory that can help us understand how the technology transfer process is communicated into existence. It facilitates the exploration of how people bring order and meaning [45] in communication between academics and industry. The research uses sense-making theory to unfold how sense-makers of technology transfer engage in cognitive frameworks and flow of understanding and acting. Sense-making is about the relationship of action and the clarification of that action, rather than the effect it has on evaluation pertaining to the choices that were made. When action is the prime focus, interpretation, not choice, is the significant phenomenon [48].

B. Process of Sense-Making

According to Chia [60, p. 517], the sense-making process starts with a flux of fleeting sense-impressions, which is then carved out and named with attention and conception. This means sense-making is based on previous experience specifically when problems arise through antecedents and coincidences. Näslund and Pemer [61] argue that if an organization is in a constant state of flux, its members may use storytelling in the sense-making process to unravel the flux and label and categorize the events taking place. Näslund and Pemer argue that the dominant story, used in the process, may be essential in establishing concepts required to capture the meaning behind events taking place in organizations.

1) Noticing and Bracketing: Weick *et al.* [15] argue that the sense-making process starts with noticing and bracketing. Noticing is the first, most basic, and most important step. Before we can make sense of something we first need to notice it. We also notice specific cues of the event that we are trying to make sense of. A person can then "bracket a portion of streaming circumstances" [15, p. 412]. This involves giving meaning to particular cues of the event. Weick *et al.* [15] suggest that our current opinions are based on previous experiences that help shape the individual process of noticing and bracketing for every new situation. Those are guided by mental models that have been attained through work, training, and life knowledge. We use acquired mental models to notice and bracket signs or events, meaning of which is unclear. Chia [60] explains that in the early stages of sense-making, information has to be decisively extracted out of the undifferentiated flux of raw experience for closer attention.

Blasco [62] explains that noticing and bracketing are a critical part of the experience in disruption. This involves identifying things that are abnormal when compared against the normal flux of events, which typically results in people looking for an explanation in their immediate context. Therefore, a new meaning, or category, must then be created for the experience that has occurred but does not yet have a name [15], in order to allow the person to comprehend it and re-engage in the experience.

2) Labeling and Categorizing: Sense-making is also about labeling and categorizing as an attempt to stabilize the experience. Chia [60, p. 517] explains that labeling works through a tactic of "differentiation and simple-location, identification and classification, regularizing and routinization the intractable or obdurate into a form that is more amenable to functional deployment." According to Weick *et al.* [15], the key phrase in Chia's statement is "functional deployment." Weick *et al.* [15] argue that functional deployment means developing labels on events that are intertwined with one another in such a way that it makes the information more manageable and coordinated in order to distribute the material to others. Therefore, the ways in which situations are interpreted are immediately organized because the events are bracketed and labeled in ways for people involved in the process to gain a common knowledge of meaning. In order for people involved in sense-making to generate a common knowledge meaning, labeling ignores the differences among the actors and therefore deploys intellectual depictions that are able to generate habitual actions.

A critical aspect of developing labels is developing categories, which are pliable. Categories in this process are malleable because they are socially defined and are adapted to individual circumstances. Moreover, according to Weick *et al.* [15], categories are radial in structure. They define the radial structure, as a few key instances within the category might have features that are shared with another category. However, the category contains also marginal instances that have only a limited amount of links. Tsoukas and Chia [63] argue that this difference is potentially critical because actors' actions are stable when they act on the basis of central prototypic cases within a category. However, when actors operate on the basis of more ambiguous peripheral cases, their actions may vary, and they may be more likely to change the organizing process.

3) Sense-Making and Communication: Communication is a pivotal component of sense-making and how people organize the process. As pointed out by Taylor and Van Every [58], the communication process itself can be seen as an attempt to make sense of the circumstances and experiences in which we find ourselves. Sense-making draws on language resources in order to formulate and exchange meaning, often through interactive talk that includes established encoded representations. Sense-making is therefore seen as an activity in which both communication and organization are patterns that are developed through actions and conversations that occur within social structures. To share understanding with others means to take knowledge out of the implied, isolated, difficult, and random to make it more clear, communal, simple, and relevant to a particular situation [65].

This happens when one person is able to convey the complexity or chaos of a situation to another person, which, in turn, communicates it to someone else; essentially, explaining the chaos of a situation through one person's discourse and making the discourse functionally deployable to someone else. Moreover, what Taylor and Van Every attempt to explain is how people try to make sense of how other people make sense of

things, which is incredibly complex; however, it can become routine in an organizational environment or in this context a TTO.

4) Sense-Giving and Sense-Breaking: Sense-giving and sense-breaking are two variations of the sense-making process. Gioia and Chittipeddi [49] explain that, particularly in an organizational setting, leaders redefine situations in order to give sense to what is happening through "sense-giving." Sense-giving happens when people attempt to influence another actor's sense-making process "toward a preferred redefinition of organizational reality" [49, p. 441]. People can engage in sense-giving by creating hypothetical situations, describing values, and attaching labels [65]. However, when sense-giving actors attempt to give either a new, better, or more desired version of sense because it is sometimes necessary to break the old, worse or less desired versions of sense, this process becomes sense-breaking.

Pratt [52] explains that sense-breaking is the breaking down of others' meaning. This differs from the sense-making process because there is no creation of meaning. According to Giuliani [66, p. 221], sense-breaking occurs when: "a person's process of sense-making is disrupted by contradictory evidence, i.e., it is concerned with breaks in the scanning, interpretation, and learning dynamics of the sense-making process." When related to people, sense-making helps to create identity constructions, whereas sense-breaking involves a critical questioning of "who one is" when their view of themselves has been challenged by others [52]. The main purpose of sense-breaking is to disrupt an individual's sense of self in order to create a meaningful void that is to be filled. When studying sense-breaking one should consider 1) what information has emerged that broke sense and 2) how, in the given context, the sense-breaking impacts the process of sense-making [67].

5) Mediated Sense-Making: In the process of sense-making, mediators are located between those engaged in sense-making and the larger environment. Mediators can create and break down barriers depending on the environment they are in [68]. They can also help foster information and develop cues between subgroups in the local context [64]. Mediated sense-making is defined by Strike and Rerup [16, p. 881] as "the process and prosocial orientation through which a mediator brings forward cues and points of view to a generated pause, doubt and inquiry among actors who are sense-making within a bounded context." Mediated sense-making helps to explain how outsiders within a given scenario make sense of things.

A mediator can help sense-makers by interrupting and reversing momentum by actors by giving voice to weak cues and facilitating doubt amongst the actors [16]. This means that mediators have the ability to stop the conversation when they notice something is confusing for other group members involved in the sense-making process. Furthermore, Strike and Rerup [16] argue that mediating these interruptions is important because people that are located in a lower position within a given hierarchy can often feel fear of speaking up or not being given a voice. As Weick [56] expresses, actors higher up in the hierarchy have little incentive to hold back and possibly distrust their knowledge, which can lead to an illusion of control and feelings of being overly self-confident. Being surrounded by people who continuously give supportive information induces

sense-makers to believe that everyone within a local context agrees with their views. Doubt-based questioning introduced by mediators encourages actors to distrust the sense that has already been made and generate new understandings [69].

IV. RESEARCH DESIGN

The research fieldwork was divided into two stages. The first part was an exploratory, ethnographic case study, which was conducted at a TTO in a university where the authors of this project worked at the time of data collection. The case was selected on the grounds of convenience sampling [70]. The selected case met the target population criteria, i.e., 1) it is a TTO engaging in communication between academics and industry partners and 2) it is located in Scotland. Thus, the selected case was suitable for addressing the project's research aim. At the same time, the selected TTO met the practical criteria of easy accessibility and geographical proximity.

Using a case study in the initial stage of the project allowed the researchers to observe the studied phenomenon in a holistic manner [71]. Since a number of organizational issues could affect how TTOs facilitate communication between academics and industrial partners, the fieldwork began with an in-depth case exploration. The case study approach is preferable for investigations of contemporary phenomena within real-life context and where projects adopt inductive reasoning [72]. As Burns [73] argues, case studies are intended to provide a detailed understanding of a specific unit (e.g., an organization). The phenomena observed in that unit could help to establish generalizations about the wider population in which that unit operates. Case studies can also be used as a valuable preliminary stage to further investigations [73].

Utilizing an ethnographic study allowed the researcher to observe how TTO employees work and how the commercialization process unfolds. Ethnographic interviews and open-ended interviews were used throughout this phase, in order to collect information about technology transfer concepts and processes, as well as to gather TTO employees' opinions. For example, the researcher was able to ask questions about how TTO office's employees made sense of different discourses used by academics and practitioners. Case studies allow the researcher to understand complex social phenomena and create meaningful characteristics of real-life events [74]. In this project, a case study was conducted over a period of three weeks during which the researcher observed how the employees of a TTO work and, in particular, how the commercialization process unfolds. As Geertz [75] explains, observation studies with detailed field notes can provide "thick descriptions" of the field, meaning a detailed set of accounts that allows the reader to gain insight on any particular settings, situations, or feelings the researcher might have experienced.

In total, 25 people were interviewed through a combination of ethnographic interviews and open-ended interviews. At this stage, data were collected from an individual university TTO office and their employees (including managers, specialists in legal and commercialization aspects, marketing and administrative staff) and academic faculty from different departments. Interview data were transcribed and, together with field notes,

they were coded and examined with the use of thematic analysis described by Braun and Clarke [76]. The three main identified themes were the following:

1) who the TTO works with;
2) knowledge of the TTO's existence;
3) communication between the Research Exchange Services office and academic/industry partners.

The themes that were highlighted at this stage became the basis for the interview questions later in the research project.

Observing and interviewing research participants throughout the first stage of the study also helped determine who should be interviewed for the second phase of the data collection, which concerned other universities across Scotland. On the basis of the data collected, a decision was made to focus in the second phase on TTO employees, specifically staff members who are involved in the commercialization process and would have most communication with academic staff and industry partners, as opposed to TTO employees who provide legal expertise or administrative services. This approach represents purposive homogeneous sampling [77]. In the second phase of data collection, the study focused on employees who had similar responsibilities in TTOs. The homogeneity of the sample allowed the project to understand and examine in more depth strategies used by TTO employees in mediating between academics and industry partners [78].

For the second part of the data collection, open-ended face-to-face and telephone interviews were conducted with employees of different university TTOs throughout Scotland. The only individuals included in the interview process were employees of Scottish TTOs, not academics or industry partners. This decision was made in accordance with the aim of the study, which was to highlight the experience of the TTOs, rather than other individuals involved in the commercialization process. At the second stage of the data collection, 16 interviews were conducted from 13 different Scottish universities. The interviews were completed over a period of five months as they were dependent on the availability of the respondents. Interviews were approximately 1 h long. The data were transcribed, coded with the use of NVivo and analyzed using the Glaserian version of the grounded theory [79].

V. FINDINGS

The process of analysis produced several themes related to the commercialization process. The findings presented and discussed in this research article focus on the following three themes.

1) TTO staff noticing and bracketing.
2) The dumbing down process.
3) Mediated sense-making.

A. TTO Staff Noticing and Bracketing

Sense-making begins with a chaotic situation. Once actors in the situation begin to perceive that communication is not flowing smoothly, the next part of the process is noticing and bracketing. The findings identified the TTO staff members as the individual or group that notices a state of chaos or confusion amongst the other group members. For example, some of the participants expressed that when they notice a state of confusion or flux, they will give both groups some time to see if they can come to a mutual understanding and try not to get involved. Thus, not stopping the sense-making process of what is being communicated. Other respondents mentioned they might ask a couple of questions to see if the communication by either group becomes clearer. Ultimately, it is up to individual TTO staff members to try and read the situation, assess the communication that is being used, and find a way to make sure the communication between the groups is clear. For example, P10 shares:

"I might take a minute or two to try and see if it becomes clearer. Once the academic or business has expanded upon their particular point, and if it is not clearer, then I would ask them to clarify it." (P10, 2015. p. 7. Lines 47–48)

Additionally, P7 states:

"I will ask both parties what is the problem we are trying to solve before we actually start throwing potential solutions at things." (P7, 2015. p. 9. Lines 40–45)

Magala [80] explains that noticing and bracketing means inventing a new interpretation or new meaning for something already happening in the course of the organizing process. TTO staff members engage in this role by noticing a complexity of the discussed subject and bracketing parts of discussion that are confusing. If the communication does not become clearer either with time or by answering questions that are designed to clarify the information that is being communicated, then the TTO employee will often resort to dumbing the information down.

B. Dumbing Down Process

If the understanding during the communication process does not become clearer through further conversation there is a strategy that TTO employees can utilize in order to make sense. In our research, we called this technique "dumbing down" because one of the participants in the study used this term in order to illustrate how they came to a mutual understanding between academics and industry when their communication had become problematic. Dumbing down is a novel concept in the process of sense-making. In this article, we conceptualize dumbing down as a way to make complicated communication or information easier to understand when the TTO employee, academic and industry partner are having a conversation with one another. This process is carried out by a mediator, and in this study, it is a TTO staff member who stops the sense-making process or the conversation, because they notice a state of confusion or chaos from either the academic or the industry partner. For example, P8 describes:

"Sometimes you have to pretend you are talking to a 12-year-old child. I do this by trying to bring it down to a base-like understanding. Get the information dumbed down to simplistic terms so that anyone can understand what technology is, not necessarily the workings of the technology but the benefits. I will ask, 'What you're talking about here,' 'Would you mind dumbing it down a little bit?' I am not afraid to say, 'I do not understand this.'" (P8, 2015. pp. 11-12. Lines 13–15.)

This momentary break from the conversation allows other group members to pause and find a way to communicate information into simpler terms, thus, dumbing down the communication so that it can be understood and used by other group members. Chia [60] explains that when this happens the information becomes functionally deployable to other members. The mediator structures the conversation in such a way that actors will not move forward in the commercialization process until everyone in the group has a mutual understanding of the communication. Once a mutual understanding is agreed upon by the group members the sense-making process can continue, along with the commercialization of university IP.

The findings show that dumbing down of communication is a way that helps to make sense of information. This process differs from other versions of sense-making literature because sense has yet to be made. Even though the process of making sense is done retrospectively, the findings demonstrate how the dumbing down of information happens as the conversation between academics and industry is taking place. Thus, dumbing down is happening in real time rather than leaving the conversation for a length of time and then starting the process again. Additionally, the findings highlight the role of TTO staff members as mediators. The findings show that there are several different ways to dumb down the information, which is usually done through phrases such as "layman's terms" or "I do not get it, can you please explain?" Regardless of how the information is dumbed down, it is used as an effort to try to re-establish communication and maintain a level of understanding between members involved in the communication process. This is when the TTO employee needs the communication to be simple and they are not afraid to appear "dumb" or "stupid" in front of the other members of the group in order to facilitate understanding. For example, P5 states:

> *"I would ask an academic to break it down for me in order for me to understand, explain it in layman's terms. It is always as easy for me to ask a stupid question, or to try to rephrase it for what either the academic has said, or for that matter what the company has said, in words that I think the other members in the conversation will understand." (P5, 2015. p. 11–12. Lines 45-12)*

Furthermore, having the ability to read body language is an important aspect in dumbing down. For someone who is experienced in these types of commercialization projects, it can be easy to see when someone does not understand what is being communicated. Reading the body language of group members can allow the TTO worker to break down the information in a more simplistic manner. For example, P8 describes:

> *"You do have to step in occasionally when you see people talking to each other and it is very obvious from the body language the person does not understand the level of detail especially if an academic or business talks very technical you can see either the academics or industry partners roll their heads." (P8, 2015. pp. 11–12. Lines 11–13.)*

As highlighted by participant 8 TTOs staff members intervention and dumbing down may be needed when either academic or industry partners use technical vocabulary. While academics can lose audience by discussing in detail scientific ideas behind the technology, industry partners may use business language that can be unclear for some academics. The strategy of dumbing down and previously mentioned noticing and bracketing highlight the role of TTO employees as mediators in the process of sense-making.

C. Mediated Sense-Making

The findings show that TTOs portray a role of mediators in the sense-making of technology commercialization. As mediators, TTO employees themselves do not have to have a detailed technical understanding of the developed technology. For example, this was highlighted by P10:

> *"There's the level of understanding I think you need. But it's not very deep in terms of a lot of the technical elements of it. We're not experts in that area."*

Similarly, P5 explained:

> *"I tend to not understand what the academics are saying but I do think it is reasonably important. You obviously want to know what you are talking about, and there is always questions that industry has about a particular project and therefore I need help from the academics. However, industry is happy with the fact I do not understand. No-one expects you to know the kind of intricate detail about the projects." (P5, 2015. pp. 11–12. Lines 29–26.)*

Thus, TTOs do not play a role of a translator but rather a mediator who is sensitive to how involved parties use different languages and make sense of the commercialization. The TTO staff member, acting as the mediator of the group, asks for clarification to be made. By doing so, TTOs are temporarily stopping the sense-making in order to resume that process with the creation of new meaning. Questions will continue to be asked by either the TTO employee, the academic, or the industry partner until sense has been made of the communication and communication has been re-established. The idea of TTOs as sense-maker mediators corresponds with the Strike and Rerup [16] argument that mediators, by regulating and catalyzing particular cues, change the pace at which meaning is created [16].

VI. DISCUSSION: THE DUMBING DOWN PROCESS

The study examines and reports how TTO employees engage in sense-making as a part of the commercialization process. Primarily, the project sheds light on how TTO staff dumb down conversation. What is interesting about this strategy is that TTOs and their staff could seek more complicated explanations of the discussed technology; however, they purposefully lower the level of sophistication to the least common denominator for all parties involved. Studies of sense-making also suggest that speed is preferable [45]. However, findings of this research illustrate that careful regulation of pace and even a temporary break in sense-making can be valuable resources.

The core of sense-making theory is based on individuals trying to make sense of the world that is around them. The findings of this article contribute to sense-making theory in four ways.

First, the findings contribute to sense-making theory by expanding the literature relating to the role that communication plays in sense-making. It is argued by the researchers of this

article that by having a breakdown and dumbing down of communication, it allows for further knowledge creation and understanding to be developed from different points of view. This further supports arguments made by Cornelissen and Kafouros [81] and Fenton and Langley [82] who have argued the importance of sense-making and communication and how it can lead to interpretation and meaning production. In this study's particular context, the TTO staff members make sense of the communication that is used by either academics or industry partners by deliberately stopping the sense-making process. TTO employees disrupt the sense-making process when they notice there is a state of confusion from other group members. They ask for clarification until the other parties involved in the commercialization process come to a mutual understanding of what is being communicated. This momentary disruption created by the members of the TTOs allows for interpretation and meaning of the communication to be produced in a simplistic way that everyone can understand (dumbing down).

Second, the research that is presented in this article adds to the existing theoretical literature by identifying particular practices that occur in relation to both sense-making and sense-breaking. This study of TTOs examines their tendency to deliberately "stop making sense" or to disrupt sense-making. This varies slightly from Pratt's [52] view of sense-breaking, since the data here is not trying to disrupt an already established sense-making pattern. Rather, the suspension of sense-making is an attempt to revisit, revitalize or reassess the ways in which participants are making sense of the communication. The process labeled here as dumbing down proceeds in one of the four stages mentioned by Weick *et al.* [15]. Participants in the communication are confronted by the pretence on the part of TTO staff members to be confounded by concepts, technologies, etc. In dumbing down, TTO employees deliberately feign a lack of sense-making, in order to further enhance the very making of sense. This paradoxical approach means that in order to maximize sense-making, TTO staff members periodically stop making sense.

Third, the findings extend our understanding of mediated sense-making developed by Strike and Rerup [16]. The role of a mediator is still largely overlooked by sense-making scholars. Early modes of sense-making express the need for group members to make sense of events, but little attention has been paid to the idea of a third party helping to facilitate the sense-making process. It was not until Strike and Rerup introduced the idea in 2016 that the concept of having a third party or mediator help facilitate the making of sense was mentioned. In the context of technology commercialization, we can recognize TTOs and their employees as mediators of sense-making. They adopt this role by facilitating a common communication between the academics and the industry partners. Strike and Rerup [16, p. 882] argue that the sense-making mediator "carefully pace but purposefully plant seeds that interrupt and invite people to make sense." According to Strike and Rerup, this can be done, for example, by bringing new cues or new knowledge. Our article expands the concept of mediated sense-making by demonstrating a new practical strategy that mediators can use, which is dumbing down the discourse.

The findings also contribute to our understanding of the sense-making process (noticing and bracketing, along with labeling and categorizing) illustrated in more detail by Weick *et al.* [15] and Chia [60]. Weick *et al.* [15] explain that the sense-making process begins with a state of chaos or a flux in the organization. The findings identify that this is where the dumbing down of information by TTO staff members starts. After the state of chaos or confusion on behalf of the academic or industry partner arises, the TTO employee naturally moves on to the next phases of the sense-making process, which is regarded as noticing and bracketing. If the state of confusion continues TTO staff implements the strategy of dumbing down.

However, little academic literature has shed light on who is doing the noticing and bracketing during the sense-making process. It is assumed by Weick *et al.* [15], Chia [60], and Pratt [52] that the person or group who is making sense is the same person or group who is also doing the noticing and bracketing. As mentioned earlier in this particular set of circumstances in dealing with technology transfer that does not have to be the case. TTO staff members notice and bracket confusing information that is being communicated by other group members during the commercialization process. This is based on the TTO employees' previous work experience, knowledge, and/or ability to read other group members' body language. The main difference between the academic literature from Weick *et al.* [15], Pratt [52], Gioia and Chittipeddi [49], and Bartunek *et al.* [65] and the findings illustrated in this article is that in this specific set of circumstances, the individual who is noticing and bracketing is ultimately not the person who is making sense of the communication used by either the academic or industry partner. They are facilitating the conversation in such a way that mutual understanding can be made.

VII. POLICY RECOMMENDATIONS

National and regional policy makers try to set incentives for universities to increase their innovation potential [6]. In this system, TTOs are seen as one of the primary means of transporting ideas of academics into the economy and society [22]. Taking into account the importance of TTOs in the commercialization process, policy makers and university management should be interested in a more comprehensive understanding of communication involved in the technology transfer process. Especially, university managers, in their efforts to improve economic and innovation activity of their institutions, should recognize practices that can aid the effectiveness of TTOs. There are two policy-related lessons that can be drawn from our study.

First, our analysis demonstrates a strategy that TTO employees can use when mediating a dialogue between academics and industry partners. The dumbing down strategy can be particularly useful for reaching mutual understanding between the parties when the exchange of technical information poses difficulties. For members of university who draft internal policies, it is important to ensure structured training for front facing TTO members of staff. The training should provide opportunities for practicing resolution of situations where dialogue is failing and on peer-led exchange of best practices in mediation between academics and industry partners. This would institutionalize tacit knowledge crucial for the process of mediation. University and TTO managers should reorganize the importance of not only

technical knowledge but also the soft skills that are required to assist business agreements.

Second, on the regional level policy makers involved in supporting university innovation could help manage industry partners' expectations of TTOs role. When promoting the role of TTOs in the region, the policy makers can also communicate the mediatory function of TTOs' staff. As experts in the technology commercialization process TTO staff can help academics and industry actors find common ground. Although they themselves do not have to have a detailed technical understanding of the developed technology, TTO staff facilitate and manage the process. In this respect, policy should not assume that the parties involved in the commercialization process understand what to expect from TTOs but rather help to set realistic expectations for the parties involved.

VIII. Conclusion

This article contributed to our understanding of the sense-making process by regarding TTO employees as intermediaries whose purpose it is to perform noticing and bracketing in a complex, multiperspective set of interactions between academic and nonacademic partners. This is done partially by examining the body language of participants and/or identifying a state of flux or chaos in group members. Once the TTO employee notices there is a state of flux or confusion between the academic and industry partner, they then bracket the information in order that sense can be made by dumbing the information down later in the sense-making process. This adds to the existing knowledge by explaining how someone who notices, and brackets can help make sense of communication (even though they are not the sense-maker), which will eventually be common knowledge for all people involved in the sense-making process.

The study has implications for shaping expectations about the role of TTOs staff in the knowledge commercialization process. The results of this study illustrated, with the use of sense-making theory, that temporary breakdown and dumbing down of communication between academics and industry partners can be an intentional maneuver introduced by mediators. The study suggested that TTO staff members may not know answers to all questions, especially those related to technical details of commercialized technology. However, TTO staff can have experience in regulating and catalyzing the form and pace of communication between parties involved, in order to help them reach mutual understanding. When managing TTOs, it is important to remember that miscommunication can arise between parties involved in technology transfer. Communication between academics and industry partners can be particularly challenging when it comes to understanding the technology. Our article makes a practical contribution to TTO management by sharing a strategy that TTO employees can use when dialogue and mutual understanding between the parties involved becomes problematic.

There are a couple of key limitations to this research. First, the researcher was not able to interview representatives from every university in Scotland. There are a total of three universities that were not represented in this study. Unfortunately, these three universities happen to be in the top five universities in Scotland

pertaining to technology transfer. Furthermore, some of these universities only have one individual who specializes in commercialization. There is, therefore, a possibility of representing only the smaller universities in the Scottish technology transfer environment. However, this study does try to mitigate this issue by including as many individuals from as many universities as possible in order to collect the most amount of information and represent the Scottish technology transfer industry accurately.

Moreover, the universities that were chosen in this study are geographically specific to Scotland. Other universities throughout the United Kingdom, Europe, and the United States were not included in this study. Regions such as England, European regions like Germany, and Ivy League Schools in the United States have several colleges and universities and in comparison, Scotland is much smaller. Therefore, the data represented in this study have a high probability of highlighting phenomena specific to the Scottish region and may not be represented in other areas. This opens further research opportunities for examining sense-making in the technology transfer in other national contexts. It could be particularly insightful to examine whether similar mediation strategies exist in high commercialization regions throughout Europe such as France, Germany, and Italy, and other parts of the world such as U.S. or China. Additionally, there are other fields of study in which dumbing down could be studied and applied, such as in politics and the ability to communicate bills and laws to the people who are ultimately voting on them. Dumbing down also has the potential to be applied in news reporting by possibly dumbing down the information to a larger audience. Dumbing down can be one of the key attributes of mass communication, where the content provider takes on a role of a mediator, in the sense-making process, and deliberately makes more complex or technical information easier to understand for all parties involved. Lastly, dumbing down could be applied in the legal field specifically during an active trial when an attorney notices a member of the jury who is confused as to what an expert witness is testifying.

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