Received: 8 May 2022 | Revised: 3 October 2022 | Accepted: 13 October 2022

DOI: 10.1111/geoj.12491

ARTICLE

THE GJ Royal Geographical Society with IBG

WILEY

Perceptions and imaginaries about the fourth industrial revolution between geographies of opportunity and discontent: Some reflections on the Italian case

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Funding information
Università di Pisa, Grant/Award Number: PRA_2020_15

Abstract

The pervasiveness of advanced technologies and their disruptive impact on society have spurred the debate on the emergence of a new industrial revolution and on its positive and negative effects, both at an individual and spatial level. This paper aims to contribute to this debate, focusing attention on the perception of changes related to the Fourth Industrial Revolution and exploring new methods of analysis of the manifestations of both techno-enthusiasm and opposition to it. Starting from the extensive literature in this field, the work adopts two research perspectives: the study of imaginaries and narratives developed around the Fourth Industrial Revolution, which convey different messages from social groups and places; the geographies of opportunity and discontent, which address the resentment expressed by some localities towards advanced technological models and growing inequalities. In this work the Fourth Industrial Revolution is not interpreted through data about the technological variables or interviews to protagonists of the phenomenon; rather, emphasis is on the points of view of non-institutional subjects and, in particular, the opinions expressed by people on the Web. For this reason, the sentiment analysis has been adopted to identify both positive and negative polarities and the relevance of specific feelings through the selection of key words related to the notion of the Fourth Industrial Revolution. The empirical analysis based on this methodology focuses on the Italian case in a specific period (first and second phase of the pandemic, from January 2020 to September 2021) and, at a local level, on the comparison between four medium-sized cities (Pisa, Lecce, Taranto and Terni). This paper also tries to extend recent contributions through the provision of new perspectives for the definition of policies designed with the involvement of the population and places regarding both the processes of technological change and the definition of new socio-spatial models.

KEYWORDS
Fourth industrial revolution, geography of discontent, imaginaries, Italy, perceptions, sentiment analysis

1 | INTRODUCTION

The diffusion of advanced technologies and the increasing pervasiveness of digital platforms, further strengthened during the COVID-19 pandemic, has fuelled the debate about their possible benefits and negative consequences. In fact, many scholars have discussed their impact on the economy and the society, as well as the radicality and speed of the changes generated by technological advances, diffusing the concept of Industry 4.0 or the Fourth Industrial Revolution (4thR) (Schwab, 2016). This concept is based on the combination of multiple technologies, such as Artificial Intelligence, Robotization, Internet of Things, Big Data, Additive Printing, Cloud Computing, Augmented Reality, Blockchain and synthetic biology (Doorsamy et al., 2020). The OECD (2017) has argued that this revolution, derived by the convergence of the above mentioned technologies, is rapidly transforming production processes and is determining disruptive effects for employment, skills, mobility, communication, well-being and the environment.

However, a unanimous opinion regarding the effects of the 4thR paradigm does not exist yet. On the one hand, in fact, it is argued that these technologies do contribute to social progress and represent an important competitive tool, especially for the most advanced countries and regions; on the other hand, others emphasise their 'darker' sides, both in terms of the excessively accelerated changes in work activities, in the dematerialisation of the economy and in terms of their possible 'dominance' over human creativity (Townsend, 2017).

Consequently, different narratives also emerge in the interpretation of the role of smart technologies in different aspects of human life (economy, society, health, place) (Avis, 2018). More specifically, these discourses are sometimes characterised by critical visions about the neo-liberal logic and the power relations imposed by the new technological paradigms and by the global tech companies (Feldman et al., 2021). Critics also often blame current tech-based development models, which tend to be monolithic and technocratic and which not all citizens and places identify themselves with (Caprotti & Cowley, 2019; Vanolo, 2014). Thus, it seems increasingly significant—as well as less studied by the literature on 4thR—to analyse not only the objective impact of new technological paradigms, but also the perceived dimension of changes and the positive and negative reactions of the population towards them.

As a matter of fact, while recognising the technological relevance for social progress and sustainable development, it can be assumed that the 4thR may increase, rather than reduce, spatial polarisation in the technology clusters, the social disparities digital divide and, finally, employment and income inequalities (Balland & Boschma, 2021; Pinheiro et al., 2022). All this could contribute to the strengthening of negative reactions, discontent, forms of resistance by individuals, groups and places. Consequently, the new technological revolution could fuel negative perceptions of different levels of development and influence the geography of discontent, examined by the literature, which considers forms of intolerance and protest voting (McCann, 2020), but also subjective perceptions of prosperity and inequality extracted from the Eurobarometer (Koeppen et al., 2021) and online hate behaviours (Denti & Faggian, 2021).

The present work aims at contributing to the debate on this specific issue, focusing attention on the perceptions related to the 4thR and exploring new methodologies to investigate expressions of both optimism and dissatisfaction emerging in social media at different spatial levels. The following two sections describe the theoretical framework, which considers and discusses two specific perspectives: (1) concerning the disruptive impact of the technological transitions and in particular the different socio-technological imaginaries, built around the notion of the new industrial revolution; and (2) regarding the relationships between development models based on knowledge and innovation and the geographies of discontent, considering narratives emerging on the Web. Section 4 describes the research methods and highlights the potential of the sentiment analysis, which has been used to examine different opinions expressed in the main social networks and blogs, regarding the processes of technological pervasiveness and digitalisation. The empirical analysis focuses on Italy, in the period from January 2020 to September 2021 and, at a local level, on four medium-sized cities, selected for their different paths and location: Pisa and Lecce (in Tuscany in Central Italy and in Puglia in the South, respectively), characterised by the presence of a university, high-tech entrepreneurship, digital infrastructures and touristic vocation; Terni and Taranto (in Umbria in Central Italy and in Puglia, respectively), marked by the presence of large plants in the steel sector, employment decline and environmental crises. The aims of the analysis at the two spatial scales is, on the one hand, to frame the phenomenon at a national level and in connection with the overall dynamics of

the country system, considering the period of the COVID-19 emergency; on the other, to stress the connections between perceptions and contextual factors, socio-economic trends on a local scale.

On the whole, this work intends to offer some theoretical and methodological keys in order to explore the complexity of the 4thR, focusing on the imaginaries and opinions about the economic, social and cultural changes produced by new technologies and also their connections to the contextual factors. In fact, we believe that this type of analysis can provide new insights for the definition of policies, not only regarding infrastructural components, but also new forms of participation of people in technological development.

2 | THE IMPACT OF THE FOURTH INDUSTRIAL REVOLUTION: TECHNOLOGICAL PROGRESS, SPATIAL TRANSFORMATIONS, IMAGINARIES

The aim of this section is to discuss the concept of the fourth industrial revolution from the point of view of its impact on the economy, the society and space, and in terms of discursive creation, which includes different types of imaginaries.

The notion of the 4thR emerged around 2011, starting from Germany and placing particular emphasis on Industry 4.0 policies and on the diffusion of advanced technologies in industrial processes, considered essential for the recovery of the European economy. These processes and policies have been activated in various countries, using different labels, with the aim of generating positive discontinuities, especially in terms of technological upgrading, smart factory spaces and new workers' skills.

The attention paid to digitalisation and technologisation processes has become central in Europe and in many countries worldwide since the 1990s, in correspondence with development models based on knowledge and high technology, and the growing dynamics of globalisation and international competition. It is therefore no coincidence that Schwab introduced the term 4th Industrial Revolution (4thIR) at the World Economic Forum in 2016, highlighting both the relevance of the new technological trajectories in the economic field, made more powerful by the combination between physical and cyber systems, and their disruptive impact at the social and spatial level (Doorsamy et al., 2020). De Propis and Bailey (2020) underline the emergence of a new techno-economic paradigm based on a linear evolutionary trajectory from the first to the fourth industrial revolution, capable of enhancing the impact of technological changes in production models in terms of greater productivity and flexibility, connections between companies and consumers, development of new products and services, contribution to regional transformations. Capello and Lenzi (2021), through an analysis of European regions based on the patents related to Industry 4.0 technologies, have shown how the current dynamic towards the 4thIR, while confirming the persistence of polarisation processes, can also represent an opportunity for some less innovative areas. The diffusion of infrastructures and digital platforms has also been contributing to the transformation of work methods and related geographies, producing a wide debate on platformisation processes in various economic sectors (from industry and tourism to e-commerce and food distribution) and different areas of social life and daily spaces (Capineri & Romano, 2021; Kenney & Zysman, 2020).

In addition to the transformations activated by the diffusion of technologies, the narratives and imaginaries developed around the 4thIR are important for the interpretation of its impact, since they convey different messages and can influence opinions of various social groups and places concerning the meaning of this phenomenon. On the one hand, socio-technological imaginaries have emerged that recall the disruptive impact of Industry 4.0 technologies in terms of boosting economic growth and improving working conditions through their use in different fields (Brynjolfsson & McAfee, 2014; Vanderborght, 2019). As argued by Jasanoff (2015), behind this notion there are collective visions of desirable futures, which are institutionally stabilised and externally communicated, based on shared meanings of forms of social life that can be reached through advances in science and technology. Recurring keywords such as digitalisation, robotisation, artificial intelligence, smart factories, and interconnectivity, have also entered the scenario of media representations, and foreshadow a change in the economy and society, driven by the transformative power of technologies.

However, alongside techno-enthusiasm narratives, dystopian visions also emerge relating to: the future of work in terms of job losses and the post-work era; the excess of digitalisation and domination/surveillance of platforms and machines on activities and human behaviours; the diffusion of socio-economic development models promoted by neo-liberal and technocratic logic, in which not all people and places are recognised; the real and perceived rise of social and spatial inequalities (Clifton et al., 2020; Kuzmenko & Roienko, 2017; Zuboff, 2018). These imaginaries express sentiments of technophobia and various conflicting feelings linked to the digital divide and social and spatial polarisation of jobs in terms of skills and wages; the growing loss of jobs and increasing unemployment, especially for the medium-low levels; the gap between deskilling and upskilling people, job insecurity and precarisation; the hegemony of technologies

and the growing power of digital capitalism (Barns, 2020; Fraser, 2019). Consequently, investigating both the relationship between technological trajectories and regional development, and the discourses produced around this topic in their contextual connotation are becoming increasingly relevant.

3 | TECHNOLOGY-DRIVEN DEVELOPMENT: GEOGRAPHIES OF OPPORTUNITY OR DISCONTENT?

In this section, we recall the notion of 'geographies of discontent', elaborated in the last years to describe the sense of dissatisfaction of some communities and localities towards real and/or perceived dynamics of socio-economic decline, in comparison to more prosperous areas (McCann, 2020). The aim is to verify whether development models based on advanced technologies can influence geographies of opportunity or discontent linked to the perceptions of positive or negative effects of the 4thR.

Since the 1990s, the literature on the geography of innovation has significantly expanded and has highlighted both the socio-economic and regional impact of technological evolution, the contextual factors that favour the production of new knowledge and the clustering and smart specialisation in specific regions and cities (Kogler & Whittle, 2018; Lazzeroni, 2010). Investments in the creative and high-tech sectors, as well as in smart technologies and digital infrastructures, have been progressively placed at the centre of regional and urban development policies (Yigitcanlar & Inkinen, 2019), nourishing trends towards techno-enthusiasm and hyper-connectivity in local institutions and conditioning their communication strategies (Kitchin, 2015).

However, in more recent years, scholars have also observed the potential negative effects and the sentiments of disappointment connected to development models based on technological innovation, which has led to different situations of prosperity, concentration of activities and human capital in some cities and regions, but also persisting gaps between technology leader regions and laggard ones (Corradini et al., 2021; Iammarino et al., 2019).

The increase in spatial divergences and marginalities has fuelled the geography of discontent that is, the reaction and sense of dissatisfaction of communities and localities in the face of dynamics of growing inequality (McCann, 2020; Rodriguez-Pose, 2018). Therefore, not only do the objective socio-economic conditions, levels of wealth and employment, and infrastructural characteristics seem to become even more relevant, but also the perceptions of profound differences in perspective, quality of life and development opportunities in comparison to populations living in prosperous areas. From an analytical point of view, the geography of discontent has been studied considering the link between regional economic performance and political implications, expressed with the recent growth of populism and votes of protest in discontinuity with respect to the past (Dijkstra et al., 2020). In examining the discontent of regional laggards, other authors (Díaz-Lanchas et al., 2021; Koeppen et al., 2021) use individual and social data from the European Social Survey and the Eurobarometer and find the place-based interplay between contextual and citizen's material conditions and subjective perceptions.

All this highlights the importance of combining quantitative measures of development and inequalities with more qualitative analyses aimed at identifying perceptions of gaps by the population and opinions regarding future technological prospects. Therefore, it is also significant to contribute to the analysis of well-being and discontent, examining different opinions with respect to technology-driven development models: on the one hand, feelings of trust, prosperity, opportunity; and on the other, fear, anger feelings like 'people and places left behind'.

In recent years, such manifestations of aversion and discontent or optimism and trust about the impact of emerging technologies on social innovation and quality of life have found spaces of ever widening expression on social media (Denti & Faggian, 2021), a space which has been amplified during the COVID-19 emergency. In fact, the pandemic has contributed to a clearer emergence of digital divide and inequalities at different scales (inter-regional and intra-urban), with a widespread disillusionment in the face of the socio-economic crisis and of the future recovery, as well as high expectations regarding EU funds and the destination of the huge resources made available (Rose-Redwood et al., 2020). At the same time, the health crisis has also given even greater evidence to the relevance of technologies and digital platforms for smart working, essential services, technological modernisation and digitalisation in companies and institutions, bringing out attitudes and rhetoric of techno-enthusiasm, opposed to phenomena of resistance to excesses of platformisation and of the dynamics of profiling and control of surveillance capitalism (Kitchin, 2020).

In this framework, the Web has been further configured as a privileged context for the production, co-creation and sharing of discourses, texts and images that convey both positive and negative perceptions and opinions on certain phenomena and in turn condition their representations and practices experienced in certain social contexts and places

(Albanese, 2021). Consequently, interpreting the 4thIR also requires listening to the Internet population and to their points of view, which may differ from the most dominant ones and possibly claim development models more oriented towards the impact of technologies in the social field and in terms of spatial justice (Schrock, 2019).

4 | REPRESENTATIONS OF THE 4THIR IN SOCIAL MEDIA: METHODOLOGIES OF ANALYSIS

A methodology based on semantic analysis—sentiment analysis (SA)—has been used to understand what perceptions, imaginaries and expectations are being generated in the social media around the 4thIR, at the urban scale, in four medium-sized Italian cities: Pisa, Lecce, Taranto and Terni.

Sentiment analysis is a methodology widely used in several research fields, with applications in political and economic analyses (Hovy, 2015; Hu et al., 2020), which analyses people's feelings, opinions and emotions in relation to specific entities and phenomena. It has also proven interesting in geographical research and regional studies because it makes it possible to analyse narratives emerging on social media and referring to specific places (Albanese, 2017; Zivanovic et al., 2020).

The nuances of feelings and opinions analysed by SA are typically expressed as short texts, videos or online scores (rankings), which are selected and organised into three macro-categories: *polarity* (positive, negative and neutral), *context* (channels in which the opinions are expressed) and *content* (most relevant words). Numerous SA techniques exist (see Beigi et al., 2016), all of which are useful to extract opinions from the web, analysing their subjectivity and formulating numerically qualitative information. An overview of the main SA techniques used from 2008 (Pang & Lee, 2008) to today (Krishna & Jagadeesh, 2021) offers the following four types of sentiment disambiguation: at word, sentence, aspect and concept levels. The one used in this study, with the App2Check software, is word level disambiguation.

As Qazi et al. (2017) pointed out, the advantages of SA are linked to the possibility of using a large amount of comments, left on the web without the filters and the conditioning which may characterise direct interviews. On the other hand, its limits are connected to the difficulty of framing the involved individuals with data and information such as age, place of residence, sex, qualifications, and so on, and identifying with precision the polarity of opinions, often consisting of opposing comments, which make the system's surveys neutral. This may also indicate the ambiguous role played by technology for future perspectives (Ford & Graham, 2016).

The present work uses the approach discussed above to exploit the semantic data offered by the Web to support social science research on populations. The analysis opens with a first listening phase, in the form of an in-depth investigation of the Web, operated through keywords on a search engine. This is useful for understanding the environments in which the topic of our interest is present in order to subsequently include the most appropriate (social media) analysis for our research in the software. In this case, after the preliminary phase of listening to the Net, the mass social networks Instagram, Facebook, Twitter and YouTube, and specific blogs were interrogated through the App2check software. It is necessary to include mass social media to detect sentiment, the communicative and perceptive wave that makes online communication more widespread and pervasive than any other medium before it.

To select the sources, the same keywords relating to the 4thIR were entered in each virtual communication environment, considering the most frequently recurring terms on this topic in the scientific literature and in general communications (Chiarello et al., 2018; Eun & Woo, 2020; Table 1).

The first group includes words related to Industry 4.0 technologies and digitalisation, while the second group includes the words that tend to express feelings which can be related to the 4thIR. The words from the second group are divided into four positive and four negative words.

To outline the different scales of analysis, which are national (Italian) and urban (cities of Pisa, Lecce, Taranto and Terni), the mentioned keywords were used with specific approaches. A national scale survey, in Italy, was based on the selection of the language of the posts to be analysed, which were all in Italian, explicitly asking the software to extract messages and comments in Italian only. The reason why English words were also included among keywords lies in the fact that many of these topics are normally dealt with using the corresponding anglicisms.

For the urban scale, a semantic filter was set up to collect geo-referenced comments. This filter consists of the combination of the name of the city with the 'AND' connector, asking the software to provide semantic results only if the name of the city also appears in the comments in addition to one of the topics divided by 'OR'. Therefore, for the urban-scale survey, the request entered in App2Check was matched with the combination of the two groups of words, plus *AND 'Pisa'*

TABLE 1 Group 1 and group 2 keywords.

Group 1	Group 2
'Machine learning' OR 'Intelligenza artificiale' OR 'Artificial intelligence' OR 'Digital platforms' OR 'Piattaforma digitale' OR 'Digitalizzazione' OR 'Digitalization' OR 'Big data' OR 'Robot' OR 'Robotizzazione' OR 'Robotization' OR 'Automatization' OR 'Automatizzazione' OR 'Additive manufacturing' OR 'manifattura additiva' OR 'Stampante 3D' OR '3D Printing' OR 'Realtà aumentata' OR 'Augmented reality' OR 'Cloud Makers' OR 'Industry 4.0' OR 'Industria 4.0' OR 'Quarta rivoluzione industriale' OR 'Fourth industrial revolution' OR 'Rivoluzione digitale' OR 'Digital revolution' OR 'IOT' OR 'Internet of Things'	'crescita' (growth) OR 'lavoro' (work) OR 'progresso' (progress) OR 'benessere' (well-being) OR 'crisi' (crisis) OR 'disoccupazione' (unemployment) OR 'scontento' (discontent) OR 'disagio' (disease).

or *AND 'Lecce' or AND 'Terni' AND 'Taranto'*. The reference time range was between 1 January 2020 and 10 September 2021.

To evaluate the sentiment associated with the extracted comments, the content of each post was analysed using a sentiment classifier that assigned a score related to the emotion expressed by the message. The classifier used by App2Check incorporates a lexical approach that uses word dictionaries and assigns such a varied score and colour: starting from 0, intense red colour (maximally negative), up to 5, dark green (maximally positive). A score of 2.5, in yellow, represents a neutral sentiment. The intensity of the colour determines the strength of the sentiment: the darker the colour, the more polarised the sentiment. In the topic clouds, grey words can also be noticed, which refer to a sentence context to which no specific opinion is associated. The size of the words in the topic cloud depends on the frequency with which they occur.

Even when more qualifying adjectives and/or more emotions in a sentence exist, the attribution of sentiment is identified by a single number which, in a similar case, derives from the average of the sentiments expressed in a sentence. Therefore, in the case in which two opposite opinions are expressed in a sentence, the sentiment is expressed by an average between the two feelings, therefore leading to a neutral yellow result. To solve this problem, the comments analysed in this study were read one by one in order to take note of the calculation of these averages. Subsequently, to improve the accuracy of the assigned score/colour, the App2Check software offers the possibility of correcting the classification of the sentences as negative, positive or neutral.

5 | CITIZENS' PERCEPTIONS OF THE 4THIR IN ITALY: SOME RESULTS FROM THE SENTIMENT ANALYSIS

5.1 | Examining 'sentiment' at national level

An initial investigation about citizens' perceptions of the 4thIR was conducted in Italy on a total of 157,080 posts, with a search process that extended from 1 January 2020 to 10 September 2021. The topic cloud, shown in Figure 1, summarises all the dashboards obtained from the single word crossings of groups 1 and 2. First, it is interesting to note how the word *revolution* does not emerge in the topic cloud, since it was mentioned very rarely.

Second, as the prevailing colours in the image show, the extrapolated comments report a strongly negative sentiment that becomes particularly dense around the word *unemployment*, which is larger and redder than all other words. This means that it is the most cited one in combination with the words from group 1 and that it is also accompanied by a feeling which is polarised towards zero. The average sentiment of the topic cloud is 1.3, which is very low.

Reading the comments one by one, shared collective perceptions spread virally around this word and are strengthened through the electronic word of mouth of the Internet. Some of the comments summarise the sentiment relating to the 4thIR stand out, representing the main issues on which Italian speakers express their opinions:

> Youth unemployment at an all-time high, artisans are struggling to find staff.
>
> (Mattia, on Twitter, 24 April 2021)

> The advance of deregulated artificial intelligence will increase unemployment.
>
> (Kushiriki, on Facebook, 1 May 2021)

FIGURE 1 Topic cloud for Italy

> Digitalization must be the engine of the re-launch because it allows us to overcome the technological gap that creates new forms of social inequalities and increases the risk of a non-inclusive recovery
>
> (Paola, on Twitter, 14 August 2020)

In addition to the word *unemployment*, the presence of the term *poverty* in the topic cloud can also indicate critical conditions in front of the pervasiveness of technology, which risks dominating and producing job losses, as well as fuelling inequalities. Indeed, these results highlight a feeling of fear and resentment linked to the social and generational polarities that the 4thIR would supposedly bring with it.

Less recurrent, but still present in the topic cloud of the most frequent words, are the terms *connection*, *signal* and *reached*, all of which have a negative sentiment. Through these words, a statement emerges concerning the digital divide caused by poor connections and low penetration of technologies in peripheral and mountain areas, which are not yet equipped with sufficient infrastructures. Moreover, contextualising the analysis from an historical perspective, the data were extracted in the period of the COVID-19 pandemic, during which digital infrastructures represented the borderline between those who were able to remain active, with regard to work, school and social relations, and those who suffered most from forced isolation. Artificial intelligence (AI) is coloured in yellow and this colour expresses a neutral sentiment; however, this value is calculated from the average of opposite sentiments placed side by side with AI; from reading all the comments, in fact, the snippets in which AI appears express either very negative (technological) or very positive (techno-enthusiasts) sentiments, highlighting once again the gaps between the disadvantaged and the favoured by technologies.

In the Cloud tag, the words with a positive sentiment, in green, are small, showing a low recurrence. By eliminating *RaiPlay*, which explicitly refers to a television channel, the first word with very positive sentiment is *robotizzazione* (*robotization*). All comments that contain this word have positive sentiment, as evidenced by the examples below:

> Enabling platforms, #robotization #digitalization, are the key to #innovation and the growth of the national production system.
>
> (Maura, Instagram, 15 May 2020)

> The economic risks of climate change and the virtuous links between #robotization #digitalization and #economicrecovery #G20.
>
> (Francesca, on Twitter, 8 September 2021)

> Enabling platforms, #digitalization, #robotization are the key to #innovation and the growth of the national production system.
>
> (Mikki, on Facebook, 12 January 2021)

Basically, when reading the conversations in extended form, a negative attitude emerges about the current state of things, especially in terms of unemployment and the loss of prospects for young people, while there is a cautious positivity regarding the national situation of digitalisation and future prospects.

5.2 | Focusing on urban analysis

In the transition from the national to the urban scale, the goal is to interpret more carefully the relationship between the opinions detected and the local characteristics, and to carry out a comparative analysis between narratives on the 4thIR emerging at Italian level and at the four urban case studies: Lecce, Pisa, Taranto and Terni. These four cases, which are similar in terms of demographic size, were selected to compare the perceptions and imaginaries in medium-sized cities located in different areas and with divergent vocations. The aim is therefore to highlight the connection between the results obtained from the SA and the place characteristics in the presence of distinct development trajectories.[1] Lecce and Pisa (95,035 and 89,969 inhabitants respectively as of 31 December 2020) are characterised by the presence of universities, research centres[2] and the presence of the high-tech, cultural and tourism sectors. Taranto and Terni (190,717 and 107,982 inhabitants respectively as of 31 December 2020) are strongly conditioned by the activity of a large heavy industry, the steel plant of ex-Ilva, currently owned by Acciaierie d'Italia in Taranto and AST (Acciai Speciali Terni SpA), founded in 1884 and currently controlled by the Arvedi group, which is specialised in processing and distribution of steel, in Terni.

The methodology used for the analysis is the same as has previously been described. As mentioned above, 'AND Lecce', 'AND Pisa', 'AND Taranto', 'AND Terni' were added to the two groups of words used at the national scale to make a software-based geographical selection.

An overall view compared with the national results shows that at the urban level the topics of discussion are much more fragmented. In fact, in Figure 1, there are fewer words than those present in Figures 2–5: discussions relating to

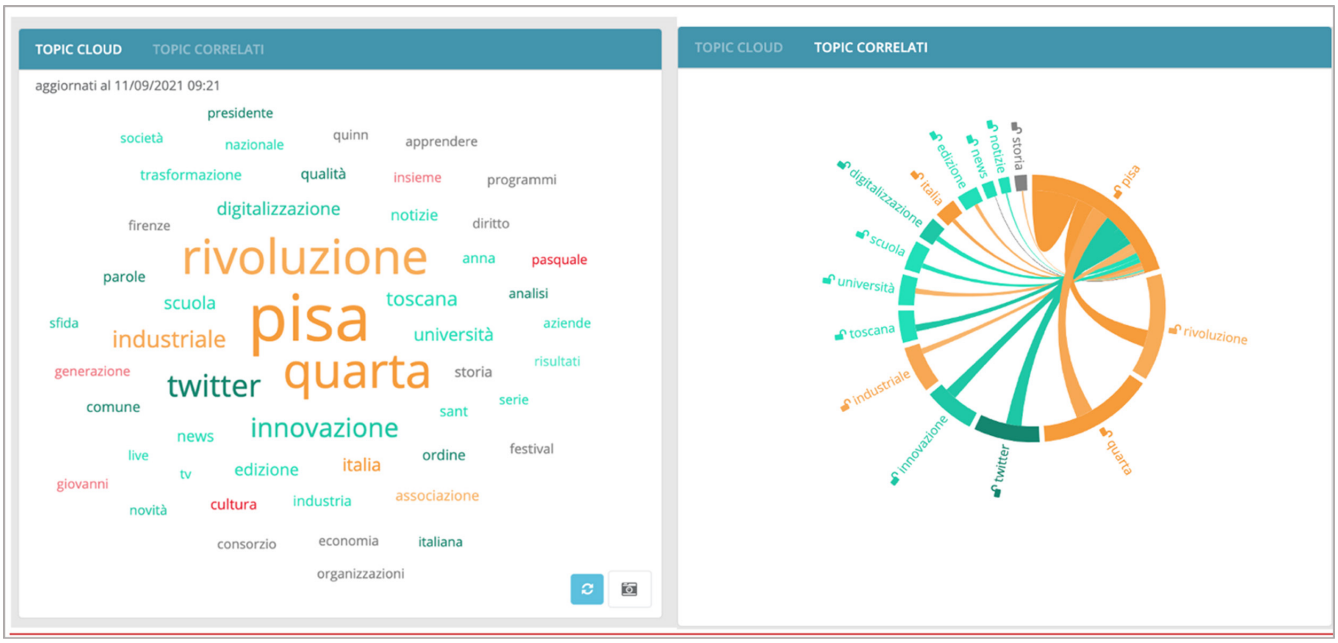

FIGURE 2 Topic cloud for Pisa

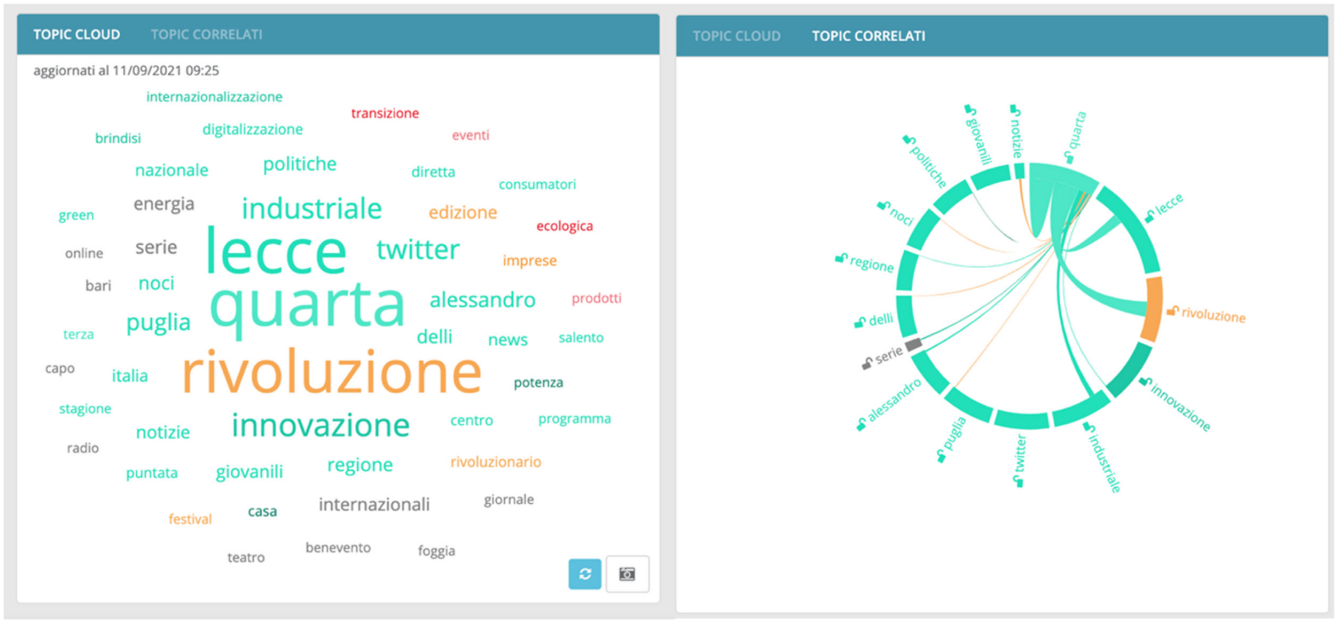

FIGURE 3 Topic cloud for Lecce.

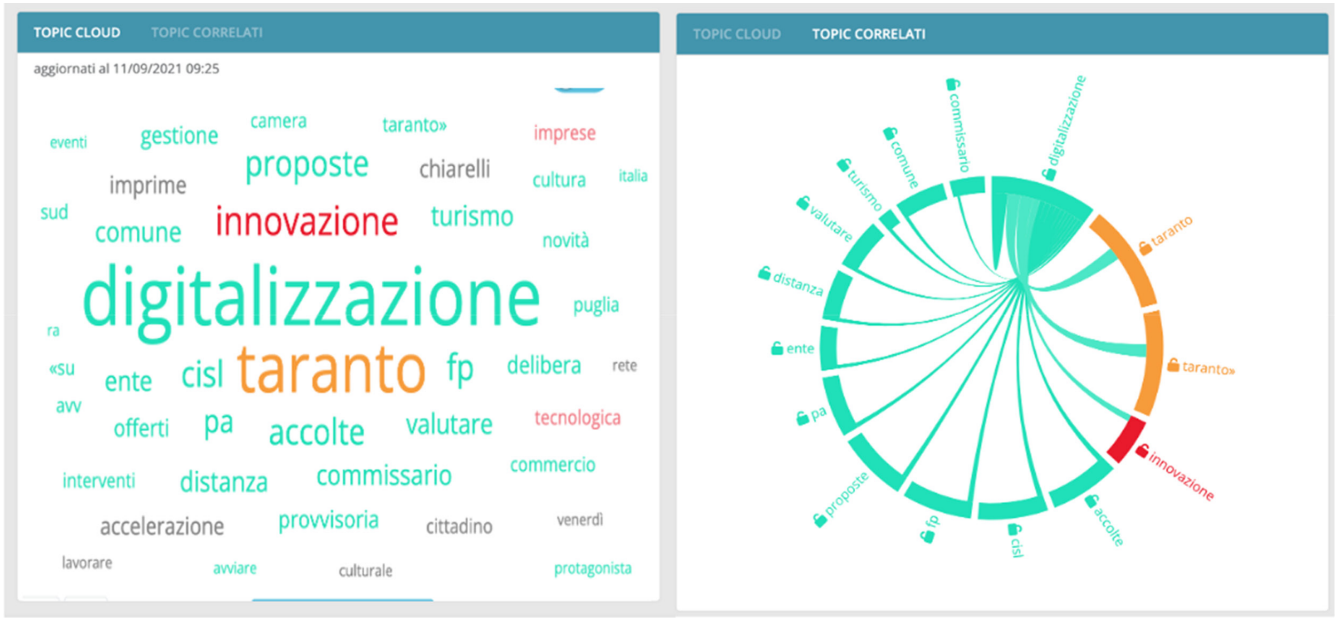

FIGURE 4 Topic cloud for Taranto.

the 4thIR are more limited and at the same time more frequent at the national level, and they mainly concern employment. Moreover, while a negative sentiment (red words) prevails on the national scale, it is exactly the opposite at the urban scale. In fact, the green colour prevails in these cases, representing a positive sentiment in Pisa and Lecce that reaches an average of 3.98 (Lecce) and 3.87 (Pisa) and also in Taranto (4.67 the highest average) and a neutral value in Terni (2.92). The perception of this optimism with respect to the 4thIR and digitalisation in Pisa and Lecce can also be attributed to the socio-economic factors and the good levels of research and investments in smart technologies, which is also highlighted by the good positions of the two cities within the ICity Rank 2021, the index of digital transformation in Italy. Pisa and Lecce are in fact well positioned, with an advanced level of smartness and digitalisation (Pisa 14th and Lecce 27th). Taranto and Terni deserve a different discussion. In Taranto, *tourism* appears from the related topics with the word *digitalisation*. Since Taranto has been suffering for many years from environmental problems (and related health

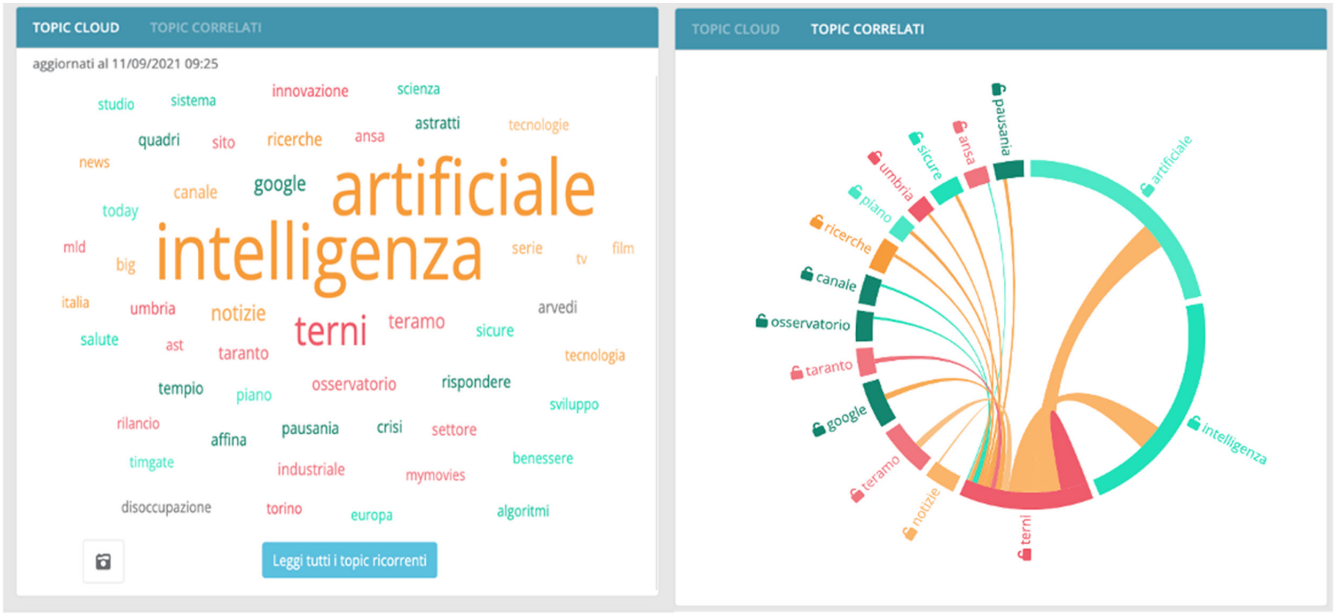

FIGURE 5 Topic cloud for Terni.

issues) caused by the steel plant, located not far from the city centre, the hypothesis could be advanced that digitalisation is considered an optimistic perspective in relation to the worse alternative, that is, the steel industry. Terni deserves a separate consideration because it is the least green of the four cities analysed. In fact, if we look at the words in red, we notice that many of them are city names, others are off-topic. Therefore, it is also interesting to direct attention towards the green words: *welfare*, *development*, *safe*, *science*, *study*, *system*, *algorithms*, *health*, and so on.

In addition to the topic cloud related to Pisa, Figure 2 also shows the image of the 15 main topics and how they are connected to each other in the sentences extrapolated from the Web; 108,809 posts and comments were analysed over the period considered. We note that there is no single word that carries a negative sentiment among the top 15 most recurring ones. It is also necessary to look at the small-sized words with low frequency to find traces of negativity, and there are only five of them in the whole topic cloud: *together*, *generation*, *young people*, and *culture*. The presence of words in red shows that there is also concern about the loss of work generated by the automation of production processes at the urban level. The most recurring (larger) words have a positive sentiment (green)[3]: *innovation*, *Tuscany*, *university*, *school*, *digitalisation*, *edition*, *news*.

The posts and comments show that the main positive elements are about the field of education, the university and its increasing digitalisation. The following comments were selected among those that can summarise the narrative on this theme in Pisa:

> From engineering for industrial design to courses in sustainable innovation in viticulture and oenology: the University of Pisa's step into the future!
>
> (Valeria, on Facebook, 29 July 2020)

> In Pisa the academic world and the #University must prepare the push for #social transformation, for #innovation. We must then focus on the #transnationality of #research.
>
> (Ambra, on Twitter, 25 September 2021)

> I'm going to #Pisa for the Talent's Tour on artificial intelligence and robotics for the fight against climate change https://scl.io/wjDmYEA
>
> (Claudio, on Twitter, 5 February 2020)

The same positive opinions also emerge in the case of Lecce, for which 115,013 comments were extracted. The only words with negative sentiment and with a very low frequency, are *transizione* (*transition*), *ecologica* (*ecological*), *eventi*

(*events*) and *prodotti* (products), while the prevalence of positivity is observed. Looking at the 15 main topics in Figure 3, we note[4]: *innovazione* (innovation), *industriale* (industrial), *Puglia*, *regione* (region), *politiche* (politics), *giovanili* (youth), *notizie* (news), *quarta* (fourth).

The impact of technologies in Lecce is perceived as positive, as can also be seen from the comments selected:

> We are witnessing a real revolution in Lecce, in which the economy and products are increasingly interconnected, digital, autonomous and intelligent.
>
> (Martina, on a Blog chatroom, 1 September 2021)

> Tweet #Innovation, #data, #digitalization to encourage business development, improving processes, reaching consumers in the most effective ways, predicting behaviours to act in advance and direct investments. #Puglia #Lecce.
>
> (Sasha, on Twitter, 13 May 2020)

> Lecce, inauguration of the biomedical innovation centre.
>
> (Goffredo, on Twitter, 24 June 2021)

In the case of Taranto, only three words are in red, that is, negative. Out of 95,030 comments extracted, only 430 are negative and refer to the lack of innovation, technologies and businesses. Focusing on the 15 main topics in Figure 4, we observe the relevance of the word *digitalizzazione* (digitalisation) and its potential impact on different context: *turismo* (tourism), *comune* (municipality), *PA* (public administration).

These results lead us to read all comments to deepen the relationship between digitalisation and tourism. As can be seen in the comments below, extrapolated from the most significant and emblematic related topics, we see tourism, accompanied by digitalisation, is expected to be the best and most likely alternative to heavy industry with a high environmental impact, which has become unsustainable.

> We have hope: tourism and digitalization will save us. #NOILVA
>
> (Letizia, on Twitter, 4 July 2021)

> Waiting for Digitalization! We have sea, heritage and culture, We just need proposal! What about them?
>
> (Giaco, on Twitter, 1 June 2021)

> If ILVA closes down we can survive! Tourism, Digitalization, what else?'
>
> (Spartacus, on Twitter, 11 June 2021)

In Terni, 93,002 comments were extracted, and in this case we observe contents that are very different from the other three cases. In fact, there is a great variety of views and comments that are difficult to summarise. While in the previous cases, reading the comments made it possible to understand the main themes around the 4th IR, in the case of Terni the view is more fragmented (this is evident from the larger number of words in the topic clouds) and furthermore, the fact that the words are all small in size points out that no single theme is really dominant. It is rather peculiar that the words *intelligence* and *artificial* are yellow, neutral, but green in aerogramme. This happens because in the topic cloud the words are considered in their absolute value, while in the aerogramme they are considered only as many times as they match the 15 most recurrent topics. Thus, a peculiarity here is that *intelligence* and *artificial* are always positive when matched with the relative most frequent topics.

We decided to extrapolate the most significant comments following the suggestions of topic correlation, just like the previous cases. The most significant phrases are the following ones:

> Is there any news about this artificial intelligence and how it will save us from extinction?
>
> (Giovanni, on Facebook, 19 April 2021)

> Google and artificial intelligence are the new medicine.
>
> (Tubi, on Facebook, 28 August 2020)

The observatory has become beautiful thanks to artificial intelligence. See!

(Mari, on YouTube, 30 September 2020)

In conclusion, at the urban level, in addition to a polarisation between techno-enthusiasm (in particular) and techno-discontent (rare), we can interpret the positioning of perceptions on the 4thIR within what Jones (2016) has defined technological utopianism or dystopian presentiment. Sentiment analysis seems to highlight manifestations of technological utopianism, in which the social context appears to be passively affected by the transformations exercised by robotisation and digitalisation; therefore, the feelings of doubt and expectation show the difficulty of people to express themselves on the long-term effects of the fourth revolution.

6 | CONCLUSIONS

The increasing pervasiveness of advanced technologies is determining profound changes in economic, social and territorial assets. Investigating the development dynamics and material transformations of such an impetuous digital process, including its more problematic sides, represents one of the most interesting challenges to which different scientific disciplines, including geography, are urged to respond.

This paper has tried to contribute to the interpretation of the 4thIR, by introducing a critical analysis of the phenomenon. With regard to the theoretical approach and the research questions, we think it is increasingly important to study the narrative dimension of the phenomenon and therefore enter the black box of socio-technological imaginaries, which often oscillate between feelings of techno-enthusiasm, mainly focused on the advantages of the pervasive use of machines and digital tools, and tendencies of techno-phobia and discontent, mainly linked to the fear of job losses and the excessive power of tech firms and platforms. For this reason, we examined the points of view of non-institutional subjects and their perceptions about ongoing changes, through new methods of analysis. The SA succeeds in capturing the recurrence of words and opinions directly connected to the 4thIR, despite some limitations, such as the inability to describe the characteristics of the people who leave comments on the web and their contexts of origin.

From an analytical point of view, the work therefore represents an attempt to explore new fields and methods to interpret the geographies of opportunity and discontent which have emerged in recent years in the face of prosperity dynamics recorded in some places and of the increase of inequalities in others. These new geographies, linked to reactions and feelings of resentment, have so far been studied through the analysis of the distribution of protest votes and their link with socio-economic and spatial characteristics. The SA conducted on social media adds further elements for understanding the phenomenon, bringing out the key words emerging in some contexts and therefore the discourses developed around Industry 4.0 and the polarisation of both positive and negative feelings.

With regard to the results of the empirical work, a misalignment has been observed between the opinions that emerge at the national level and what is instead detected at an urban scale. The semantic questioning on social media in the entire Italian context highlights a negative sentiment and therefore a general concern towards the effects of the 4thIR, especially in terms of unemployment and poverty, on the one hand, and the use of the Internet, connection, deregulation, on the other. However, perceptions, narratives and expectations on an urban scale appear in general positive or with a neutral and less negative meaning, demonstrating how the feelings about the 4thRI can be context dependent and in close connection with the characteristics of places.

The case studies at an urban scale highlighted diversities of opinion and expression of the sentiments. In Pisa and Lecce, the presence of the university, the specialisation in high-tech sectors, the cultural and tourist vocation, and the regional policies supporting innovation (Tuscany with specific actions on Industry 4.0; Puglia with investments in bio-technologies and digital infrastructure) have apparently contributed to creating a more aware and mature context from the point of view of the production and use of technologies, which makes citizens more capable of perceiving positive implications. The Web demonstrations in Taranto and Terni are more divergent: in the first case the diffusion of digitalisation and Industry 4.0 technologies is perceived as a tool for undertaking new development paths alternative to the current ones; in the second, artificial intelligence is also greeted with optimism, although much more cautiously than in the other three cities, probably for more difficulty in foreseeing and constructing new visions. Therefore, at the national level, even during the pandemic, discordant opinions emerged on the interventions of the Italian government on technological and digital issues, which may have fuelled negative reactions, suspicion and low credibility, with respect to actions promoted on a regional and urban scale, that are perceived closer to spatial and people needs and consequently more understood by citizens.

The question of policies is inserted in this last discourse. Considering European and Italian levels, if the key priorities have so far been those of acting on economic, social and spatial cohesion to reduce existing inequalities by investing in various areas of innovation, digital skills and telematic infrastructures, it is necessary to plan these actions by paying specific attention to the perceptions that individuals manifest in the face of their own life perspectives and the role that technological change can play on them. In fact, the geographies of discontent can manifest themselves not only in marginal areas, but also in places where individual experiences or social relations are static or fragmented and which are not attentive to the expectations of residents, in particular people who 'do not count' or 'are left behind'. Consequently, analysing opinions expressed by the people of the Web on the real or perceived impact of the 4thIR can represent a useful tool for planning future paths that are more in keeping with the different needs of people and places and more aimed at solving problems of inequality and discontent, which technological changes should be accentuating.

ACKNOWLEDGEMENTS

This paper benefitted from discussions within the research group on the interdisciplinary project 'The impact of the fourth industrial revolution between opportunities and inequalities', coordinated by Alberto Mario Banti (University of Pisa). The authors would like to thank Alberto Vanolo (University of Turin) for the discussion about the earlier version of the paper and the two anonymous reviewers for their helpful comments that contribute to improve the paper.

AUTHORSHIP

This paper is the result of joint research activity. However, Michela Lazzeroni wrote sections 1, 2, 3, 6; Valentina Erminia Albanese sections 4 and 5.

FUNDING INFORMATION

University of Pisa, PRA_2020_15 'The impact of the fourth industrial revolution between opportunities and inequalities'.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are obtained from the App2check software, whose access and use are under license. For this reason, the original research data are not available.

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ENDNOTES

[1] The two researchers reside in Pisa and in Lecce and know the two cities from previous in-depth studies; consequently, these cities have also been chosen for connecting the results obtained from the Internet survey with the characteristics of the contexts and the local actors. Terni and Taranto are very frequently cited in scientific and political debates at a national level due to their industrial history and the decline and environmental problems that currently characterise them.

[2] In Pisa there are three universities: University of Pisa (47,575 students and 1490 scholars at 31 December 2021), Scuola Normale Superiore, Scuola Superiore Sant'Anna—plus the National Research Centre (CNR) and the National Institute for Nuclear Physics (INFN); in Lecce the scientific system is composed of the University of Lecce (18,952 students and 852 scholars and research staff), the National Research Centre (CNR) and the Interuniversitarian Research Center Industry 4.0.

[3] We removed the word Twitter, because it is often included with a hashtag in comments extrapolated from Twitter and it falls within the topic cloud for this reason, not because it has a narrative value.

[4] The previous considerations apply for 'Twitter'. We also removed the words 'Alessandro', 'delli' and 'Noci' because they refer to a proper name Alessandro delli Noci, Councillor for Economic Development, Competitiveness, Economic Activities and Consumers, International Policies and Foreign Trade, Energy, Networks and Material Infrastructures for development, industrial research and innovation, youth policies of the Puglia region.

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How to cite this article: Lazzeroni, M. & Albanese, V.E. (2022) Perceptions and imaginaries about the fourth industrial revolution between geographies of opportunity and discontent: Some reflections on the Italian case. *The Geographical Journal*, 00, 1–15. Available from: https://doi.org/10.1111/geoj.12491