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A PROPOSITION OF AN EMERGING TECHNOLOGIES EXPECTATIONS MODEL: AN EXAMPLE OF STUDENT ATTITUDES TOWARDS BLOCKCHAIN

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Abstract. The paper proposes an Emerging Technologies Expectations Model (ETEM) that aims at explaining the differences in perception of new technologies as well as the expectations towards them. These Expectations, classified into Technology Evolution, Technology Revolution, Social Evolution and Social Revolution are explained by Knowledge and Usage that in turn are shaped by Information Sources. The Information Sources factor, which influences both Expectations and Knowledge, and the Usage factor both play an important role in the model. The application of this model was illustrated using blockchain as an example of an emerging technology, and data from a survey conducted among IT university students in Cracow, Poland. The proposed model contributes to filling the research gap concerning a comprehensive explanation of people's expectations towards emerging technologies, considering the way people absorb knowledge and undertake the usage of technology based on various information sources. It also provides practical implications, since the knowledge of the factors that can influence people's expectations towards emerging technologies might be useful in shaping these expectations.

Keywords: technology adoption model, emerging technology, blockchain, young people's expectations, students' sources of knowledge.

JEL Classification: A2, C51, C83, O3.

Introduction

Beginning from the 50s of the 20th century we have been faced by an increasing number of various technologies emerging into the business and our lives. This phenomenon has rapidly intensified with the proliferation of the Internet in the turn of the century. According to Rotolo and colleagues (2015), emerging technologies are characterised by the following properties: "(i) radical novelty, (ii) relatively fast growth, (iii) coherence, (iv) prominent impact,

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and (v) uncertainty and ambiguity" (Rotolo et al., 2015, p. 1828). Thus, they have a potential to influence the socio-economic environment in the future, although the actual scale of this impact is unknown.

Emerging technologies typically have two modes of existence: (1) they enter the market very quickly, everyone jumps at them and they migrate effectively and quickly to the group of technologies being used, (2) they migrate to areas of applications slowly, and might be perceived as niche solutions; it takes a long time before they become widely used; at first people get to know them, start familiarising with them, after which they are chosen to achieve business goals and are slowly moved to wider areas of applications. An example of the first type of technology might be cloud computing, the usage of which has spread vastly in a short time, whereas Python might be an example of the second type of technologies. It has never had the status of a "buzzword", but nowadays it is perceived as the main language for supporting data analysis.

Emerging technologies might be part of the so-called "technological innovations" (OECD & SOEC, 1997). However, it should be noted that not always innovations have a technological background. Innovation is one of the incentives that drives economic development (Schumpeter & Backhaus, 2003). One could imagine an emerging technology, which is not innovative, but according to the attribute quoted earlier (Rotolo et al., 2015) an emerging technology is characterized by radical novelty. For this reason, the terms emerging technology and technological innovations will be used in this article interchangeably.

The phenomena of new and emerging technologies' acceptance and diffusion has attracted researchers' attention in the previous decades (Taherdoost, 2018; Lai, 2017). A number of well-established theories and frameworks have been developed including Theory of Reasoned Action (Ajzen & Fishbein, 1980), Theory of Planned Behaviour (Ajzen, 1985), Social Cognitive Theory (Bandura, 1986), Technology Acceptance Model (Davis, 1989; Davis et al., 1989), and The Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003) (see the Related work section for a concise description of these theories). The review of these theories has revealed that people's attitude towards emerging technologies in terms of expectations aroused in them have not yet been thoroughly investigated. Thus, we identified this as the research gap that has motivated our research. Filling this research gap would allow us to better understand the phenomenon of the adoption of emerging technologies and would provide premises that might shape the expectations towards these technologies.

In this vein, we formulated the following research goal: the development of a model that captures the factors influencing expectations towards an emerging technology and showing the application of this model on the blockchain case. In order to achieve the research goal, the following research questions have been formulated:

1. What factors influence the expectations towards emerging technologies?
2. How might the expectations towards emerging technologies be classified?

Based on the literature review and our observations we will formulate a model that will describe the expectations towards emerging technology, which will provide the answers to the research questions. Then, we will show its applicability on an example of blockchain technology (BC). Our example will concern a student population, however, it should be noted that the model could be applied to all generations.

The results of this study contribute to the theory and practise by developing an original model that explains user expectations towards new technologies and is based on innovation and acceptance literature. It is comprised of four constructs: input – Information Sources, mediators – Knowledge and Usage, and output – Expectations. The focal outcome variable is measured on a four-item ordinal scale: Technological Evolution, Technological Revolution, Social Evolution and Social Revolution, which constitutes an additional contribution of the study. The model was tested on the example of the attitudes towards BC among IT students. One of the interesting outcomes of the model usage was that students with low knowledge and usage of blockchain perceive it as Social Revolution. The model may be used to plan promotional activities and educational curricula by institutional bodies. Although the model application was demonstrated on the example of BC technology used by young people, it is not limited to this technology or to the examined group of technology users (IT students).

The paper is organised as follows. The next section contains the literature review of the relevant models and frameworks. Then, the development of the model of expectations toward emerging technology is presented. Next, an illustration of the model application is reported. Finally, the model applicability and research contribution are discussed, followed by the research summary in the conclusion section.

1. Related works

1.1. Technology/Innovations diffusion and adoption models

Diffusion of Innovations (DOI) proposed by Rogers in the sixties of the previous century, belongs to the oldest social science theories (Rogers, 2003). It explains how, over time, a given idea reaches momentum and spreads over the population. An application of this theory to the Information Technology and Information Systems (IT/IS) field focuses on the utilization of a new technology. According to DOI there are five groups of technology adopters, of different characteristics, that follow an approximately normal distribution over time (Rogers, 2003): Innovators (2.5%) – venturesome individuals who play a role of opening the gates for new ideas, and are willing to endeavour quick and risky projects; Early adopters (13.5%) – respected in society individuals who, by adopting the technology, show by example that this technology deserves to be noticeable and should be adopted; Early majority (34%) – individuals who follow new technology adoption with deliberate willingness, and have a wide social network; Late majority (34%) – sceptical individuals who adopt new technology when convinced by peers of the economic necessity; and Laggards (16%) – individuals with traditional attitudes, suspicious of everything that is new.

Another classification of population as far as the embracing of new technologies is concerned was developed by Parasuraman and Colby (2015), who on the basis of the Technology Readiness Index proposed by them make the following segmentation of the population (Parasuraman & Colby, 2015, p. 13): Sceptics (38% of consumers) – they are rather indifferent towards or uninterested in new technologies; Explorers (18%) (similar to early adopters defined in the Roger's model) – open to new technologies; Avoiders (16%) (similar to Laggards) – resistant to applying new technologies; Pioneers (16%) – strongly engaged, aware of the pros and cons of new technologies; and Hesitators (13%) – waiting for the outcomes.

Interestingly, the researchers have developed some characteristics of the groups, for example the Explorers tend to be younger people, with a higher education background, professional connections, and enjoying technology gadgets.

In turn, the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) and the Theory of Planned Behavior (TPB) (Ajzen, 1985) have their origin in social psychology and the theory of consumer behaviour. They belong to the so-called A-B (attitudes-behaviour) models and are frequently used in various contexts (Han & Stoel, 2017). The relationship between attitude and factual behaviour is shaped through a mediator – the intention. TRA and TPB have been adopted to the IT/IS area to examine user attitudes and behaviour concerning the introduction of a new technology.

The Technology Acceptance Model (TAM) is building on the theoretical foundations of TRA and TPB. In it, five constructs are specified: Perceived Ease of Use, Perceived Usefulness, Attitude Toward Using, Behavioural Intention to Use, and Actual System Use being the focal dependent variables of the model (Davis et al., 1989). TAM has various extensions including the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). UTAUT consists of four key exogenous constructs: Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions, which have direct impact on the Behavioural Intention of Use (mediator) and Use Behaviour (focal dependent variable). Other variables, i.e. Gender, Age, Experience and Voluntariness of Use have moderate impact on the key exogenous constructs. UTAUT builds on various theories (including all of the ones mentioned earlier) and thus is perceived as the most comprehensive framework of technology acceptance and adoption. The Technology Acceptance Model and its derivatives, despite of their long history, still belong to the frequently studied phenomena in the area of new technology adoption (Althuizen, 2018).

The Technology Readiness (Parasuraman, 2000) and Technology Acceptance Model (Davis, 1989; Davis et al., 1989) have been unified in the Technology Readiness and Acceptance Model (TRAM) that might be particularly useful for explaining the adoption of a new technology that is not authorized by administrative guidance (Lin et al., 2007). In TRAM, the Technology Readiness, represented by four constructs (optimism, innovativeness, discomfort, and insecurity), influences the Use Intention directly, and indirectly, via the Perceived Usefulness and Perceived Ease of Use. The first two of the Technology Readiness constructs, i.e. optimism (positive attitude towards technology) and innovativeness (openness towards new technologies) might be perceived as drivers of the Technology Readiness whereas the latter two, i.e. discomfort (uneasiness about not having control over the technology) and insecurity (distrust towards technology, lack of belief that it might work properly) might be perceived as inhibitors. It should be noted that empirical research conducted by Parasuraman (2000) confirmed the relation between Technology Readiness and Propensity to use technology.

New technology adoption aspects were also tackled by Ratchford and Barnhart (2012) who developed the Technology Adoption Propensity (TAP) index. Similarly to (Parasuraman, 2000), they distinguished four constructs of consumers' technology adoption propensity: two driving factors and two inhibiting factors. In the first group they include optimism (belief that technology contributes to providing control and flexibility in life) and proficiency (confidence in having no problem with acquiring new technical skills), and in the second

dependence (feeling of danger of being overwhelmed by technology) and vulnerability (belief that technology makes people more prone to criminal attacks).

From the organisational perspective an interesting concept in the context of new technology adoption is the so called "absorptive capacity" defined as "the ability of a firm to recognise the value of new, external information, assimilate it and apply it to the commercial ends" (Cohen & Levinthal, 1990, p. 128). It focuses of a firm's capacity to absorb new technology and perceives this capacity through the lens of the absorptive capacity of the firms' members that depends on their prior related knowledge and background. The researchers stressed that a vital role for companies' absorptive capacity plays investment in research and development, made at the right time (early enough).

Similarly, a company's perspective of innovations is also tackled in The Technology – Organization – Environment framework (Tornatzky et al., 1990). It shows that a company's technological innovations are influenced by technological, organisational and environmental contexts. The technological context takes into account current technologies that are used in the company, and the organizational context is related to the company's resources, whereas the environmental context encompasses the external factors that influence the company's functioning, such as industry specification and availability of service provides (Baker, 2012).

A formalised method of analysing the potential of technology impact is presented in research works under the umbrella of the Future-Oriented Technology Analysis (Cagnin et al., 2008) or technology foresight (Magruk, 2011). It encompasses business, science, and technology to identify the possible opportunities for the development of new technologies. An innovative classification of methods that might be applied in this process was presented by Halicka (2016), who using Kohonen's self-organizing maps distinguished seven stages of the analysis, and the associated data analysis methods of each of the stages (accumulation – information collection; creation – new knowledge generation; retrospection – analysis of historical data; exploration – analysis of technologies from various perspectives, including social, technological, economic; quantification – technology cost effectiveness analysis; selection – choosing the right technology; projection – presentation of the technology's development trajectory).

1.2. Social influence on learning and technology perception

The Social Cognitive Theory (SCT) is an advanced version of the Social Learning Theory (SLT) (Bandura, 1986). It emphasises that learning occurs in a social context with dynamic and mutual interaction of an individual, his or her behaviour, and the environment. SCT uses five constructs used in SLT: Reciprocal Determinism, Behavioural Capacity, Observational Learning, Reinforcements and Expectations, and defines a new construct – Self-efficacy. The main aim of SCT is to explain how people control their behaviour while achieving defined goals over time.

Similarly, the Social Shaping Technology approach emphasises the key role of the social context in technology development (MacKenzie & Wajcman, 1999). For example, according to Social Construction of Technology, technological products might be evaluated differently by various social groups, and these groups determine the "success" of "failure" of these products (Pinch & Bijker, 1984). Furthermore, in the literature related to socio-technical issues,

the interrelation between people and technology is emphasised (Sawyer & Jarrahi, 2014) and the relationships among socio-technical system components are investigated (Borrás & Edler, 2020). In this vein, Shin and Park (2019) conducted a distinctive research on the fairness, accountability, and transparency of algorithms as properties that facilitate the provision of socially desirable services. Interestingly, they perceive an algorithm as "a socially recreated artifact based on users' cognitions and contexts" (Shin & Park, 2019, p. 277).

1.3. Expectations in various contexts

The construct Expectation is present in a number of models, mainly related to the prediction of consumer behaviour. In this vein, the Expectation Confirmation Theory has been posed (Oliver, 1980). According to this theory, expectations towards a product's performance together with the perceived performance influence post-purchase satisfaction with disconfirmation being a mediator, i.e. positive disconfirmation (product outperforms expectations) results in post-purchase satisfaction, negative disconfirmation (product below expectations) results in dissatisfaction. Thus, expectations reflect anticipated behaviour (Churchill & Suprenant, 1982).

Another perspective of expectations was employed in the Multi-motive Information Systems Continuance Model (MISC) (Lowry et al., 2015) that explains users' satisfaction and intention for the continuous use of information systems. In this model, the following expectation-related constructs were distinguished: the design-expectations fit that reflects the fit between technology and the tasks that it performs; perceived ease of use – defined similarly to that in the TAM; design aesthetics – appropriate and professional design of the user interface.

Furthermore, the Expectancy Value Theory (Rayburn & Palmgreen, 1984; Wigfield & Eccles, 2000), updated recently to the Situated Value-Expectancy Theory (Eccles & Wigfield, 2020), suggests that expectancy assessed as the probability that an object has a certain property, or that a behaviour has a certain outcome, influences behaviour, behavioural intentions, or attitudes.

2. Development of an Emerging Technologies Expectations Model

2.1. Rationalities

In the previous section, an overview of related models and theories has been presented. We consider them as the starting point for the development of our model that captures the factors that influence people's expectations towards emerging technologies. The proposed model might be perceived as an illustration of a certain way of thinking about the penetration of an emerging technology. The three main pillars that comprise the background to our model are the following:

1. absorption of technology innovations (see 1.1),
2. social context of learning and technology perception (see 1.2),
3. expectations in the consumer behaviour context (see 1.3).

Hence, a certain hybridization of three perspectives takes place. We include in our model the following components: technology, the consumer of this technology, and the environment. In our model, "expectations" will appear, but they are considered as the consumer's expectations. However, at this point we do not consider to what extent these expectations will be met. It should be noted that our model does not refer to the diffusion of innovation (see section 1.1), our "product" is an innovation (a technology). In the context of expectations towards technology, the awareness of its existence is essential. This means that knowledge plays a key role in defining expectations: technology innovation must exist in the mind of the "expectant", and she or he must have an opinion on this technology (cannot be indifferent towards it). This is related to the role of various sources of acquiring and shaping knowledge, and the topic of popularization of a given technology, including the occurrence of the so-called "buzzwords".

2.2. Technology innovation impact

An innovation is by definition a new method, idea or product that meets specific needs and can be replicated at a reasonable economic cost (OECD & SOEC, 1997). We will now concentrate on technological innovations, particularly focusing on the following issue: how and to what extent can technological innovations affect the contemporary world, and thus what expectations can be formulated towards them?

New and innovative ideas or inventions, i.e. innovative technologies, affect the functioning of the contemporary world and drive the economic development. Technological innovations, like others, can have a different scope and speed of impact. A significant part of technological innovations is industry-specific, i.e. they affect only a limited domain of applications and they are not noticed by a wider group (e.g. new technologies in the field of metal processing, new methods of steel cutting, construction of microprocessors, and new tools such as CAD (Computer-Aided Design) or CAM (Computer-Aided Manufacturing)). There are also technological innovations, the applications of which may have a wider scope of impact, directly influencing and shaping the functioning of entire communities, e.g. the Internet influencing telecommunication, transport, social media, and mobile technology. This means that technological innovations may have a direct effect on changes of a social nature (Hostettler, 2018). At the formal level, it is difficult to distinguish between these two types of innovation. Firstly, because their perception may depend on the direct recipient (a person who does not deal with metal processing will not notice the change, and for a person working directly in metal processing, the way she or he functions may change, both at the professional and social levels). Secondly, because often what is perceived by many as a single innovation is in fact the result of many innovations, often spread over time and having background in different domains (such as the Internet, for example). Hence, the range can be local (limited) or global – narrow or wide.

The speed of the impact is another issue. The literature distinguishes two types of impacts (Hostettler, 2018): evolutionary, when the impact and related changes are extended in time, often taking an iterative character, and revolutionary, when these phenomena occur abruptly, in a relatively short time. The main problems with the formal definition of this

criterion is the precise definition of the time horizon; how is an evolution different from a revolution: when a phenomenon has been evolving over a decade is it a revolution or still an evolution? For example, the time from an idea to its concretization and transformation into a product may be very long – "the idea phase" (which is not observable for people who are not directly involved) and the remaining part of the process can be very quick. A single technology innovation may not be a "breakthrough" in terms of changes at the social level, but the combination of innovations from several different domains can create a synergy effect and lead to a technological or social revolution.

These four types of impact (speed – slow and abrupt, scope – local (in terms of an innovation field of applications) and global (in terms of the influence on the whole society)) might provide a scale that can be used to assess the expectations towards innovations. The following four basic types of innovation impact can be identified:

- Technological Evolution – a process limited to a particular industry, progressing gradually over a longer time frame,
- Technological Revolution – a process limited to a particular industry, proceeding rapidly, in a short time period,
- Social Evolution – a process encompassing the whole society, proceeding gradually over a longer time frame,
- Social Revolution – a process encompassing the whole society, proceeding rapidly in a short time period.

It should also be noted that the ability to formulate expectations regarding technological evolution or revolution requires knowledge of a given domain (industry). The level of this knowledge should at least make it possible to understand the essence of a given innovation, although it does not have to be at an expert level. People implement the phenomenon of innovation transmission; the question arises: what are the sources of information about emerging technologies, on the basis of which people build their expectations towards emerging technologies? This leads us to the discussion of concepts related to information sources presented in the next section.

2.3. Sources of information

In general, identifying sources of information encounters several fundamental problems. On one hand, we have the characteristics of the information itself, covering many properties such as Effectiveness, Efficiency, Integrity, Reliability, Availability, Confidentiality and Compliance (IT Governance Institute, 2007). These kinds of characteristics can be applied to a single, well-defined source including materials with similar properties. However, when analysing sources of information related to knowledge acquisition, it is not possible to focus directly on the quality of the information. Instead, the focus should be on the characteristics of the source itself. On the basis of (Lee et al., 2012) and our own observations, the following criteria were distinguished: (1) the form of the shared resources (printed, online, mass media, people), (2) the accessibility, i.e. effort required to use the resources, (3) the entry requirements for recipients, i.e. whether and to what extent specialist knowledge of the domain is needed to be able to use this resource, and (4) the credibility of the source itself

assessed on the basis of the existence of a verification procedure and the verification process itself (assuming that the content being verified by specialists in several-stage procedures benefits credibility). Additionally, when categorizing information sources, one should take into account the possibility of revealing sources of information unique to specific groups of recipients (e.g. lectures for students).

2.4. The role of expectations in an emerging technology implementation

In today's dynamic world, innovation has become the so-called "buzzword", a concept used so often and in such different contexts that it has practically lost its original meaning, which is illustrated by the appearance of slogans such as "innovate innovation" (Hostettler, 2018). However, this does not change the fact that innovations influence and affect the way society functions, and that their role in the increase in the pace of changes is fundamental.

Every innovation goes through three basic stages of development (Silva et al., 2016): idea ("idea of something new"), elaboration [development] ("doing of something new") and implementation [commercialization] ("selling something new"). Transitions between these phases (as well as the actions taken within them) are associated with the necessity of incurring, often significant, expenditures and, consequently, with taking the risk of unsuccessful investments. Willingness to incur expenditures depends to a large extent on the attractiveness of potential benefits, i.e. the expected results. It should be noted that both inputs and expectations relate to different groups of entities coexisting throughout the process. In addition to the obvious stakeholders such as investors or end recipients (who perceive innovation most often in investment and economic terms), there are also other groups that may appear in the entire process, which, based on their own expectations, may adopt different attitudes towards a certain innovation, and thus influence its development cycle. For example, based on their own expectations, researchers fascinated by a specific concept will be ready to invest their time, knowledge and skills in the development of a certain idea, even if the results (i.e. transitions between the phases of the cycle) do not appear quickly and are not spectacular (e.g. graphene or quantum computers). Furthermore, it can be noticed on the example of the dot.com bubble that the level of expenditure increases with the level of expectations, even to an irrational level (Mandel, 2000; Howcroft, 2001). The expectation mechanism is not only pro-innovative; the example of "Google Glass" shows how innovation can be stopped (or rather slowed down, because work on similar solutions in the area of augmented reality is being continued) by the expected negative effects of its adoption. This might happen even though most of the possible negative effects have been proposed by people not directly involved in the process of the innovation's development, but who are affected by this product's introduction.

When analysing the development of an innovation, it might be assumed that the expectations that are associated with it may have a significant impact on the transition process from an idea to implementation. Start-ups are one of the symptoms of this phenomenon today. Since expectations have strictly subjective/personal nature, we can conclude that expectations towards an emerging technology might have a correlation with the prior knowledge and experience (usage) related to this technology.

2.5. The Emerging Technologies Expectations Model

Summing up, we propose an Emerging Technologies Expectations Model (ETEM) presented in Figure 1.

The model presents Information Sources as the independent variable, with Expectations being the focal dependent construct. It also includes two other mediator constructs: Knowledge and Usage. The model shows that Information Sources, Knowledge and Usage influence Expectations directly, however it should be noted that Knowledge and Usage are also influenced by Information Sources. As it has been mentioned before, Knowledge and Usage are mediators. It is difficult to capture the direct relationships between Information Sources and Expectations, but these two mediators represent the diffusion of innovation.

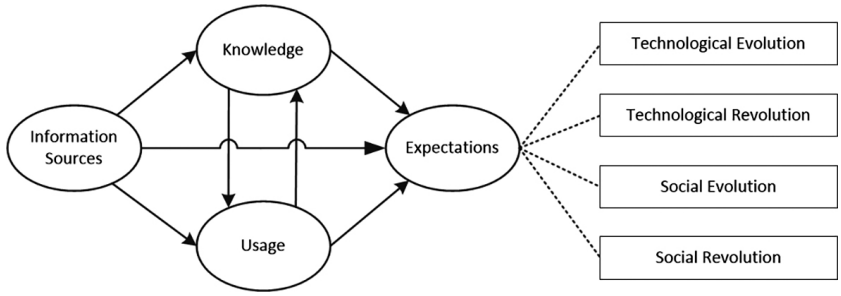

Figure 1. The Emerging Technologies Expectations Model (ETEM)

It should be emphasised that our model concerns individuals, not organizations. We are investigating the absorptive capacities of individuals, because they have an impact on shaping the organization, as it was stated in the Absorptive Capacity Theory Model: "An organization's absorptive capacity will depend on the absorptive capacities of its individual members" (Cohen & Levinthal, 1990, p. 131). Thus, the summary of individuals' features is shaping organizations. This individual approach is similar to that present in the UTAUT model, where the characteristics of individuals are present (e.g. gender, age) in the form of external variables.

3. The model's illustration: a case of blockchain technology

3.1. Background – blockchain

The BC concept was introduced in the paper (Nakamoto, 2008). It is based on five underlying principles (Iansiti & Lakhani, 2017): distributed database, peer-to-peer transmission, transparency with pseudonymity, irreversibility of records, and computational logic. Apart from the fact that blockchain is a collection of interlinked information, it also includes an algorithmic layer. This layer consists of two types of algorithms. First, known as consensus mechanisms, are related to the capability of creating ways of providing internal chain integrity (i.e. validation of transactions) that assesses the value of the information stored and secures the chain against information altering. Examples of such algorithms include: Proof-of-Work (PoW) (Jakobsson & Juels, 1999), Proof-of-Stake (PoS) (King & Nadal, 2012; Xu et al., 2019),

and Proof of Elapsed Time (PoET) (Chen et al., 2017). The second type of algorithms that BC provides are smart contracts (Szabo, 1997) "that create and distribute computational trust" (Frizzo-Barker et al., 2020, p. 12). These are "systems which automatically move digital assets according to arbitrary pre-specified rules" (Buterin, 2014, p. 1). They allow for the automatic execution of agreements between two parties (blockchain users) without the assistance of a third party (middleman). The algorithms are responsible for contract facilitating, verification, and enforcement. The transactions connected to the contract execution are fully trackable and irreversible.

Although in a widespread perception BC is mainly associated with cryptocurrencies (Mazambani & Mutambara, 2019), the vast range of possible applications have been considered by researches including finance (Schuetz & Venkatesh, 2020; Ghatpande et al., 2019; Westhuizen, 2016; Kinai et al., 2017), healthcare (Dhagarra et al., 2019), e-government (Khan et al., 2019; Lemieux, 2016), education (Bore et al., 2017), and the labour market (Bhattacharyya & Nair, 2019). The blockchain phenomenon has been analysed from various perspectives. They include, among others, the socio-technical context (Shin & Ibahrine, 2020) and digital trust (Shin, 2019). However, this technology's diffusion, especially among the young generation, remains to be investigated.

BC has been chosen by us purposely. It might be still perceived as an example of an emerging technology because despite its potential influence on the various areas of people's lives, its actual impact is still quite unpredictable. It should be noted that the vast majority of research works related to BC has concentrated on conceptual issues rather than on practical ones (Frizzo-Barker et al., 2020). On one hand, it is a so called "buzzword" that became popular in the media, and on the other hand it has been present in "reality" for a number of years. In our opinion it is a good example of an emerging technology with which IT students should be familiar, since it has been coined long enough ago to be known (and should be known) by IT students.

3.2. Survey

3.2.1. Research model

The preliminary results of investigating students' attitudes towards blockchain we have presented in (Dymek et al., 2020). However, we have extended this research considerably by proposing classification of the information sources and providing a thorough discussion of the sources' usage by different subgroups of respondents (students' working status, university type).

To illustrate the model's applicability we chose young people, specifically IT students. They come to work with a certain perception of the world, openness to new ideas and solutions. Their cognitive and imaginary perspectives are not closed in the organizational governance. That is why in our opinion they are shaping companies' future technology choices (see section 1.3). Of course, the question remains whether after entering the organizational environment their perceptions and attitudes towards technological innovations do not change (when they enter the corporate routine), but discussion of this issue is out of the scope of the current research.

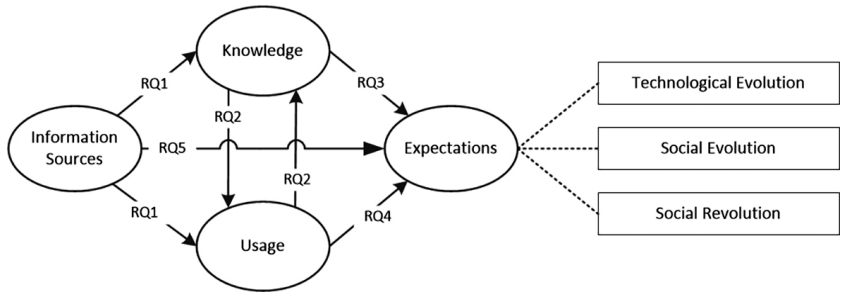

Figure 2. The Emerging Technologies Expectations Model applied to the blockchain case

Although BC is still perceived as an emerging technology, it has been present on the market for a number of years, and incorporates other existing technologies, therefore we have arrived at the conclusion that in the blockchain case it is rather pointless to expect its perception in terms of a "technological revolution". Hence, at the initial stage, we excluded this expectation from our model. The final research model applied to blockchain perception is presented in Figure 2.

We would like to answer the following research questions:

RQ1: Does the use of certain types of information sources impact the knowledge or usage of BC?

RQ2: Are there any relationships between the knowledge and usage of BC?

RQ3: Are there any relationships between students' knowledge and their expectations towards BC?

RQ4: Are there any relationships between technology usage and expectations concerning BC?

RQ5: Are there any relationships between the information sources used and expectations concerning BC?

3.2.2. Site of research

We conducted our research in Cracow, Poland. For centuries, Cracow was a vibrant centre of intellectual and economic growth. According to (Tholons, 2018), Cracow is the 6th best outsourcing destination in the world hosting such companies as: Akamai, Capgemini, Cisco, Google, HCL, HSBC, IBM, Motorola, Nokia, Sabre, and Samsung.

One of the key factors that contribute to the growth of the business environment is Cracow's academic heritage. It hosts the oldest Polish university, one of the oldest universities in the world – the Jagiellonian University, which was established in 1364. Other well-known Cracow universities include the AGH University of Science and Technology, Cracow University of Economics, and Cracow University of Technology. These institutions were the target group of our research since they offer various IT related courses, including computer science and applied informatics at undergraduate and graduate levels.

3.2.3. Survey items development

Based on our experience we developed a questionnaire. Its main goal was to assess the knowledge and usage of BC among IT students, to evaluate students' expectations towards blockchain and provide answers to the research questions. Our main goal was to assess the general knowledge concerning BC, hence we do not tackle highly specialised issues in the questionnaire. We were aware that the student population might be diversified as far as knowledge of this emerging technology is concerned. The questionnaire consists of a mix of closed-ended (including multiple-choice) and open-ended items (see Appendix for the list of the survey items).

3.2.4. Data collection and analysis

The survey was implemented using the G Suite Google Cloud package and was made available online between April and June of 2019. The link to the survey was sent via email to heads of relevant IT departments of the major Cracow universities listed in the 3.2.2 section, with a request to distribute it among students. The number of IT students at these universities is approx. 1500. As the number of returned questionnaires was 257 (including 256 valid responses), the response rate of our research reached 17.1%. Based on the modified Cochran Formula for smaller populations such a response means the margin of error is equal to 5.58%, with a confidence level of 95%. The data were analysed using descriptive and inferential statistics.

3.2.5. A proposition of assessing knowledge and usage

In order to analyse Knowledge and Usage of BC by respondents we developed two indicators: a knowledge factor (KF) that represents respondents' general knowledge of BC, and a usage factor (UF) that reflects the previous experience and readiness for the use of BC applications by respondents.

The knowledge factor was calculated using the answers to questionnaire items 3, 4 and 5 in the following way (see Appendix): question 3 answers scored from 0 to 11 points, one point for every correct answer; question 4 answers were scored from 0 to 6 points, one point for knowing the consensus method and two points for being familiar with its algorithm, and additionally one point for the correct indication of other algorithms; question 5 answers were scored from minus two to plus four, the lowest value assigned to the worst answer, the highest to the best answer. A weighted sum of points obtained from questions 3, 4, 5 was calculated; the weight being one with an exception to question 3, to which a weight of three was assigned, because it was the most complex question. Finally, the achieved result was normalized and expressed as a percentage of the maximum score. Based on the value of the KF, the following three levels of the respondents' technological knowledge were distinguished: low (L) indicating poor knowledge of BC ($KF < 30\%$); medium (M) indicating a circumstantial knowledge of BC ($30\% \leq KF < 50\%$); high (H) indicating good knowledge and understanding of the technological aspects of BC ($KF \geq 50\%$) (Dymek et al., 2020).

Since the most widespread and popular use of BC are cryptocurrencies, the usage factor was assessed on the basis that in a student population the usage of BC is reflected in the experiences and usage of cryptocurrencies (the first item in the questionnaire). UF was com-

puted as a normalized value of the sum of the points achieved by respondents (one point for knowing the mentioned cryptocurrency, two points for its usage, and additional two points for identifying other cryptocurrencies) and expressed as a percentage of the maximum score, i.e. eight. Based on the value of the UF, three groups of respondents were distinguished: low usage (L) covering respondents who have not had contact with cryptocurrencies (UF < 25%); medium usage (M) comprising respondents whose contact with cryptocurrencies is sporadic or narrowed to practically one cryptocurrency (25% ≤ UF < 50%); high usage (H) which includes respondents actively using cryptocurrencies (UF ≥ 50%) (Dymek et al., 2020). The border values for UF categorisation are slightly different from the ones for KF because they measure different attributes based on a different range of information.

3.2.6. Expectations assessment

Expectations towards BC were assessed on the basis of the answers to question 6 (see Appendix) in the following way:

- Technological Evolution – "BC used as one of many available database technologies utilized to solve specific problems in an innovative way",
- Social Evolution – "Public registers in various areas (administration, judiciary, science, medicine) where a high level of confidence is desired",
- Social Revolution – "Creation of new values (concepts), e.g. cryptocurrencies which can have a revolutionary impact on the society".

As it has been mentioned already in section 3.2.1 we decided to exclude the Technological Revolution as one of possible expectations, because BC has been introduced several years ago and has not had such kind of impact on Information Technology as should be demanded from a revolutionary technology.

3.2.7. Respondents' structure

Table 1 depicts the respondents' characteristics. For the purpose of further analysis, we distinguished three main categories of universities: business (Cracow University of Economics), technical (AGH University of Science and Technology and Cracow University of Technology), and academic (Jagiellonian University). To deepen the analysis, we also considered division into working and non-working students. The vast majority of the respondents were full-time students aged between 18 and 24, whereas part-time students were mostly below 30 years old, since in IT-type courses we do not encounter lifelong learners.

Table 1. Respondents' structure

	Category	Number	Gender [%]		Form of study [%]	
			F	M	Full-time	Part-time
University type	Business	105	6.3	34.8	28.9	12.1
	Technical	93	5.5	30.9	35.9	0.4
	Academic	58	4.3	18.4	22.7	0.0
Students' working status	Non-working students	150	8.6	50.0	57.4	1.2
	Working students	106	7.4	34.0	30.1	11.3
Total		256	16.0	84.0	87.5	12.5

3.3. Results

3.3.1. Respondents' distribution versus knowledge and usage factors

Table 2 presents the respondents' distribution as far as knowledge and usage factors are concerned in different subgroups. The largest group is made up of business students with a low knowledge factor and a medium or high usage factor. The second most representative group are technical-type students.

Table 2. Respondents' characteristics in different subgroups according to knowledge and usage factors

	Category	Knowledge factor [%]			Usage factor [%]		
		L	M	H	L	M	H
University type	Business	40	35	25	22	40	38
	Technical	34	42	24	25	45	30
	Academic	26	45	29	21	28	52
Students' working status	Non-working students	37	39	24	26	39	35
	Working students	32	41	27	18	39	43
Total		35	40	25	23	39	38

Note: L, M, H – low, medium, high levels of factors.

3.3.2. Information sources versus knowledge or usage

Since we focused our research on students at different levels of education, the basic types of information sources on which they build their knowledge and, consequently, their attitude towards BC should be discussed. Naturally, one could assume that the primary source of information should be classes during their studies or sources indicated during their studies. However, it should be remembered that students begin their studies already having some knowledge, often exceeding the earlier stages of education curricula since they might acquire knowledge by themselves, especially the knowledge related to their interests.

Following the previously mentioned approach to the creation of a classification of information sources (see. 2.1), six types of information sources used by students for acquiring knowledge about BC were distinguished. They are presented in Table 3 together with their characteristics in terms of accessibility, entry requirements, and credibility.

Table 4 shows the distribution of information sources used by respondents in relation to their KF and UF. The most popular sources of knowledge are popular Internet portals and direct social contacts. Professional Internet sites and scientific resources were of moderate popularity with an exception of users with high levels of KF and UF, who appreciate these sources of information at the highest degree. Unexpectedly, the lowest attractiveness gain traditional media and university courses. The average numbers of indicated sources of knowledge (among respondents with different levels of KF and UF) in different subgroups fell between 2.1 and 2.66, with more sources being pointed out by people with higher KF and UF. This result is consistent with intuition but has been supported by data.

Table 3. Classification of information sources

	Type	Examples	Form*	Accessibility	Entry requirements	Credibility
1	Popular Internet portals	News portals, social media including popular, non-subject-specific forums, blogs	Online	Very high	None	Not verified by specialists; use of far-reaching simplification
2	Traditional media	Television, radio, newspapers, popular-science magazines	Mass media printed resources	Very high	None	Not verified by specialists; use of far-reaching simplification
3	Professional Internet sites	"Grey literature" (Auger, 2017) (reports, whitepapers, working papers)"; industry portals including websites of companies dealing with a given issue, specialized forums, blogs	Online (the vast majority), some of them also available in a different form	High / Medium	Basic knowledge of the domain; familiarity with terminology	Non-uniform: some are subject to restrictive multi-stage verification processes, but some are based solely on the authors' knowledge; in the second case, information is verified and commented on by readers
4	Scientific resources	Research papers, monographs and scientific briefings	Printed materials, often available also online	Medium – requires effort from the potential recipient	Specialized knowledge of the domain	Several-stage verification: authors, reviewers, publishers
5	University courses	Classes carried out in the study program along with the recommended textbooks and other educational materials	People printed and online resources	Low – targeted to the specific/ selected group of recipients	Basic or specialized knowledge of the domain	Several-stage verification: the lecturers and verification bodies of the referenced resources (authors, reviewers, publishers)
6	Direct social contacts	Conversations with other people (family, peers) or discussions during meetings, video conferences/ workshops with professionals, discussion during lectures	People	Indeterminate: depends on the category of people - from low to high	Indeterminate: depends on the conversation participants' knowledge	Unverifiable directly, possible verification on the basis of the recommended sources

Note: *Classification based on Lee et al. (2012).

Table 4. Information sources' distribution in relation to knowledge and usage factors

Information sources	Total [%]	Knowledge factor [%]			Usage factor [%]		
		L	M	H	L	M	H
Popular Internet portals	63	63	65	60	55	68	62
Traditional media	14	18	12	12	29	11	8
Professional Internet sites	43	31	42	62	17	36	65
Scientific resources	43	38	38	46	33	49	43
University courses	11	10	13	9	10	12	10
Direct social contacts	58	60	53	63	64	63	49
Other	7	2	6	14	2	6	10
Average number of sources used by respondents	2.39	2.22	2.35	2.66	2.1	2.46	2.48

Note: L, M, H – low, medium, high levels of factors.

Table 5. Information sources in relation to university type and working status

Information sources	University type [%]			Students working status [%]	
	Business	Technical	Academic	Non-working students	Working students
Popular Internet portals	69	61	55	63	62
Traditional media	10	11	26	17	10
Professional Internet sites	45	40	47	40	48
Scientific resources	42	41	48	45	40
University courses	10	2	26	10	12
Direct social contacts	63	57	50	51	68
Other	5	6	10	8	5
Average number of sources used by respondents	2.44	2.18	2.62	2.34	2.45

Similar conclusions might be drawn considering the university type and students' working status (Table 5). In all respondent subgroups, the indication of popular Internet portals and direct social contacts as a source of knowledge was pointed out by about 60 percent of respondents. However, the analysis based on professional activity reveals differences between groups, i.e. working students more often indicate direct social contacts (68%) than popular Internet portals (62%). Similarly, the frequency of direct social contacts is significantly higher in the group of working students than in the group of non-working students, of which only 51% indicated this source. The lowest percentage of students indicated university courses as a source of knowledge regardless of the university type (10% – business, 2% – technical, 26% – academic). This can be seen equally clearly if we narrow the analysed group to KF = H, then as much as 86% of working respondents indicate direct social contacts, while in the non-working group this is only 44%.

Some responders indicated the Other sources category, providing mainly examples related to dedicated workshops and courses (e.g. connected with their professional activities) or Internet multimedia channels (e.g. YouTube). The limited number of responders that chose this category and the high variability of sources pointed out in the description section made us decide to consolidate them in a separate category.

3.3.3. Relationships between knowledge and usage

Table 6 shows the distribution of knowledge and usage factors for all respondents. For both factors, the characteristic of sub-groups with a given level of factor (L, M, H) is similar: the smallest percentage of respondents represent the low level of factor (respectively KF or UF = L) and the biggest percentage of respondents represent the middle level of factor (respectively KF or UF = M). When we compare the data taking into account both factors, we can see that the biggest sub-groups are those with the same level of KF and UF (see the diagonal in Table 6). Hence, the results indicate that the knowledge and usage are related – respondents who have the knowledge about BC are more willing to use BC-based solutions or inversely, respondents who have used the BC-based systems are trying to get more knowledge about this technology. However, currently we do not have enough data to decide what is the casual relationship between those two factors. This issue requires further investigation.

Both factors are measured on a nominal scale, hence to verify the statistical significance of the relationship between KF and UF the χ^2 test was performed. Due to the small size of the low category of UF (L), only two categories of UF were considered (L + M, H) for the purposes of the test. The results indicate the existence of a weak relationship between KF and UF (for significance $\alpha = 0.005$ and two degrees of freedom, the border value of the χ^2 test is 10.597 whereas the calculated value was 11.530 with Cramer Index V = 0.212). This might suggest that to some extent the usage is the verification of the knowledge.

3.3.4. Expectations and knowledge and usage factors

Respondents' expectations towards BC in relation to their KF and UF are depicted in Figure 3. Interestingly, students with a medium and high KF identify it primarily as a tool for Social Evolution, whereas respondents with low level of KF perceive it as a tool of Social Revolution (the lower the level of knowledge, the higher the expectations). A similar conclusion might be drawn in the case of UF: students with a low level of UF perceived it as a tool of Social Revolution.

Table 6. Respondents' distribution according to knowledge and usage factors

		Usage factor [%]			Total [%]
		L	M	H	
Knowledge factor [%]	L	12.1	12.5	10.2	34.8
	M	9.0	16.8	14.1	39.8
	H	1.6	9.8	14.1	25.4
Total [%]		22.7	39.1	38.3	

Note: L, M, H – low, medium, high levels of factors.

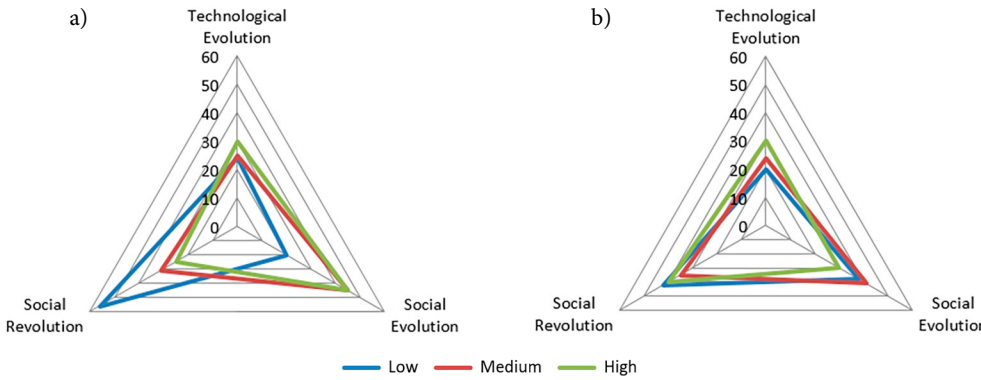

Figure 3. Students' expectations in relation to knowledge (a) and usage (b) factors [%]

In order to assess the relationship between expectations, KF and UF the χ^2 test was used. The calculated values indicate the existence of an average relationship between expectations and KF (for significance $\alpha = 0.001$ and 4 degrees of freedom, the border value is 18.47 whereas we obtained the value 21.67, with the Cramer index V = 0.296). In the case of UF, a similar relationship has not been detected.

The analysis of relationships between the particular types of information sources and the values of KF and UF only in the case of "Professional Internet sites" indicates the existence of a statistically significant relationship. The calculated values of χ^2 for KF and UF are respectively 13.94 and 36.98, which with the border value of 13.82 for $\alpha = 0.001$ and 2 degrees of freedom, indicates the existence of a weak and average relationship (Cramer V index is 0.23 and 0.38 for KF and UF, respectively). Thus, it might be concluded that the respondents' use of this source largely determines their knowledge about BC and their tendency to use solutions based on this technology.

Table 7 presents the application domains pointed out by respondents with different levels of knowledge and usage factors. The most frequently indicated areas of application are Trade, Traditional Banking, Administration and Logistics. Other areas are pointed out less frequently. It is worth noting that the number of indicated areas of applications significantly differs between groups with different KF and UF values. For both indicators, respondents in the H category indicate significantly more areas of applications than others. This is partly contrary to expectations. Respondents from KF = L have the highest expectations of the role of BC (Social Revolution), but at the same time indicate the least number of potential applications of this technology, which may indicate that their expectations do not have a solid, knowledge-based origin/background.

Table 8 shows the distribution of pointed out application domains in relation to expectations. Respondents with the Social Revolution expectation pointed out on average less than two areas of BC applications (below of the average for all respondents). This fact is connected with the low level of pointed out "Other" application domains by this group, and can raise the question "what is their imagination of a social revolution?". The respondents with the Social Evolution expectation pointed out more application domains than the other two groups.

Table 7. Application domain in relation to knowledge and usage factors

Application domain	Total [%]	Knowledge factor [%]			Usage factor [%]		
		L	M	H	L	M	H
Trade	46	47	46	45	45	42	51
Traditional banking	44	34	45	55	43	35	53
Administration (central, local)	31	12	30	57	26	22	43
Logistics	23	13	22	40	28	20	24
Insurance	16	8	16	26	19	9	20
Healthcare	14	2	13	32	9	13	18
Education	9	9	7	12	7	8	11
Public transportation	8	6	5	15	5	5	12
Other (please specify)	9	6	7	15	7	7	11
Average number of application domains pointed out by respondents	*1.99*	*1.37*	*1.90*	*2.98*	*1.88*	*1.61*	*2.45*

Note: L, M, H – low, medium, high levels of factors.

Table 8. Application domain in relation to expectations

Application domain	Total [%]	Expectations [%]		
		Technological Evolution	Social Evolution	Social Revolution
Trade	46	49	43	36
Traditional banking	44	51	49	36
Administration (central, local)	31	22	48	18
Logistics	23	25	27	19
Insurance	16	14	17	14
Healthcare	14	14	20	6
Education	9	14	8	6
Public transportation	8	8	9	5
Other (please specify)	9	10	9	5
Average number of application domains pointed out by respondents	*1.97*	*2.08*	*2.30*	*1.59*

3.3.5. Information sources and expectations

The distribution of indicated sources of information in relation to their expectations is depicted in Table 9. Column Total shows the percentage of respondents who pointed out the given source of information whereas the Technological Evolution, Social Evolution and Social Revolution columns present the percentage of students with a certain expectation who pointed out the given source. The expectations of respondents pointing to popular Internet portals as a source of knowledge are most often associated with Social Revolution, while in the group of respondents pointing out other sources, Technological Evolution is the most often mentioned expectation. The exception is a source of information described as "Direct social contacts", where the largest group of students pointed to Social Evolution.

Table 9. Sources of knowledge in relation to expectations

Information sources	Total [%]	Technological Evolution [%]	Social Evolution [%]	Social Revolution [%]
Popular Internet portals	63	59	62	67
Traditional media	14	21	9	13
Professional Internet sites	43	46	45	40
Scientific resources	43	52	40	38
University courses	11	16	12	6
Direct social contacts	58	59	65	50
Other	7	5	1	12
Average number of information sources pointed out by respondents	*2.37*	*2.57*	*2.35*	*2.27*

3.4. Analysis of results

As far as the relationships between information sources and knowledge and usage factors are concerned (RQ1), firstly, it should be noted that the average number of pointed out sources increases with the increase in the value of both factors. It is not surprising considering that the most popular sources of information are those connected with the Internet, including "Popular Internet portals", "Professional Internet sites" and "Scientific resources" (that are mainly accessible on-line via Internet). On the second place are "Direct social contacts", which can indicate that students have a strong need to share and verify their knowledge with other people, and are open for such kind of communication. Secondly, analysing the data in the groups of respondents according to the value of the KF and UF coefficients, there is a visible difference in the types and number of indicated information sources. This is particularly visible in the case of "Professional Internet sites", which might be perceived as one of the most reliable sources; students with a high level of KF pointed out twice as often this information source than those with a low level of KF (62% for KF = H and 31% for KF = L), and in the case of UF the difference in the frequency of indication is even more apparent (65% for UF = H and 17% for UF = L). It should be also noted that respondents with higher KF and UF indicated on average more information sources, which might suggest that knowledge or willingness to use the technology motivates the searching for additional sources of information. Surprisingly, the results of the investigation indicate that the role of traditional media and university education in the enhancement of knowledge and usage of BC is marginal. The low percentage of students who indicated university courses as a source of information may suggest that students who start their studies already have some knowledge acquired on their own, hence they do not perceive university courses as the major source of knowledge.

As far as information sources in the context of working and non-working students are concerned, only the difference in direct contact indication is noticeable (in favour to more direct contacts in the group of working students). This is in line with an observation that professional activity is conducive to direct knowledge exchange. In this context, a question can also be asked about the impact of the current situation related to COVID and the increased importance of remote work on this form of communication and gaining knowledge. This issue might comprise an interesting path for future research.

Taking into account the university type, a difference in the average number of indicated information sources has not been visible. Similarly, in working and non-working subgroups the averages are quite similar (2.45 vs. 2.34), but the group sizes were too small to draw conclusions.

The results of investigating the relationships between KF and UF (RQ2) indicate that there is a relationship between these coefficients, although based on the current research it cannot be directed in the sense of causality. This relationship can have a twofold interpretation: (1) people with greater knowledge are more likely to use BC or (2) people with greater willingness to use BC want to know more about it.

Interestingly, Social Revolution is the most frequently indicated expectation by respondents with a low level of both KF and UF (RQ3 and RQ4). It should be noted that students with high and medium levels of KF were more cautious and mostly did not indicate Social Revolution as their expectation. They recognise the influence of BC on society functioning but rather in the form of a lengthy process (Social Evolution). In all groups of respondents, it was visible that BC's influence has spread beyond the IT domain (hence, its influence is not limited to Technological Evolution). Summing up, as knowledge increases, expectations for BC's potential impact on the functioning of society decrease.

The results indicate that there is no direct relationship between information sources and expectations (RQ5). This is not surprising, considering the fact that it is not possible to extract the influence of a separate information source on the expectations. Acquiring knowledge is a cumulative and multistage process. The analysis of an average number of information sources in relation to expectations shows that an increasing number of sources moves the expectations from Social Revolution to Technological Evolution. It is similar to the previous observations (Table 4, Figure 3) concerning the relations between information sources, knowledge and expectations. However, these results should be taken with caution considering the relatively small group size, and they require further investigation.

4. Discussion

4.1. The model's applicability

Personal feelings or attitudes towards a certain emerging technology, expressed in the proposed model as "expectations", influence the tendency to use it in professional life. Therefore, the basic question that we have tried to answer relates to what shapes these expectations. The presented model shows that the main impact on expectations towards new technologies is shaped by various sources of information that affect expectations by: building knowledge about innovation (the knowledge factor) and encouraging the use of solutions incorporating a certain innovation (passive experience in using technology – the usage factor).

Identification of information sources on which people build their attitudes towards technology gives the opportunity to pursue a long-term policy of innovation promotion. These sources may differ depending on the field of innovation or the characteristics of the group of people under consideration, thus the possibility of influencing their content or selection may be different. However, the mere knowledge of these sources may be a valuable guide

when taking actions related to e.g. an emerging technology's promotion, changing attitudes towards the technology, or changing expectations.

The model is illustrated on a population of IT students whose characteristics fit to some extent into the "explorers" category (Parasuraman & Colby, 2015) (see section 2.1). The choice of IT students as the studied group results from the fact that they are one of the groups most open to innovation. Besides, due to the characteristics of their field of activity and interests, i.e. information technology, they must base their actions and decisions on verified premises (computational logic background). Nevertheless, with a high probability they will indirectly (expressing opinions) or directly (making decisions) influence technological choices in the near future, in the companies for which they will work. That is why it is worth knowing what their expectations towards emerging technologies are and how they are shaped.

In the example of using the proposed model, it was possible to identify the types of information sources that significantly influence the acquisition of knowledge about BC and the propensity to use this technology (see RQ1). Although the data do not show a direct relationship between sources of information and expectations (RQ5), the use of intermediaries such as Knowledge and Usage allows us to formulate a conclusion about the existence of an indirect relationship in relation to the identified sources (the relationship between the source, KF and UF (RQ1), the relationship between KF and UF (RQ2), and the relationship between KF and expectations (RQ3)).

However, it should be remembered that the types of information sources (and their characteristics) have been adapted to a specific group of people, in this case students. In the case of other groups of respondents, the classification of information sources should be tailored to the characteristics of the group under investigation and may differ both in the number of types and the level of detail. Similarly, the methods of defining the Knowledge and Usage factors should be adjusted.

The conducted research shows that the most popular sources are based on the Internet (types: 1, 3, 4 in Table 3), among which type 1 (Popular Internet portals) is the most frequently indicated source, regardless of the values of KF and UF for the respondents. Its characteristic feature is the ease of access and the lack of requirements for users. In order to influence the expectations, in such a situation it would be necessary to either influence the choice of information sources (see 4.2) or influence the reliability of information in popular portals (popularizing activities or supporting initiatives related to the credibility of the content (in the context of anti-fake-news)), or facilitate access to professional sources (type 3 and 4 of information sources in Table 3), and better tailor the content to non-professional people (reduce the entry requirements).

Expectations with regard to emerging technologies significantly influence the potential acceptance of these technologies in the future. This impact is not always positive, as exemplified by the augmented reality glasses developed by Google (see 2.4). Therefore, it is important not only to learn about the expectations of groups of people with different characteristics in relation to innovation, but also to identify sources of information from which they derive their knowledge about a given new technology.

The proposed model can be treated as a different perspective of TAM and its extensions since our view on innovation issues focuses on other aspects of the process of their imple-

mentation. To some extent, Perceived Ease of Use from TAM may have some relation to Usage in our model. We focus on the expectations towards technology (which may affect its acceptability) through the prism of the sources of information that shape these expectations. We believe that various sources of information, influencing the level of knowledge (Knowledge construct in our model) of a given technology and the propensity to use it (Usage), result in different expectations towards the effects of implementing (using) a given technology, and, consequently (in some cases even decisively) shape the future of new technologies (their level of acceptance and implementation).

We can explore attitudes towards emerging technologies at various stages of the educational process (bachelor/master). However, it should be noted that in the IT domain learning is a lifelong process. We investigated how the exposure to different sources of knowledge acquisition might influence the perception of an emerging technology and openness towards embracing it. We are aware of the fact that resistance to change increases with age. However, this issue is outside of the scope of our current research.

4.2. Limitations and future research

The main limitations of the conducted research were the size and detail of the questionnaire, the primary data source. There was a compromise between the desire to obtain data and the number of questions that respondents would be willing to answer. Besides, the response rate is acceptable for conducting the analysis, but is not fully satisfactory. Another limitation concerns the survey target group: we directed the survey to IT students from selected universities. Therefore, an interesting topic for future research is to extend the investigation to other target groups. Regardless of the more extensive scope of a target group, it would be interesting to repeat the research in the same target group, which would allow for the identification of changes in attitudes towards BC and the factors influencing these attitudes over generations.

During the research, we identified several issues requiring in-depth analysis. The most important aspects are: the process of shaping attitudes towards new technology (when, how, why, and what sources shape attitudes) and the way of alternating existing attitudes. The promising directions for future research are those related to the influence of knowledge sources on building attitudes, including the categorization of knowledge sources. Another important topic worth investigating is the impact of an individual's opinion on a given technology on the readiness to promote it in their future professional life. Verification of the proposed model in the case of other innovative technologies, not necessarily in the area of information technologies, e.g. autonomous transport might also be an interesting path for future research.

4.3. Contribution to research and practice

4.3.1. Theoretical implications

The result of the research contributes to the expanding of the literature concerning the acquisition of emerging technologies. From the theoretical point of view, the proposed model is an attempt to explain how attitudes towards innovative technologies might be shaped. The

role of the knowledge sources encourages not only focusing on the topics related to the types of knowledge sources and their quality, but also on answering the questions: why these and not other sources of knowledge are selected, and how these choices might be influenced. The authors have already undertaken research in this area and have developed an ontological representation of the knowledge acquisition process (Paliwoda-Pękosz et al., 2021).

4.3.2. Implications for practice

The identified relations between the sources of knowledge and attitudes towards BC show that the sources of knowledge might influence the attitude towards new technologies. This implies that the model might be used in shaping these attitudes. Additionally, the knowledge of the relationships can be used in activities promoting innovative technologies targeted at specific professional or social groups. For example, trying to influence the expectations of IT students by changing the information sources they use. These attitudes may have a significant impact on decisions regarding the choice of technologies by companies. Thus, they may affect the pace of adaptation (implementation) of emerging solutions.

In the case of BC, a promising potential area of influence are university courses that are relatively rarely indicated by the respondents. A possible form of action might be to incorporate BC-related content into classes in the early years of study and create dedicated courses in the older years.

Conclusions

Staring from the review of models and frameworks that are related to innovations in general, and to new/emerging technologies' adoption in particular, we developed the Emerging Technologies Expectations Model. It concerns an individual's perception of emerging technologies and the factors that might influence these perceptions. According to this model, knowledge and usage of technology influence the expectations towards this technology together with the usage of particular sources of information. These information sources might influence the knowledge and usage directly, and expectations indirectly (via knowledge and usage). The awareness of the factors that influence individuals' expectations is of vital importance, as individuals shape organisational policy concerning the adoption of new technologies. In this context, young people play an important role since they are usually open to new ideas, and by entering the labour market they will contribute to the future shape of the companies for which they will work. That is why we decided to show an application of the model on the IT student population. As an emerging technology, we have chosen blockchain, since in our opinion this is an example of an emerging technology with which IT students should be familiar. Especially for the IT student population and blockchain we developed the knowledge and usage factors that might represent Knowledge and Usage present in our model, and proposed the assessment of the students' expectations.

The results of the investigation of the applicability of the model to the IT student population and blockchain showed that students with a low level of knowledge and usage tend to have higher expectations towards blockchain (they perceived it in terms of a social revolution). Students who have experience with using this technology and considerable knowledge

about it have more cautioned expectations, and perceive it as a tool for Social Evolution. The analysis of the information sources used by students on the basis of the proposed information sources classification revealed that the students with high values of knowledge and usage factors rely mostly on professional, and therefore more reliable sources of information, and they derive information from more sources.

The proposed model might be applicable to other populations, however it will require modifications of the Knowledge, Usage and Expectations assessment. In our opinion, the proposed classification of information sources might be a starting point for the classification of information sources used by other populations, but it might require some adjustments.

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APPENDIX

Survey items

1. Blockchain technology (BC) is most often associated with the concept of cryptocurrency. Mark one of the following three options against each item: *I do not know*; *I know*; *I have used it*.

   Bitcoin; Ethereum; Ripple; Other (please specify)
2. Mark the main sources of information concerning BC.

   Popular Internet portals; Television, radio or other media; Specialized industry-specific Internet sites; Papers and scientific briefings; University classes and lectures; Conversations with other people; Other (please specify)
3. To what extent do the following sentences fit your perception of BC? Mark one of the following three options against each item: *Not applicable to BC*; *Applicable to BC but not crucial*; *Crucial for BC*.

   It is a distributed system; It is a database; It is a register that resembles an accounting book; Used for cryptocurrency transaction processing; Thanks to cryptography the operations are anonymous; Thanks to cryptography data are persistent; Enables databases with a high level of security; Ensures complete data security; Enables data processing with a higher efficiency than that of traditional methods; Thanks to cryptography frauds are not a threat; Used for processing of banking transactions
4. In the concept of BC, saving the content requires its authorization by specific instances. This authorization is based on various algorithms of the so-called consensus. Indicate which of the approaches listed below are familiar to you and to what extent. Mark one of the following three options against each item: *Not familiar*; *Familiar but I have not analysed its mechanism*; *Familiar with its algorithm*.

   PoW (Proof of Work); PoS (Proof of Stake); PoET (Proof of Elapsed Time); Other (please specify).
5. Mark the best description of the BC application for content storage.

   Can use any database (including commercially available databases, e.g. relational databases); Requires tailored, dedicated database systems customized to its specific forms of collected and stored content; Does not utilize database systems at all, because it relies on other solutions; I do not know how content is stored in BC.
6. Which of the BC applications are the most promising according to you?

   Public registers in various areas (administration, judiciary, science, medicine) where high level of confidence is desired; Creating of new values (concepts), e.g. cryptocurrencies which can have a revolutionary impact on the society; BC used as one of many available database technologies utilized to solve specific problems in an innovative way; Other (please specify).
7. Characteristics of the respondent.

   Gender (male/female); Form of study (full-time/part-time); Type of studies (undergraduate, graduate); Profile of studies (IT, technical, math/physics); Status (student, working student); University (Cracow University of Economics, Jagiellonian University, AGH University of Science and Technology and Cracow University of Technology)