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IMPLEMENTATION OF INDUSTRY 4.0 TECHNOLOGIES IN CROATIA: PROACTIVE MOTIVES AND A LONG-TERM PERSPECTIVE

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The aim of this study was to develop a model that links the motives, obstacles and expected outcomes of Industry 4.0 implementation. First, it aimed to determine the extent of use of Industry 4.0 technologies and then to investigate the motives, expected outcomes (short and long-term), and the relationship between them. Obstacles to the implementation of new technologies in Croatian companies were identified. The sample comprised 91 companies that had implemented new technologies by 2020. Data were collected using on-line surveying tools. The results show that the surveyed companies are considering new technologies for several proactive reasons, and primarily stress the expected long-term strategic benefits over short-term efficiency. The lack of human resources is the most critical obstacle in the implementation of new technologies. The paper provides several managerial implications.

Keywords: Industry 4.0, Croatia, regional comparison, policy-making, managerial implications

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INTRODUCTION

Industry 4.0 (hereafter I4) is a term that denotes the 4th industrial revolution and refers to several novel/breakthrough technologies in physical capital (e.g. robotics, use of 3D technologies, smart mobile devices etc.), digital technologies (e.g. artificial intelligence, big data, the Internet of Things) as well as biology (genetics, 3D&4D (tissue) print etc.) (Redek et al., 2019a; Schwab, 2019). It is contributing to the development of an innovative, knowledge-led economy (Stiglitz & Greenwald, 2014). While much focus has been put on the actual use of new technologies, not enough is known about the rationale for such investments, given that theory usually addresses investments primarily in terms of a financial perspective, uncertainty, or managerial incentive (Glover & Levine, 2015; Israelsen, 2010). While Croatia is more service-oriented, Veža et al. (2015) emphasised that its manufacturing was still largely on the level of the 2nd industrial revolution, as characterised by the use of assembly lines and mass production. The third industrial revolution, which began in the 1970s, was characterised by further automation using electronics and IT (Prašnikar et al., 2017b). This paper addresses this lag by exploring first the extent of use of new Industry 4.0 technologies in 2020, but importantly also the motives for that use, the obstacles, the expected short-term efficiency results and long--term strategic results of new technology implementation in Croatia using survey data. It also provides a comparative perspective (largely with Slovenia).

The paper makes several *contributions* to the literature. In terms of the gap in the literature, this paper highlights the importance of understanding the motives and obstacles in investments, which are not simply financial. Non-financial drivers, motives and obstacles can also be very important for determining the investment activities of firms generally, including technological investments. We chiefly highlight the importance of the motives, and the short-term efficiency and long--term strategic outcomes. Especially the latter also include elements that move beyond "financial performance" (see Gao et al., 2012; Müller et al., 2018). The paper is also one of the first extensive analyses of I4 in Croatia to examine the use, motivations, obstacles, and other dimensions of I4 on the company level. Third, since the survey was motivated by a comparable survey conducted in the region, it additionally allows a broader, comparative view of the motives, expected results, and obstacles. The results highlight the link between the implementation of new technologies, proactive motives and strategic results and, among the obstacles, the need for increased IT lite-

racy, human capital investment generally, and awareness--raising. However, this exploratory research aims to deepen what is understood about investments in new technologies, and not to generalise the findings as representing the situation in Croatian companies. The results also provide relevant managerial and policy implications.

INDUSTRY 4.0 IMPLEMENTATION IN THE THEORETICAL AND EMPIRICAL LITERATURE

The *motives* for introducing new technologies can be divided into reactive and proactive motives. Proactivity describes activities that a company undertakes alone, by being future--oriented, to enhance its position, "to bring about change in their current organisation" (Brege & Kindström, 2020) or with a view to "making things happen" (Parker et al., 2010). *Proactive motives* for technology implementation are, for example, expected competitive advantage, revenue and turnover growth (Čater et al., 2019), a market-share increase, improved productivity, speed and flexibility, and others (Zimmerman & Blythe, 2013). Technology also increases quality, allows customisation, shortens reaction times, including delivery times, improves employee satisfaction, efficiency, and motivation etc. (Černe et al., 2017). *Reactive motives* reflect companies' reactions to changes in the environment (Alonso-Almeida et al., 2015). These include the pressures from the competition, buyers and suppliers, the requirements of partners within global value chains, reactions to the increased complexity of processes and products, requirements from a more competitive business environment, including regulatory changes, and other pressures from the outside.

TABLE 1
Expected short- and long-term results/consequences of the use of I4 technologies

Short-term orientation (efficiency)	Long-term (strategic) orientation
- decreased costs	- implementation of new business models
- increased quality	- creation of new business models
- traceability	- leading solutions for the customers
- lower inventories	- creating knowledge that is hard to imitate
- increased flexibility, speed and other	

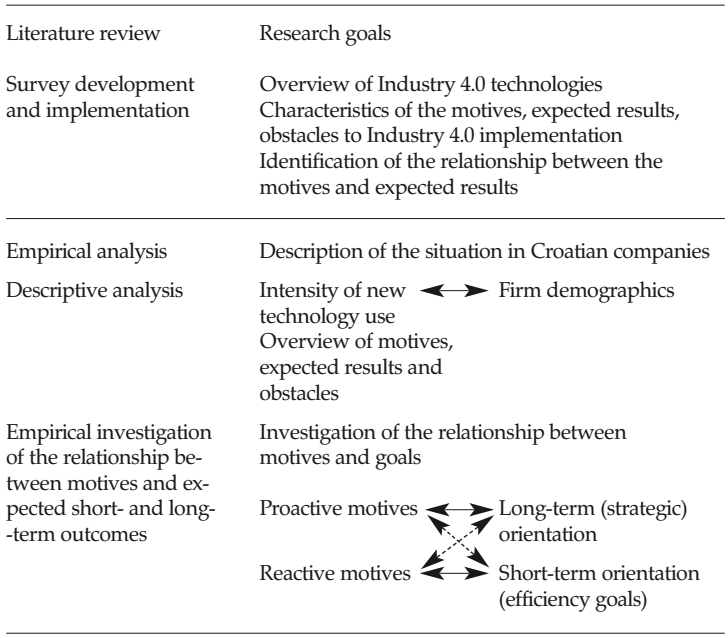
Source: Adapted from Gao et al. (2012) and Müller et al. (2018)

Companies generally implement new technologies because they expect positive consequences from them (Table 1). Technologies impact firms' efficiency and operational performance in the short run (Müller et al., 2018), which includes e.g. decreased costs, increased quality, traceability, lower inventories etc. Expected impacts on effectiveness and long-term performance include the implementation of new business mod-

els, creation of new, leading solutions for the customers, creating knowledge that is hard to imitate, and others. The latter are closely related to proactive motives since they facilitate the creation of competitive advantage. Other factors impact companies' decisions to implement new technologies, for instance, company size, industry, product type and organisation. Companies also vary in the obstacles they face, from sufficient financial and human resources, their competencies, the match between the organisational structure and the requirements of new technologies, and others (Redek et al., 2019b).

Studies confirm the positive impacts of I4 on companies. For example, 84% of Swiss companies expect that I4 technologies could significantly boost their competitiveness. Over 60% of them report (very) strong potential for transformation and 30% already notice a strong transformation (Deloitte, 2015). Italian companies especially highlighted the positive impacts of robotics and laser cutting. Technologies requiring a more extensive adaptation of the company (such as the IoT) were seldom used (Bettiol et al., 2019), which might be related to the typical obstacles: finance, organisational structure, size, industry, and human capital (Rüßmann et al., 2015; Schröder, 2016). Studies also point to benefits for emerging markets. Dalenogare et al. (2018) find positive effects in Brazil, particularly of integrated engineering systems for product development and manufacturing, incorporation of digital services into products, additive manufacturing, and cloud services. Operational benefits are positively related to computer-aided design, digital automation with sensors for process control, and big data. However, positive results require an increase in learning and knowledge sharing (Tortorella et al., 2020). In Slovenia, out of 250 respondents, 88% were either beginners in implementing I4 technologies or partially digitalised. Companies were expecting a positive impact on competitiveness and reputation and efficiency (Čater et al., 2019; Redek et al., 2019b; Prašnikar et al., 2017b).

While the research studies the use of technologies and their impact on performance, little is known about the motives for implementing the technologies and their expected outcomes. The paper addresses this void. We assume that the rationale for implementing new technologies will be driven by both proactive as well as reactive factors. We expect proactive motives to be more strongly related to long-term strategic motives and short-term efficiency to be more closely related to reactive motives (Figure 1 presents the concept of the research). We also highlight selected other issues related to Industry 4.0 in Croatia, such as the obstacles.



➲ FIGURE 1
Research concept for investigating implementation of Industry 4.0

RESEARCH DESIGN

The paper investigates the characteristics of Industry 4.0 in Croatia using company-level survey data. The key *research questions* are: (1) what is the extent of the use of new technologies; (2) which are the motives, expected short- and long--term results, and obstacles in the implementation of new technology; and (3) what is the relationship between the motives and the expected results?

Survey design and measurement scales. The online questionnaire included 26 questions, which replicated a questionnaire developed for Slovenia (Redek et al., 2019a), after being adapted to the Croatian economy. The questions used established measurement scales. Proactive and reactive motives were investigated based on Oliveira et al. (2017), PWC (2014), Obal (2017), Banerjee et al. (2003) and Weiss et al. (1999) (also see Table A1 in the appendix for more details). The attitudes to the use of I4 technologies were built on Müller et al. (2018) and Obal (2017), usefulness on Venkatesh and Davies (2000), and intention for future use on Gao et al. (Gao et al., 2012). Obstacles were studied based on scales taken from Oliveira Neto et al. (2017), Redek and Oblak (2016) and Prašnikar et al., (2017a; 2017b). The expected impacts/results[1] were measured according to the scales proposed by Müller et al. (2018), Gao et al. (2012) and Prašnikar et al. (2017a; 2017b).

[1] Questions relied on a 7-point Likert scale (1 = completely disagree, 7 = completely agree).

Implementation and sample description. The data were collected in early 2020. The questionnaire was sent in spring 2020 to companies with more than 10 employees using contacts from the Croatian Chamber of Commerce and the Amadeus database. Although 232 companies started the survey, in the end we had 96 partially and 34 fully completed questionnaires. Table 2 provides a description of the sample. The questions used in the analysis are presented in greater detail in Table A1 in the appendix.

Sample size and structure represent a limitation of the analysis. First, the sample is not representative and is relatively small. Second, the survey completion rate of 35% is another deficiency, which prevents us from going deeper into the analysis of the role of demographic factors (size, industry etc.). However, the analysis does not aim to generalise the results as being representative of the economy but is exploratory, linking factors within the given sample.

TABLE 2
Demographics of the sample

Criterion	Group	Share (%)
Company's size[i]	Small companies	14.7
	Medium-sized companies	47.1
	Large companies	38.2
Company's position in the value chain[ii]	Producers of end-products	64.7
	Suppliers of semi-finished products or components for end products	32.4
	Producers of machinery used by other companies in their production	5.9
	Suppliers of basic (raw) materials	20.6
Company's digitalisation level[iii]	Digital novices (beginners in digitalisation)	33.7
	Digital integrators (partly digitalised processes; using I4 technologies only internally)	42.2
	Horizontal collaborators (many digitalised processes; also using I4 technologies to cooperate with partners in the value chain)	14.6
	Digital champions (heavily digitalised processes)	4.5
Sectoral structure[iv]	Retail trade sector (NACE G)	29.4
	Manufacturing (NACE C)	23.5
	Construction (NACE F)	17.6
	Other	29.5
Respondent's position in the company[v]	Members of management or department directors	2.9
	Directors (or chairpersons of the management board)	20.6
	Deputy directors (or members of the management board)	29.4
	Persons responsible for introducing new technologies	5.9
	Other (mostly middle-management) positions	23.5

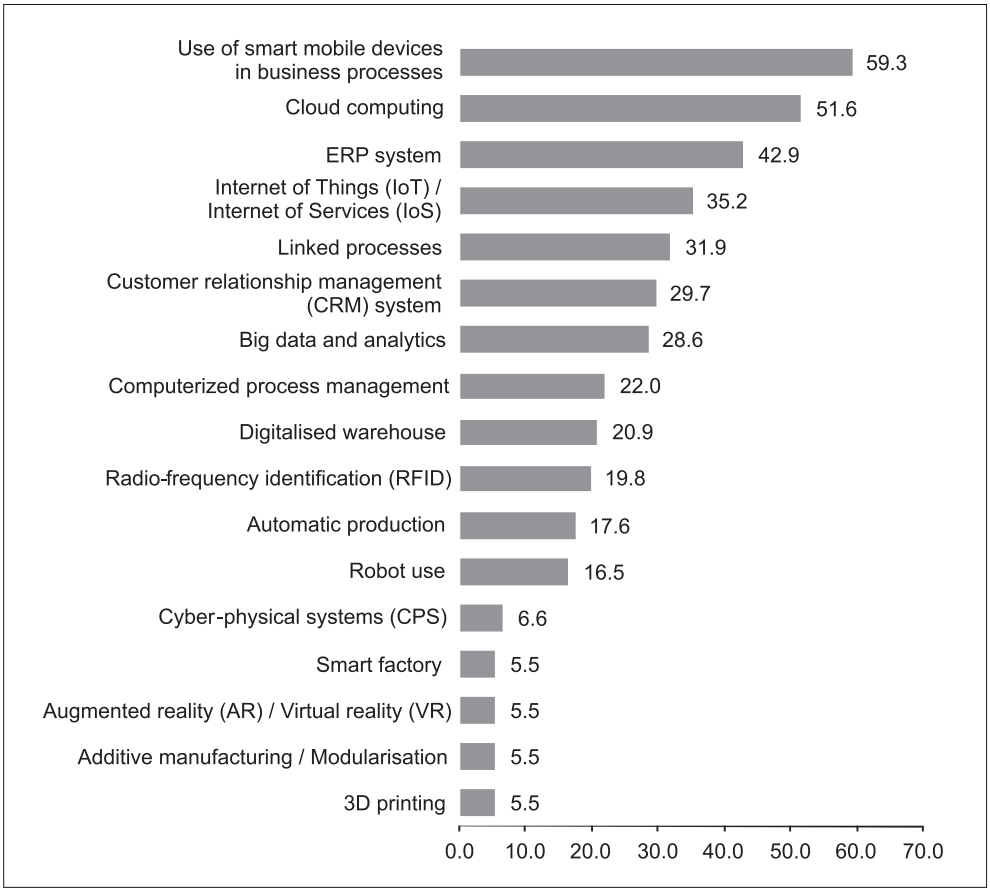
[i]Valid percent reported, 34 respondents; [ii]Companies could choose more than one, 56 respondents; [iii]91 respondents; [iv]Valid percent reported, 34 respondents; [v]Valid percent reported, 34 respondents.

RESULTS

The use of new technologies, motives, expected results, and obstacles

Most Croatian respondents claim to be novices in the field of using I4 technologies (33.7%) or to be partially digitalised (42.2%). In total, close to 20% are highly digitalised (integrators or digital champions). In Slovenia, 47.8% of companies were partially digitalised, 1.8% were digital champions, and 38.7% were novices. The two most widely used technologies were cloud and smart mobile devices (over 40% of respondents), followed by ERP, CRM, and automatic production (Redek et al., 2019b). Medium and large companies are, as expected, more digitalised since many technologies are more appropriate for larger companies that have more economies of scale. In Croatia, the most widely used technologies were smart mobile devices used in business processes, and cloud computing. More complex and expensive technologies, which are also more appropriate for larger businesses (smart factories, robots, automatic production), were only used in a handful of companies (Figure 2).

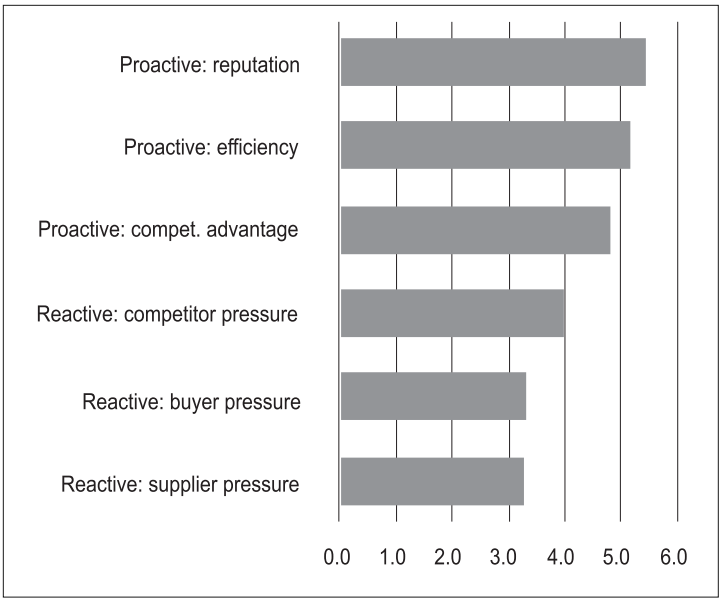
FIGURE 2
The use of specific technologies, percent of companies which reported using a specific technology (91 respondents)



The companies that were using new technologies most often used them in finance and accounting and communication (around 2/3 of respondents), followed by business planning and control as well as marketing and sales (around one-half). More than 40% of the respondents who were using new technologies reported using them in production, logistics and purchasing. Among the companies that reported their use of new technologies, larger companies (50 or more employees) represent roughly 80%–90% of all. In Slovenia, the share of companies was significantly smaller, although small companies also represented around one-half of the Slovenian sample, which impacts the results.

Companies have different motives for implementing and using new technologies. Proactive and reactive motives were measured using a set of four tested statements (Table A1) from the literature relying on a 7-point Likert scale (Figure 3).

➲ FIGURE 3
Proactive (P) and reactive (R) motives for using Industry 4.0 technologies, the average value of an answer (scale 1=completely disagree, 7=completely agree)*



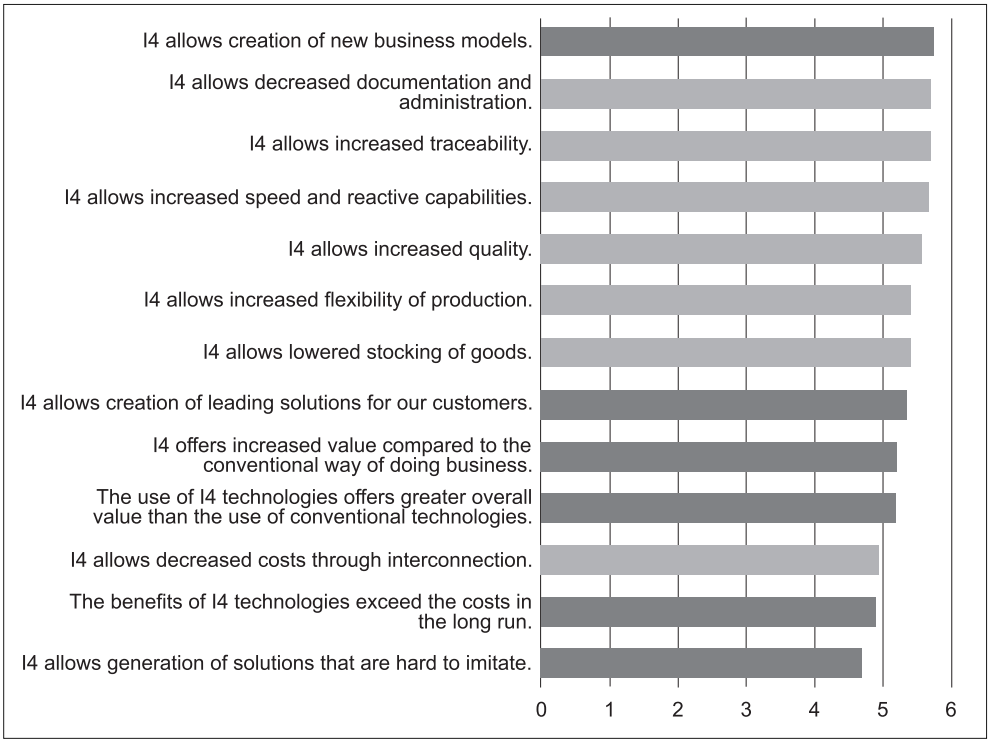
* Between 45 and 55 companies evaluated each statement. Each motive was measured with a set of statements (Table A1).

Reputation (average value of 5.43) is the most important proactive motive for companies, followed by efficiency (5.17) and competitive advantages (4.79). A proactive motive of using I4 technologies due to efficiency is the single-most important motive with an average evaluation of 5.64, followed by use of I4 in order to be seen as successful (5.46), stable (5.46), professional (5.54) – all being proactive reputational motives. These are followed by an improvement in the quality of products and processes (5.31) and streamlining operations (5.26), and

"being a market leader" (4.91). Among all statements that describe selected motives, the first statement that refers to a reactive motive is ranked 12th, stating that "the best in business are using I4", which represents a reactive motive of competitive pressure (4.49). In Slovenia, reputation was also the highest-rated (5.5 on a scale of 1–7), followed by competitive pressure (5.5), efficiency (5.2) and expected competitive advantage (4.9) (Čater et al., 2019). In Croatia, there are no significant differences in the importance of motives by company size in the case of the role of reputation and supplier pressure. Yet, when it comes to efficiency and competitive advantage motives as well as buyer and competitor pressure, smaller companies found these motives to be significantly less relevant. But due to the small number of firms that provided an answer about their size, we do not elaborate on any causalities or conduct deeper statistical analysis. On the other hand, this is expected since large companies are often much more exposed to other pressures, primarily also foreign ones (see e.g. Prašnikar et al., 2017a).

Companies implement new technologies because they expect positive consequences or results (Figure 4). On average, while Croatian companies evaluate the role of short-term or efficiency consequences as very high, the long-term strategic consequences are not significantly less important.

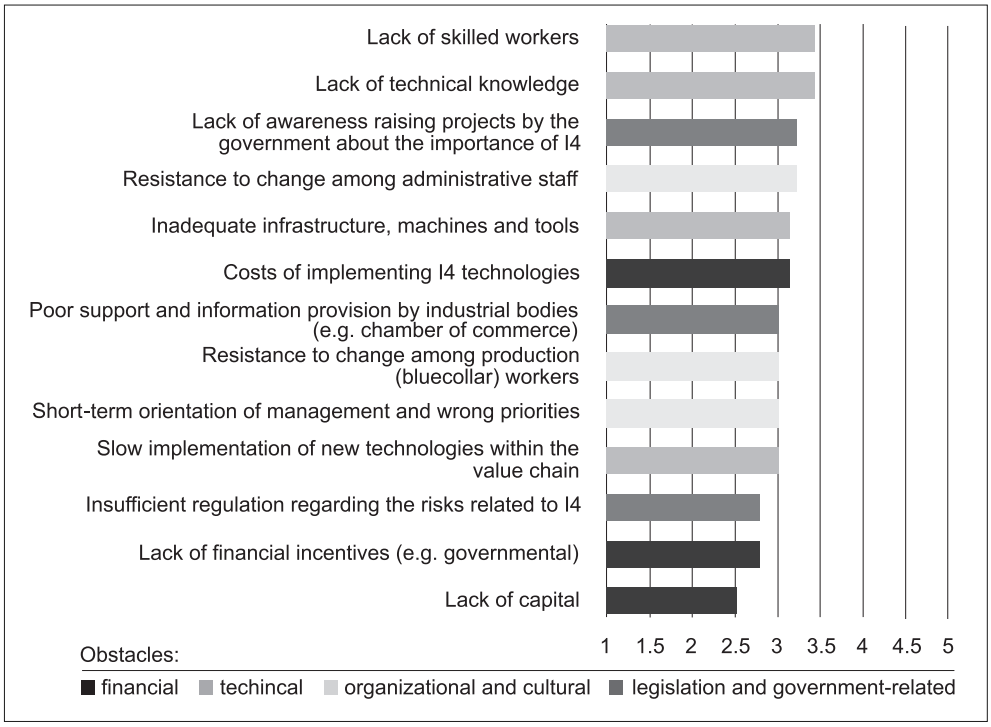
FIGURE 4
Expected short (light-grey) and long-term (dark-grey) results/consequences of I4 technologies use: the average agreement with statements on a scale 1 (completely disagree) to 7 (completely agree) (34 companies responded to this question)



The creation of new business models was ranked highest among the expected consequence of I4, followed by several short-term efficiency effects: the decreased need for documentation and administration, improved traceability, increased speed, ability to react, higher quality and flexibility, and lower stock. In Slovenia, for comparison, traceability was the highest-ranked expected consequence, followed by the equally important increased quality and creation of new business models. The short-term focus on lower inventories, less administration, and increased speed and reactive capabilities followed (Čater et al., 2019). Considering these results in the context of motives, where the proactive motives dominate, these results also reveal the need/desire to be efficient.

The literature stresses several obstacles to the implementation of new technologies (Müller et al., 2018). Obstacles in this survey were divided into four groups (Figure 5): (a) economic/financial; (b) technical and human; (c) organisational and cultural; and (d) legislation-related barriers, following Oliveira Neto et al. (2017).

FIGURE 5
Average importance of selected obstacles in the implementation of I4 technologies* (shading indicates the type of obstacle; 34 companies responded to this question)



* On a scale from 1 (not an obstacle at all) to 5 (a very important obstacle)

Technical obstacles are most important (where the average score for all factors is 3.22), followed by organisational and cultural (average score 3.06), legislation, and government-related obstacles (average score 3), while financial barriers are

the least important (average score 2.8) (Figure 5). The two technical obstacles – lack of skilled workers and lack of technical knowledge (54% skilled workers, 48% lack of technical knowledge) – are the most important in general. There are no statistically significant differences regarding the importance of these obstacles by company size, which might also be due to the sample size. Technical barriers are followed by organisational and cultural – the lack of awareness and resistance to change among employees (administrative workers). Human resources are overall an extremely important obstacle – leading barriers are directly or indirectly linked to human resources. In Slovenia, the lack of skilled personnel and lack of technical knowledge were the most important obstacles (Redek et al., 2019b).

Despite the obstacles, the respondents see the technologies of I4 as one of their priorities. Over 70% completely agree or agree they wish to further digitalise their businesses, around 60% either agree or completely agree with the (extended) future use of I4 technologies.

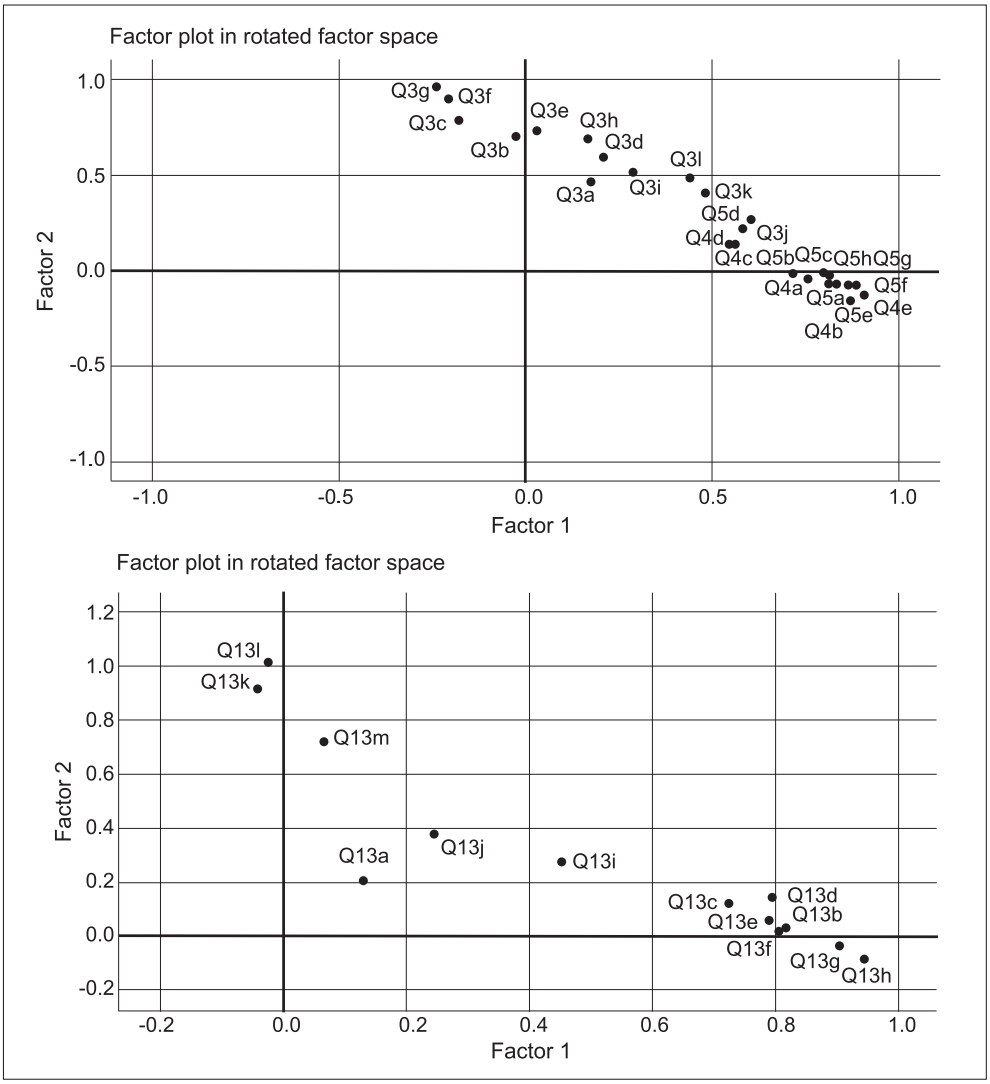
The relationship between proactive, reactive motives, short-term efficiency and long-term strategic results

This section investigates the relationship between the motives and expected short-term goals (efficiency) and long-term strategic goals. Proactive motives are more long-term-oriented, related to the exploiting of internal strengths and often linked to well-performing companies (Barton et al., 2017; Pett et al., 2004); therefore, they should be closely related to strategic (long--term) goals. However, due to the importance of the 'efficiency' (reactive) motive, a close relationship with operational efficiency would also be expected. We examine whether: (1) Croatian companies, depending on their proactive or reactive motives, are more focused on their operational efficiency or the long-term consequences; and (2) those that are more successful are also more proactive when it comes to implementing new technologies.

To answer these two research questions, factor analysis was performed on both the motives and the consequences (short-term efficiency, long-term strategic goals) to reduce the number of variables. The analysis was run in SPSS. To calculate the factors, all motives (Table A1 in the appendix) and all expected consequences (Figure 4) were used. In both cases, there is a high correlation between the scales, therefore a promax rotation was used and the number of factors was limited in both cases to 2 to also test whether the loadings reflected the division into proactive and reactive factors. The two factor analyses provided solutions with very high eigenvalues for the first two factors (12 and 3.3 for motives, then dropping

to 1.8, and 7 and 1.3 for consequences). In all four cases, the variables with the highest loadings (but at least 0.7) were used to calculate a new variable (reactive motives, proactive motives, strategic and operational consequences, see Tables A3 and A4). As the factor loadings show (as well as the factor plot, Figure 6), when considering the appropriate loadings (above 0.7), the two factors obtained were both very clearly determined by either proactive/reactive motives or strategic/operational short-term outcomes.

FIGURE 6
Factors from the motives (top) and expected consequences (bottom)*



* List of variables in Tables A2, A3, A4 in the appendix

There is a strong and significant positive relationship between the proactive motives and both perceived strategic and

operational consequences of new technologies (Table 3). The relationship is aligned with theoretical expectations. Reputational motives (loadings, Table A2) and motives of expected competitive advantages (cost advantages, streamlining operations, transacting costs) support the achievement of strategic outcomes, such as greater value than the conventional way of doing business, the generation of solutions that are hard to copy, and new business models. However, since the proactive motives of increasing competitive advantage are mainly closely linked to operational efficiency as well, proactivity is also positively related to more short-term consequences. But, in fact, as suggested by the literature, long-run orientation is positively related to medium- and long-run performance (Brauer, 2013). This makes it important that the proactive motives in Croatian companies are strong and also that the relationship between both strategic and operational efficiency is positive and significant.

TABLE 3
Relationship between motives' factors and perceived outcomes/ consequences (Spearman correlations)

	Factor					
	Reactive motives			Proactive motives		
Variable	Corr.	Sig.	N	Corr.	Sig.	N
Factor Strategic outcomes	0.254	0.183	29	0.513**	0.003	32
Factor Operational (short-term) outcomes	-0.159	0.410	29	0.480**	0.005	32
Return on assets (ROA)	0.154	0.424	29	0.283	0.117	32
Return on sales (ROS)	0.186	0.353	27	0.408*	0.023	31
Profit growth	0.091	0.640	29	0.422*	0.016	32
Market share growth	0.121	0.541	28	0.401*	0.025	31

Proactive motives are also related to firm performance. Firm performance was measured relative to competitors on a 7-point Likert scale.[2] The results show that the proactive motives' factor is strongly and positively related to return on sales, profit growth, and market share growth. Considering the importance of the reputational and competitive motives loadings, these results are expected, since increased competitiveness (due to cost advantages, streamlining operations, transacting costs) is positively related to return on sales, profit growth, and market share growth, which also depends on company reputation. Interestingly, in all cases reactive motives are not significant. This is in line with the theoretical idea that those who are reactive are often less successful (Pett et al., 2004).

[2] 1 = significantly worse, 7 = significantly better than competitors

DISCUSSION WITH CONTRIBUTIONS

Discussion and implications

The results show that Croatian companies are using new technologies, but simpler ones like cloud and smart mobile devices dominate. Larger companies are also using more complex technologies. This is comparable to other economies where

the use of I4 is lower in SMEs. For example, in Germany and Italy SMEs see less benefit from more complex technologies and have fewer resources (human in particular) that can specialise in implementing new technologies and required organisational change. However, our results show that among the motives to use I4 technologies the proactive motives are stronger than the reactive ones, and companies have a very positive future outlook towards I4 (Table 4), like in other countries. In Slovenia, for example, the most important motives were the reputation of the company in the industry, increased efficiency, and possible competitive advantage (Redek et al., 2019b). Furthermore, there is a strong link between proactive motives and both strategic and operational (efficiency) outcomes. Especially in the long run, strategic orientation is critical (Brauer, 2013) and it is important to see in the results a strong and positive proactive motives – business results relationship. This could further motivate Croatian companies to continue to invest in new technologies. As Apsolon (2019) noted, positive experiences observed in the economy might motivate other companies to invest in new technologies.

TABLE 4
Overview of the key results of the survey data

Technology aspect	Key results and implications
Use of Industry 4.0 technologies	- Use of I4 simpler technologies - I4 is primarily used in finance & accounting, communication and marketing, and sales - The (comparative) observed use of new technologies is a consequence of both the intensity of implementing I4, but also the sectoral structure of the Croatian economy
Motives	- Proactive motives dominate (reputation and competitive motives) - Among reactive motives, pressures from suppliers, buyers and competition are important
Expected consequences	- Importance of a strategic, long-term focus and operational/ efficiency consequences
Obstacles	- Lack of skilled workers, lack of technical knowledge, lack of awareness about the importance of I4, resistance to change - Financial resources are a significantly less important obstacle - Similar experience in other countries
Future outlook	- Companies will further digitalise, will implement I4

Still, the results also point to barriers in the implementation of new technologies, primarily technical barriers (lack of technical knowledge, lack of skilled workers/human capital) and organisational and cultural barriers (resistance to change and a short-term orientation). Majdandžić (2019) shows that several Croatian companies reveal potential and are very strong in their market segments, even developing their own technologies (e.g. the neurosurgical robot RONNA, Gideon Brothers, etc.). Yet, if the country is to take a step towards becoming tech-

nologically more advanced, such companies should prevail, which is not the case (Veža et al., 2015). This is confirmed by our results. One-third of the companies are novices, while another 40% were partially digitalised.

Several implications of this research are important. *First*, companies are currently not using the new technologies intensely, and simple technologies are mainly being used. However, the results show that the proactive, long-term-oriented companies are also enjoying positive results. This speaks in favour of using new technologies. Moreover, the 'trickle-down' effect related to positive experiences could lead to extending the use of new technologies to other companies. Given the obstacles noticed by our respondents, we agree with Apsolon (2019) that the companies should be led by highly motivated, skilled and innovative managers who are strategically focused on long-term competitiveness and multinational markets. Such management will more easily overcome the obstacles, especially given the high pressure also for short-term results. Learning and knowledge transfer, particularly from the leaders in the international markets, investment in technology (tangible capital), but also complementary intangible capital (Corrado et al., 2018) are very important (Table 5). This is especially true for investment in human capital, which is acknowledged as a major obstacle. Decisions on investment in intangible capital should be made with a future outlook in mind, taking technology implementation into account due to the complementarity between the two. Companies should complementarily also adapt their business models by taking full advantage of the digital tools in revenue and cost management, embracing the digital organisational culture (McKinsey Global Institute, 2018).

TABLE 5
Summary of the recommendations

Policy area	Company-level implications
Long-term orientation	- Focus on achieving long-term goals, which will also support the achieving of short-run efficiency - Ensure management's support for the implementation of I4 - Focus on increased internationalisation, which can support a virtuous cycle of growth due to learning and open innovation
Digital transformation	- Investment in modernisation and development as a strategic goal - Invest in related intangible capital
Complementarity of Industry 4.0 and intangible investment	- Change corporate cultures - Human resources management, job training, life-long learning Engage quality and digitally aware leaders, challenge the status quo

The *second* set of implications highlights the role played by policy-makers. Experiences of leading economies show that successful transformation to a digital society requires state

support, particularly for infrastructure development. Different policy and awareness-raising programmes can support this transformation (Stiglitz & Greenwald, 2014). Croatian companies are ready to implement new technologies but miss supportive national policies to stimulate their implementation (Rončević et al., 2019). Despite the wide set of programmes available in Croatia (Barać, 2018), what is mainly needed is a focus on and sufficient investment in information and digital infrastructure, digital services of public administration, to align the education system to stimulate enrolment in STEM programmes, build digital skills and modernise the regulatory framework (European Commission, 2020).

Contributions with challenges for future work

This research contributes in several ways to the field of knowledge concerning the implementation of new technologies. It holistically addresses new technology implementation, not focusing solely on its use, but also investigating its motives and obstacles. By including several non-financial drivers and motives, the paper shows that, in fact, these drivers are very important while making investment decisions on new technologies. Second, to the best of our knowledge, this paper is a first for Croatia in that it comprehensively (and comparatively) presents the situation in Croatia using its own survey data. The paper also develops a model that links the motives, obstacles, and expected outcomes.

We must also acknowledge certain limitations, principally the sample size and structure, which at the same time introduce challenges for future research. A larger sample would allow more detailed analysis also across sectors' and firms' characteristics (e.g. size). The sample size does not allow us to generalise the situation with the use of new technologies. The research hence focused on linking motives, obstacles, and expected results, thereby stressing the importance of proactive motives and a long-term perspective, but the results are not representative. In the future, a repeated representative survey would also allow generalisation.

CONCLUSION

The Croatian economy is a medium-developed EU economy, as also reflected in its rate of digitalisation, and intensity of I4 use. The intensity of use of I4 technologies is low. Importantly, the motives of Croatian companies to pursue implementing I4 are proactive, driven by the desire to change and succeed in not only the use but also the development of new technologies. The obstacles relate more to human resources than to finance, although financial factors are still important. Nonetheless, the future outlook is positive because compa-

nies have seen positive results from the use of new technology. The role of the state is also extremely important in terms of both suitable industrial policy and regulatory change.

APPENDIX

TABLE A1
Overview of motives (average value, scale 1 to 7), sorted by importance

Question/Motive	Avg.
Q3a to 3l sorted by importance	
We consider using I4 technologies because we think it would increase our efficiency (P)	5.64
We consider using I4 technologies because we want to be viewed as a successful firm (P)	5.46
We consider using I4 technologies because we want our partners to see us as a stable firm (P)	5.46
We consider using I4 technologies because we want to be seen as being a very professional firm (P)	5.42
We consider using I4 technologies because we want our firm's reputation to be highly regarded (P)	5.38
We expect the use of I4 technologies will contribute to the improvement of the quality of our products and processes (P)	5.31
We consider using I4 technologies because we think it would streamline our operations (P)	5.26
We expect the use of I4 technologies will lead to substantial cost advantages for our firm (P)	5.07
We consider using I4 technologies because we expect them to reduce the costs of running our business (P)	5.06
By regularly investing in new I4 technologies our firm can be a leader in the market (P)	4.91
We consider using I4 technologies because we believe it would reduce the cost of transacting business with our exchange partners (P)	4.72
We consider using I4 technologies because the best in the business are doing so (R)	4.49
Q4a to 4e sorted by importance	
Our firm can enter lucrative new markets by using I4 technologies (P)	4.36
Our firm will increase market share by using I4 technologies (P)	4.31
We consider using I4 technologies because our suppliers are using them (R)	4.29
Our competitors that use I4 technologies are perceived favourably by others in our industry (R)	3.93
Our competitors that use I4 technologies benefited greatly (R)	3.91
Q5a to 5h sorted by importance	
We consider using I4 technologies because our buyers are using them (R)	3.73
We consider using I4 technologies because several industry sources, including our suppliers, promote them (R)	3.65
We consider using I4 technologies because several industry sources, including our buyers, promote them (R)	3.64
We consider using I4 technologies because our key competitors are using them (R)	3.64
We feel pressured to adopt I4 technologies by our buyers (R)	3.00
We feel pressured to adopt I4 technologies by our suppliers (R)	2.80
Large pressure is placed on our firm by our buyers to use I4 technologies (R)	2.76
Large pressure is placed on our firm by our suppliers to use I4 technologies (R)	2.30

*Table A3 lists questions by number as well

TABLE A2
Pattern matrix for motives

Question/Statement		Factor 1	Factor 2
Q3a	We are considering using I4 technologies because our suppliers are using them	0.177	0.469
Q3b	We feel pressured to adopt I4 technologies by our suppliers	-0.029	0.699
Q3c	Large pressure is placed on our firm by our suppliers to use I4 technologies	-0.180	0.786
Q3d	We are considering using I4 technologies because several industry sources, including our suppliers, promote them	0.207	0.596
Q3e	We are considering using I4 technologies because our buyers are using them	0.029	0.731
Q3f	We feel pressured to adopt I4 technologies by our buyers	-0.207	0.897
Q3g	Large pressure is placed on our firm by our buyers to use I4 technologies	-0.239	0.963
Q3h	We are considering using I4 technologies because several industry sources, including our buyers, promote them	0.165	0.691
Q3i	We are considering using I4 technologies because our key competitors are using them	0.290	0.516
Q3j	We are considering using I4 technologies because the best in the business are doing so	0.604	0.267
Q3k	Our competitors that use I4 technologies have benefited greatly	0.482	0.408
Q3l	Our competitors that use I4 technologies are perceived favourably by others in our industry	0.441	0.485
Q4a	We expect the use of I4 technologies will lead to substantial cost advantages for our firm	0.757	-0.042
Q4b	By regularly investing in new I4 technologies our firm can be a leader in the market	0.817	-0.069
Q4c	Our firm can enter lucrative new markets by using I4 technologies	0.561	0.138
Q4d	Our firm will increase its market share by using I4 technologies	0.550	0.135
Q4e	We expect the use of I4 technologies will contribute to the improvement of the quality of our products and processes	0.905	-0.130
Q5a	We are considering using I4 technologies because we think it would increase our efficiency	0.864	-0.075
Q5b	We are considering using I4 technologies because we expect them to reduce the costs of running our business	0.716	-0.005
Q5c	We are considering using I4 technologies because we think it would streamline our operations	0.802	-0.012
Q5d	We are considering using I4 technologies because we believe it would reduce the cost of transacting business with our exchange partners	0.580	0.222
Q5e	We are considering using I4 technologies because we want to be seen as a very professional firm	0.869	-0.159
Q5f	We are considering using I4 technologies because we want to be viewed as a successful firm	0.884	-0.075
Q5g	We are considering using I4 technologies because we want our firm's reputation to be high	0.836	-0.070
Q5h	We are considering using I4 technologies because we want our partners to see us as a stable firm	0.813	-0.022

TABLE A3
Pattern matrix for consequences

Question/Statement		Factor 1	Factor 2
Q13a	I4 allows decreased costs through interconnection	0.131	0.202
Q13b	I4 allows increased quality	0.817	0.029
Q13c	I4 allows increased traceability	0.725	0.117
Q13d	I4 allows lowered stocking of goods	0.796	0.142
Q13e	I4 allows decreased documentation and administration	0.792	0.056
Q13f	I4 allows increased flexibility of production	0.806	0.011
Q13g	I4 allows increased speed and reactive capabilities	0.905	-0.041
Q13h	I4 allows the creation of new business models	0.945	-0.089
Q13i	I4 allows the creation of leading solutions for our customers	0.454	0.275
Q13j	I4 allows the generation of solutions that are hard to imitate	0.247	0.380
Q13k	I4 offers increased value compared to the conventional way of doing business	-0.044	0.913
Q13l	The use of I4 technologies offers greater overall value than the use of conventional technologies	-0.025	1.012
Q13m	The benefits of I4 technologies exceed the costs in the long run	0.064	0.722

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Implementacija tehnologija Industrije 4.0 u Hrvatskoj: proaktivni motivi i dugoročna perspektiva

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Cilj ovog istraživanja bio je razviti model koji povezuje motive, zapreke i očekivane ishode od implementacije tehnologija Industrije 4.0. Prvo, cilj je bio utvrditi opseg upotrebe tehnologija Industrije 4.0, a zatim istražiti motive,

očekivane ishode (kratkoročne i dugoročne) i njihov odnos. Identificirane su zapreke za implementaciju novih tehnologija u hrvatskim kompanijama. Uzorak je obuhvaćao 91 kompaniju koje su do 2020. godine primijenile nove tehnologije. Podaci su prikupljeni alatima za provođenje anketa na daljinu. Rezultati pokazuju da anketirane kompanije razmatraju nove tehnologije iz nekoliko proaktivnih razloga, ali prije svega naglašavaju očekivane dugoročne strateške koristi nad kratkoročnom učinkovitošću. Manjak ljudskih resursa najvažnija je zapreka u primjeni novih tehnologija. Rad pruža nekoliko preporuka za menadžere.

Ključne riječi: Industrija 4.0, Hrvatska, regionalna usporedba, kreiranje politika, preporuke za menadžere