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Organisational learning antecedents and open innovation: Differences in internationalisation level

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ABSTRACT

The aim of this study is to inspect differences in internationalisation level of firms from a transitional economy based on their innovation outcomes, open innovation and organisational learning practices. Results indicate that firms with lower internationalisation level owe their innovation success to coupled and outbound open innovation practices that originate from market research, competitor tracking and public information. Mediating effect of outbound innovation is present in the relationship between market research and innovation success. Firms with higher internationalisation level do not exhibit significant effect of open innovation on innovation success, but their organisational learning antecedents such as market research and research and development negatively affect innovation success, while public information and forecasting have a significant positive effect on innovation success. The major contribution of this study is the understanding of how organisational learning antecedents and open innovation practices interact in firms with different internationalisation levels, whereby firms with higher internationalisation level already have competitive advantage that lower internationalisation firms need to achieve.

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1. Introduction

High uncertainty, risk and competitiveness on global and local levels pressure firms to use various growth strategies (Hitt et al., 2014). Global product development and simultaneous sale on various international markets enable risk minimisation, increased efficiency and profit maximisation resulting from the customisation of products to local specificities (Lasserre, 2007, p. 279). Finding undiscovered global needs located in leading markets enables firms to profit and achieve their growth potential (Kalish et al., 1995; Kotabe and Helsen, 1998; Beise, 2004; Steenkamp, 2014).

Herein, network externalities increase the benefits of innovation within different national and organisational contexts (Beise, 2004). Countries that are innovation leaders (Sweden, Germany, Denmark and Finland) move further ahead of the less innovative countries of the European South, wherein belongs the Republic of Croatia (European Commission, 2013). This research is set in the geographical area of the Republic of Croatia where the lack of cooperative stakeholder relationships preclude risk sharing that would otherwise incite innovative projects with higher value added, readily hampering Croatia's innovative activities (Račić et al., 2007). A lack of exchange of innovations between Croatian and foreign firms could be used to attain a synergy between the existing organisational learning capabilities formed by its antecedents and the added value of products or services which firms offer.

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Torkelli et al. (2009, p. 187–188) indicate that in the presence of network externalities (and before the emergence of a standard) the *effect of complementary assets and absorptive capacity is muted, and the propensity to use external knowledge increases*. As explained by the network theory, this happens due to the coexistence of relationships that shape dynamics of innovation diffusion and enable adjustments to the changing market conditions and new strategic opportunities (Ceci and Iubatti, 2012), as is the case in coexisting innovation-internationalisation strategies. Network externalities (Stoneman, 2007, p. 381): (1) propagate the number of innovation users, (2) reduce *uncertainties* connected to future dominant technology application, (3) provide *complementary inputs* to innovation processes, (4) *reinforce alternative diffusion drivers*. They aid in innovation diffusion, facilitate open innovation and act as motivating factors for firms wishing to join the innovation landscape.

Open innovation is an important aspect of increasing firms' competitiveness in which game theoretic issues incur costs for firms. Firms must set foundations for easier collaboration and sharing of innovation that is complementary to their innovation and internationalisation strategies. Hence, this paper aims to answer the research question: What are the differences between low and high internationalised firms based on their organisational learning practices, open innovation and innovation outcomes? This research question is contemporary in the international scientific community and their identification is essential for strengthening the innovative performance of Croatian firms in the telecommunication industry, especially under the concept of smart specialisation of the European Union. Importance of this research question is twofold. Firstly, many firms are not able to bridge the internationalisation gap and, therefore, remain focused on their domestic markets. By identifying organisational learning antecedents that facilitate transition towards international markets and greater involvement into international markets, low internationalised firms could enhance their organisational practices and enhance their revenue streams. Secondly, in times of crisis, such as the COVID-19 and post-COVID-19 era, organisations should be versatile enough to disperse their revenue streams towards different markets. Open innovation model is important for organisations to enable flexibility and transformation and for organisations to remain successful in their own domains. Furthermore, this paper analyses transition market's telecommunications industry, which could prove to be a good example in the COVID-19 and post-COVID-19 era when telecommunications companies gain their momentum through changing market demands that require increasingly innovative products and services.

In order to answer this question, this paper is structured as follows. The literature review section provides rationale of the study and presents research hypotheses. Methodology section depicts the methodology used in the empirical study and is followed by results of the empirical research. The final section concludes the paper with practical implications and limitations of the study.

2. Literature review

2.1. Organisational learning

Organisational learning enhances firm competitiveness when a firm's response to a market need is aligned with the firm's environment (Hannan and Freeman, 1984, p. 151). Creation of organisational core competences (Prahalad and Hamel, 1990) stems from the availability, heterogeneity and immobility of scarce and intangible resources which explains how organisations achieve and maintain competitive advantage (Benevene and Cortini, 2010; Bakar and Ahmad, 2010; Lin et al., 2010; Branstetter et al., 2011). Therefore, these resources and capabilities, which form firms' social capital, are dependent on the political and social contexts (Auh and Menguc, 2009) and influence organisational performance (Felicio et al., 2014). Reinvention, transformation and utilisation of — sticky and imperfectly mobile resources is difficult to imitate (Reed and DeFillippi, 1990) and detach from an organisation. Moreover, resource effectiveness can be prolonged and obsolescence prevented (Barney, 1991, p. 101; Auh and Menguc, 2009) through organisational learning capability (Hsu and Fang, 2009).

Structural capital includes processes and databases that enable functioning of human capital in an organisation (Maddocks and Beaney, 2002). As a supportive element of organisational infrastructure that facilitates an innovative organisational environment (Burgess, 2013), structural capital's components are decomposed into: (1) organisational capital, (2) process capital, and (3) innovation capital (Maddocks and Beaney, 2002). Organisational structures such as learning, amoeba or bonsai organisation need to support and adapt to innovation at different skill levels, tasks, contexts, organisational co-competencies and learning changes (Terziovski, 2010). In that way organisational structure allows enough flexibility to overcome organisational inertia. Hence, the following section illustrates the importance of organisational flexibility and describes capabilities necessary for the successful execution of organisations' innovation goals.

Structured organisations are environments in which uncertainty and constraints create homogeneous structures, cultures and results, but do not necessarily imply organisational efficiency (DiMaggio and Powell, 1983). If firms want to efficiently adapt to external dynamics, they need to allow certain amount of strategic flexibility to respond and adapt to environmental challenges (Cingoz and Asuman Akdogan, 2013). Strategic flexibility can be achieved more or less formally (Terziovski, 2010). Flexibility can lead to negative project planning effects and positive product specifications effects (Candi et al., 2013). Technologies require hierarchical processes (Aoki, 1986) with higher formality. Formality that is achieved through greater work rules, regulations, policies and procedures (Hernaus et al., 2013, p. 27) encourages employee commitment and organisational effectiveness (Patel, 2005; Prakash and Gupta, 2008 in Terziovski, 2010, p. 893). On the other hand, capability development requires horizontal processes (Aoki, 1986).

A timely response to market conditions is enabled by opportunity and risk recognition (Beise, 2004, p. 1012) grounded in learning about different environments (Kogut and Zander, 1992; Teece et al., 1997; Todorova and Durisin, 2007, p. 783). On the other hand, organisational learning is a gradual process (Foss et al., 2012), which requires an analysis of organisational resources, their complementarities and routines. Herein, motivation to learn and incite external participation into innovation processes is important (Dahlander and Piezunka, 2014). Hence, two types of knowledge become critical for successful innovations: (1) *technological knowledge* for exploratory learning (Cohen and Levinthal, 1990), and (2) *market knowledge* for exploitative learning. With respect to the two types of knowledge, firms participate in distinct international innovation networks (Dittrich and Duysters, 2007) that make them learn about and identify open innovation possibilities. This paper differentiates between different identifications of open innovation possibilities, i.e. organisational learning antecedents.

2.2. Innovation and open innovation

Innovation processes should be flexible, allowing a firm to decompose its innovation tasks and access the necessary knowledge in a timely manner that does not affect the way an organisation functions (Lakhani and Tushman, 2012). Self-organising innovation communities in which firms gain necessary knowledge and innovation foster collaboration, process decomposition and knowledge dispersion (von Hippel, 2005; Chesbrough, 2010). In this way open innovation complements traditional innovations. Time-consuming and expensive internal product and service development demands from firms to seek solutions on the market. The "search" process is usually performed by engineers with knowledge on innovation (Pyka, 2007). Although acquainted with technical specificities, engineers might not be able to recognise potential partners because of their possibly poor managerial experience related to their inability to acquire comprehensive non-technical information (Dyer and Singh, 1998). These limitations might lead to a broad innovation search (Garriga et al., 2013). Hence, firms' search strategies can vary in depth and breadth (Garriga et al., 2013). Deep, thorough search positively affects incremental innovation, while search breadth relates to radical innovation (Chiang and Hung, 2010).

Although von Hippel (1988) recognised the importance of cooperation and exchange of innovation, Henry Chesbrough (2003) was the first author to define cooperation and exchange of innovation as open innovation. According to Chesbrough (2003, p. 1), open innovation is "*a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology*." Later, Chesbrough et al. (2006, p. vii) defined it as — "*the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. [This paradigm] assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology*". This is the definition used in this paper. The idea of open innovation is portrayed on the continuum at whose ends stand closed and open innovation and which includes various levels and forms of openness (Chesbrough et al., 2006). There are differences between inbound and outbound open innovation. Inbound open innovation includes the acquisition and adoption of competences, knowledge and technology, while outbound open innovation illustrates a process in which a firm sells ideas and resources on the market thereby selling licences or externalising its R&D activities which it finds no longer necessary, e.g., by forming spin-off firms (Carayannis et al., 1998; Dahlander and Gann, 2010). They are used in market-oriented activities such as improvement of products and services with respect to market requirements or for the purpose of sustaining firms' competitiveness. Open innovation modes include: seeking innovation on the market, integrating innovation from external environment in the internal innovation processes, making the internally unused innovation available on the market to become further developed in the exchange for a fee given to a firm that created it (Gassman and Enkel, 2009). Zucchella and Siano (2014) noted that there exist differences in firms' approaches to open innovation and internationalisation.

2.3. Firm internationalisation

Successful internationalisation is embodied in a firm's innovative capability and comes from a firm's relationship with other firms in the environment in which it operates and creates added value (Schumpeter, 1934; Kirzner, 1973). According to Drucker (1985, p. 19), — "*innovation is the specific tool of entrepreneurship, the means by which they exploit change as an opportunity for different business or different service. It is capable of being presented as a discipline, capable of being learned, capable of being predicted. Entrepreneurs need to search purposefully for the sources of innovation, changes and symptoms that indicate opportunities for successful innovation. Also, they need to know and to apply the principles of successful innovation*" This paper uses Drucker's (1985) approach in viewing innovation as an entrepreneurial tool to achieve competitiveness. Competitiveness is achieved either by developing firms' internal capabilities or by acquiring them from the environment. Lack of innovation within a firm can be ameliorated if innovation is bought or adopted from the market and integrated into a new product or service (Chesbrough, 2003). If a market is limited with many closed relationships that transfer knowledge, as are the markets of small open economies, a firm should seek innovation on the global market whereby geographic dispersion and information asymmetry (Beise, 2004) might restrict the process of innovation absorption making it dependent on the environment, networks, internal resources and capabilities.

In order to answer the research question: What are the differences between low and high internationalised firms based on their organisational learning practices, open innovation and innovation outcome? this paper poses and explains the rationale behind the following hypotheses:

Hypothesis 1. *Organisational learning antecedents positively affect open innovation.*

Conceptually, organisational learning is defined through five aspects: collectivity of individual learning; process or system, culture, knowledge management, and continuous improvement (Wang and Ahmed, 2003). This paper takes the process aspect of organisational learning by identifying organisational learning antecedents that differentiate between their effects on inbound, coupled and outbound open innovation. In this sense, this study explores how organisational learning antecedents transform into successful open innovation practices. Some studies have found a reverse link of inbound open innovation on organisational learning processes (Severoni and Muldoon, 2019), while other explain that negative effects of quality management on open innovation can be minimised through adaptive and complementary organisational learning (Roldan Bravo et al., 2017), such as through information technology (Adamides and Karacapilidis, 2020).

Hypothesis 2. *Organisational learning antecedents positively affect firm innovation output.*

Weng and Huang (2017) found a positive effect of organisational learning on organisational innovativeness. Social media often plays an important part herein (Zhan et al., 2020). Although exploitative and explorative learning demand diverging organisational models (Bröring and Herzog, 2008), both could be combined into a single organisational model to manage successful appropriation of inbound, coupled and outbound open innovation.

Hypothesis 3. *Open innovation positively affects innovation output.*

Four organisational dimensions relate to open innovation's effect on innovation: networks, organisational structures, evaluation processes and knowledge management systems (Chaironi et al., 2011), whereby assimilation of knowledge, relationship, and organisational characteristics dependent on the open innovation practice (Bacon et al., 2019), and type of innovation, i.e., incremental or radical (Peris-Ortiz et al., 2018).

Hypothesis 4. *Open innovation mediates the relationship between organisational learning antecedents and innovation output.*

Naqshbandi and Tabche (2018) do not find interaction of organisational learning on open innovation. Cognitive biases, concerns about transaction costs, and shortfalls in terms of organisation capability could cause a lack of correlation (Hong et al., 2019). Nevertheless, Greco et al. (2019) had shown that neither costs nor competitive advantage are minimised under inbound innovation, while Milan et al. (2020) demonstrate how innovation assets and capabilities become liabilities for technologically innovative firms. In terms of organisational learning, inbound open innovation affects innovation output more effectively through exploitative activities, while outbound open innovation is more effective through exploration activities (Sun et al., 2020). This study inspects: market research, research and development, competition tracking, public information and forecasting as organisational learning antecedents. Hence, this study provides an in-depth analysis of exploitation and exploration activities and their effect on innovation output through each of the three open innovation: inbound, coupled and outbound.

Hypothesis 5. *Firms with low and high internationalisation level use different organisational learning antecedents and open innovation practices that affect their innovation output.*

Three open innovation failures minimise benefits of open innovation practices: lack of information about the capabilities of potential partners and a lack of information about the trustworthiness of potential partners (Hewitt-Dundas and Roper, 2017). Orientation to organisational learning, such as commitment to learning and open-mindedness, affect open innovation model and impact innovation output (Stelmaszczyk, 2020). In order to foster competitiveness, firms interact in the international arena with variety of potential partners and competitors. Thereby, firms encounter numerous challenges and facilitators both in terms of their innovation and international competitiveness (Santoro et al., 2019).

In terms of emerging economies where executive decisions are often accompanied with negative effects, open innovation could improve innovation performance especially in contexts where prior export performance is indicator of current export performance (Chung et al., 2019). Furthermore, organisational learning practices could positively affect liability of foreignness in international operations (Arzubiaga et al., 2021), especially in times when technological collaboration rests primarily on collaboration in learning (Dodgson, 2018). Nonetheless, dynamic capability perspective argues that innovation and internationalisation are complementary activities that could positively impact profitability depending on low or high international performers (Battagalia and Neirotti, 2020). Hence, this study takes the latter perspective to determine differences in successful organisational learning through each different open innovation practice for firms that differ in their international engagement, i.e., low or high internationalisers.

3. Methodology

The empirical research is based on firms from the Croatian telecommunications industry. Telecommunications industry is composed of firms whose at least fifty per cent of added value activities come from:

- high-technology manufacturing industries, and
- knowledge-based telecommunications services (Eurostat, 2008).

High-technology manufacturing industries (e.g., manufacturing of communication equipment) are specified under the NACE statistical classifications 26.3 and 26.4. Knowledge-based telecommunications services are assigned to NACE statistical classification 61 (Eurostat, 2008). Telecommunications firms are classified either under manufacturing or services. However, service telecommunications often do some manufacturing, and manufacturing telecommunications firms provide some service. Therefore, this empirical research integrated both types of activities and under the term "telecommunications industry", which is used to refer to the both types of telecommunications domains. Croatian telecommunications industry comprises 347 firms (Orbis, 2013).

For the purpose of the research, method of examination was used. It was based on the structured questionnaire survey, which served as a research instrument. Survey was conducted on the senior members of the project team. Senior project team members were considered to be able to provide information on firm's internationalisation and open innovation. Senior project managers include top management such as: Chief Executive Officers, Chief Financial Officers, Chief Marketing Officers and Chief Operating Officers. Respondents were identified and contacted over the phone before filling in the survey. Purposive sample aimed to approximately incorporate similar number of internationalised and non-internationalised firms, which included firms with higher values of intangible assets in order to gain an insight into the difference in structures of firms' open innovation and internationalisation practices. Data gathering procedure took place in 2014. After data cleaning and removal of ambiguous data, 82 responses were used. Statistical software package SPSS was used to calculate hierarchical linear regression analysis.

3.1. Dependent variable

Innovation output is a dependent variable of the model. Innovation output refers to perceived or actual performance of organisations occurring as a result of organisations' innovation strategy. It is composed of eight items: greater number of product, service and process configurations, increased quality, increased technical performance, faster time to market, lower unit costs, number of innovation adoptions by customers, lower development and production costs. Exploratory factor analysis confirmed that all eight items form a single component whose eigenvalue is less than 1. Principal component analysis stated that Kaiser-Meyer-Olkin measure of sampling adequacy was 0.892, and Bartlett's test of sphericity's *P*–-value was 0.000. All communalities were greater than 0.5, while the total variance explained was 65.096%, Cronbach's alpha was 0.921.

3.2. Independent variables

Organisational learning depicted as identification of open innovation possibilities is measured by fourteen items. Each of the fourteen items describes practices that firms used to identify ideas for a new product, service or process development, i.e. their organisational learning practices. They included: benchmarking, quantitative data analysis, social networks, market research studies, explicit tracking of competitors' findings, trade fairs and conferences, reverse engineering, gathering information from suppliers, publications, sharing organisation's goals and visions, publishing organisation's research discoveries, hiring R&D personnel, technological forecasting or foresight, and the use of users, customers or consumers in the product, service or process development. The majority of items were acquired from the Australian Research Council Discovery Project on Assessment of Innovation Capability Models to Create Innovation Driven Firms at the Centre for Global Innovation Management, University of Melbourne; and the project by Committee for Economic Development of Australia and The Business Council of Australia on Management and Innovation in the 21st Century obtained from the University of Melbourne, Melbourne Institute of Applied and Social Research (obtained from Terziovski, M., in March 2014). The items on organisational learning were adjusted to fit the purpose of this research, i.e. the identification of open innovation possibilities. The consequent analysis made a distinction between the *generic (market-oriented)* and *specific (technically-oriented)* identification of open innovation possibilities. The distinction is in accordance with papers that studied the impact of technological learning on market performance and proposed a differentiation between strategic and basic operational learning (Carayannis and Alexander, 2002). Herein, 14 item scale was inspected through exploratory factor analysis that used principal components analysis and found five factors with eigenvalues greater than 1. First component was organisational learning through market research (quantitative data analysis, social networks, market research studie9s), where Kaiser-Meyer-Olkin measure of sampling adequacy was 0.662, and Bartlett's test of sphericity's *P*–-value was 0.000. All communalities were greater than 0.5, while the total variance explained was 54.003%, Cronbach's alpha = 0.725. Second component was organisational learning through research and development (publishing organisation's research discoveries, hiring R&D personnel, reverse engineering). Kaiser-Meyer-Olkin measure of sampling adequacy was 0.608, and Bartlett's test of sphericity's *P*–-value was 0.000. All communalities were greater than 0.4, while the total variance explained was 56.463%, Cronbach's alpha = 0.614. Third component was organisational learning through competition tracking (benchmarking, explicit tracking of competitors' findings, trade fairs and conferences). Kaiser-Meyer-Olkin measure of sampling adequacy was 0.641, and Bartlett's test of sphericity's *P*–-value was 0.000. All communalities were greater than 0.5, while the total variance explained was 58.136%, Cronbach's alpha = 0.638. Fourth component was organisational learning through publicly available information (gathering information from suppliers, publications). Kaiser-Meyer-Olkin measure of sampling adequacy was 0.500, and Bartlett's test of sphericity's *P*–-value was 0.000. All communalities were greater than 0.7, while the total variance explained was 73.614%, Cronbach's alpha = 0.641. Fifth component was organisational learning through forecasting (technological forecasting or foresight, the use of users, customers or consumers in the product, service or process development and sharing organisation's

goals and visions). Kaiser-Meyer-Olkin measure of sampling adequacy was 0.542, and Bartlett's test of sphericity's *P*–-value was 0.000. All communalities were greater than 0.4, while the total variance explained was 56.273%, Cronbach's alpha = 0.606. All components were subsequently converted into factors with principal axis factoring as a confirmatory factor analysis method, and as such used in the analysis.

Open innovation construct evaluates firms' actually performed open innovation. The construct includes a nine-item scale composed of questions on inbound (outside-in), coupled and outbound (inside-out) practices. Questions on actually performed open innovation were obtained from: Chesbrough (2003), Chesbrough and Crowther (2006), Lind et al. (2012), Hung and Chou (2013), Sisodiya et al. (2013), Parida et al. (2013) and Huang et al. (2013). Items measured the extent to which firms used clients, competitors, suppliers, government agencies, research institutes and universities in product, service or process design to: gather information, exchange experiences, buy or use technology, adopt available external knowledge and technology to internal developments, jointly undertake R&D activities, develop a product or cooperate on a project, promote ideas that cannot be self-developed, sell a firm's non-core technology and commercialise a firm's intellectual property. Principal components analysis indicated the existence of three components with eigenvalues greater than 1. Three components were extracted based on varimax rotated component matrix with Kaiser normalisation. Items (1–3): gather information, buy or use technology, adopt available external knowledge and technology to internal developments formed the first factor: Inbound open innovation (Kaiser-Meyer-Olkin measure of sampling adequacy was 0.650, and Bartlett's test of sphericity's *P*–-value was 0.000. All communalities were greater than 0.5, while the total variance explained was 61.968%, Cronbach's alpha = 0.692). Items (4–6): exchange experiences, jointly undertake R&D activities, develop a product or cooperate on a project, formed the second factor: Coupled open innovation (Kaiser-Meyer-Olkin measure of sampling adequacy was 0.625, and Bartlett's test of sphericity's *P*–-value was 0.000. All communalities were greater than 0.4, while the total variance explained was 54.003%, Cronbach's alpha = 0.574). And items (7–8): promote ideas that cannot be self-developed and sell a firm's non-core technology and commercialise a firm's intellectual property formed the third factor: Outbound open innovation (Kaiser-Meyer-Olkin measure of sampling adequacy was 0.500, and Bartlett's test of sphericity's *P*–-value was 0.001. All communalities were greater than 0.68, while the total variance explained was 68.157%, Cronbach's alpha = 0.507).

Internationalisation level was measured by a single five item 7-point Likert scale where answers ranged from: (1) 0%, (2) 1%–10%, (3) 11%–20%, (4) 21%–30%, (5) 31%–40%, (6) 41%–50% and (7) more than 50% of (a) share of exports in total sales, (b) share of income from foreign subsidiaries, (c) share of income from foreign strategic alliances, (d) share of foreign added value in total added value, and (e) share of licences sold to foreign organisations. After conducting a principal component analysis that indicated only one component with eigenvalue greater than 1, Kaiser-Meyer-Olkin measure of sampling adequacy was 0.806, and Bartlett's test of sphericity's *P*–-value was 0.000. All communalities were greater than 0.5, while the total variance explained was 60.707%, Cronbach's alpha was 0.835. Hence, single factor was extracted named internationalisation level. After standardisation of the factor, firms with values less than or equal to 0 were those with low internationalisation level, while firms with internationalisation level greater than 0 were firms with high internationalisation level.

3.3. Control variables

Firm size (turnover). 28 (33.3%) firms had an average annual turnover between 0 and 5 million HRK in the last four years. 25 (29.8%) firms had the average annual turnover between 5 and 75 million HRK. If the size of a firm is measured according to the amount of turnover, 53 (63.1%) firms in the sample are small firms. 17 (20.2%) firms' average annual turnover was between 75 and 350 million HRK, which makes them medium-sized firms and only 14 (16.7%) firms are large firms that obtained more than 350 million HRK in turnover. In measuring the firm's sizes, there is a consistency between the size of a turnover and number of employees.

Industry (manufacturing). Only 10 firms responded that they are manufacturing telecommunications firms. However, due to the possible discrepancies between manufacturing and service-oriented firms, this study controlled for the effect of manufacturing firms on innovation outcome in the sample.

Internationalisation year. The respondents were asked to indicate the first year a firm internationalised through, but not exclusive to, exports, outsourcing or international joint ventures. The results displayed in Table 6.2. show that 7 (8.4%) firms internationalised before 1996 which is explained by the firms' foundation in the former socialist system of Yugoslavia. The total of 63 (75.0%) firms internationalised after 2001, 49 (58.3%) after 2006 and 20 (23.8%) after 2010.

R&D size (personnel). The size of the R&D department portrays a much different picture. 46 (53.5%) firms have between one and five employees dedicated to their R&D department, and 25 (27.9%) firms have between six and fifty R&D employees. In 15 (18.6%) firms the R&D department counts more than 51 employees.

4. Results

Descriptive statistics of the dependent, independent and control variables are depicted in Table 1. All data were standardized to avoid possible multicollinearity issues.

Table 2 points to cross-correlations of the variables, while Table 3 illustrates the results of organisational learning antecedents on inbound, coupled and outbound open innovation. Results show that competition tracking is the single organisational learning antecedent that significantly positively predicts inbound open innovation. Organisational learning through research and development and publicly available information statistically significantly predicts coupled open innovation.

Table 1
Descriptive statistics.

	Minimum	Maximum	Mean	Std. Deviation	Skewness (S.E. = 0.266)	Kurtosis (S.E. = 0.526)
Innovation output	−2.491	2.004	0	1	−0.508	−0.316
Inbound open innovation	−2.465	1.740	0	1	−0.112	−0.827
Coupled open innovation	−2.370	2.483	0	1	−0.018	0.044
Outbound open innovation	−1.441	2.400	0	1	0.109	−0.829
OL: Market research	−2.165	2.323	0	1	0.013	−0.621
OL: Research and development	−1.697	2.046	0	1	0.029	−0.936
OL: Competition tracking	−2,24347	2.054	0	1	−0.151	−0.514
OL: Public information	−2.436	2.148	0	1	−0.235	−0.258
OL: Forecasting	−2.790	1.161	0	1	−1.239	1.156
Size (turnover)	−1.170	1.578	0	1	0.185	−1.369
Industry (manufacturing)	0	1	0.120	0.329	2.354	3.629
Internationalisation year	−1.180	2.742	0	1	0.707	−0.160
R&D size (employees)	−1.308	2.584	0	1	1.024	0.393
Internationalisation	−1.151	2.679	0	1	1.232	0.805
N	82					

Source: Author's calculation.

Finally, organisational learning that takes place through market research, research and development and publicly available information statistically significantly predict outbound open innovation.

Table 4 provides results of regression analysis of organisational learning antecedents and open innovation on innovation outcome. Organisational learning through research and development, competition tracking and publicly available information positively predicts innovation outcome, as well as coupled and outbound open innovation. Inbound open innovation does not statistically significantly predict innovation outcome. Results of the mediation analysis are also shown in Table 4. Only previously obtained statically significant relationships were tested for mediation. Sobel (1982) test was used to depict significant mediation (Eq. 1):

$$z - value = \frac{a \times b}{\sqrt{b^2 s_a^2 + a^2 s_b^2}} \tag{1}$$

Sobel test is used when statistically significant relationship exists between: (1) an independent and dependent variable, (2) independent variable and mediator, and (3) mediator and dependent variable. All three conditions must be satisfied for the analysis to proceed to test mediation effect. Mediation effect is calculated using a Sobel test whereby regression coefficient and its standard error between (a) the independent variable and the mediator, and (b) the mediator and the dependent variable. Sobel test provides a ratio that states whether the indirect effect between the independent and dependent variable via the mediator is statistically different from zero (Baron and Kenny, 1986). Only coupled innovation proved to be statistically significant mediator. Coupled innovation mediates the relationship between organisational learning through research and development and publicly available information and innovation outcome.

Differences between low and high internationalisation firms were considered and presented in Table 5. For firms with low internationalisation organisational learning through competition tracking was a significant predictor of inbound open

Table 2
Cross-correlations.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Innovation output	1													
2	Inbound open innovation	0.068	1												
3	Coupled open innovation	0.052	0.254*	1											
4	Outbound open innovation	0.179	0.127	0.222*	1										
5	OL: Market research	0.255*	0.174	0.111	0.274*	1									
6	OL: Research and development	0.415**	0.000	0.445**	0.375**	0.164	1								
7	OL: Competition tracking	0.464**	0.220*	0.023	0.015	0.482**	0.350**	1							
8	OL: Public information	0.065	0.267*	0.381**	0.138	0.176	0.150	0.208	1						
9	OL: Forecasting	0.281*	0.045	0.012	0.252*	0.235*	0.380**	0.292**	0.028	1					
10	Size (turnover)	0.140	0.121	−0.076	0.113	0.188	−0.031	0.246*	−0.105	0.093	1				
11	Industry (manufacturing)	0.270*	0.056	0.032	0.028	−0.090	0.137	0.076	0.024	0.097	0.109	1			
12	Internationalisation year	−0.129	0.001	0.071	0.022	−0.180	0.037	0.042	0.125	0.001	0.316**	0.179	1		
13	R&D size (employees)	0.265*	0.086	−0.019	0.251*	0.160	0.236*	0.268*	−0.060	0.163	0.631**	0.239*	0.300**	1	
14	Internationalisation	0.310**	−0.096	−0.123	0.139	−0.000	0.259*	0.341**	−0.121	0.268*	0.124	0.179	0.059	0.319**	1

Source: Author's calculations.

Table 3
Organisational learning antecedents and open innovation.

	Inbound open innovation					Coupled open innovation					Outbound open innovation				
	M1	M2	M3	M4	M5	M1	M2	M3	M4	M5	M1	M2	M3	M4	M5
Control variables:															
Size (turnover)	0.454*	0.533*	0.312	0.566**	0.534**	0.135	0.318*	0.045	0.205	0.106	−0.130	0.186	−0.053	0.207	0.046
	(0.197)	(0.205)	(0.201)	(0.201)	(0.195)	(0.164)	(0.139)	(0.174)	(0.156)	(0.159)	(0.205)	(0.226)	(0.241)	(0.213)	(0.220)
Industry	0.466	0.565	0.495	0.554	0.586	0.244	−0.024	0.191	0.176	0.179	0.308	0.396	0.514	0.488	0.493
(manufacturing)	(0.679)	(0.696)	(0.651)	(0.689)	(0.692)	(0.566)	(0.473)	(0.562)	(0.538)	(0.563)	(0.707)	(0.766)	(0.781)	(0.733)	(0.782)
Internationalisation	0.117	0.046	0.128	−0.006	0.042	0.318*	0.332**	0.365**	0.197	0.349**	0.299*	0.125	0.170	−0.105	0.144
year	(0.143)	(0.139)	(0.134)	(0.158)	(0.139)	(0.119)	(0.094)	(0.116)	(0.123)	(0.113)	(0.149)	(0.153)	(0.161)	(0.168)	(0.157)
R&D size	−0.596**	−0.623**	−0.639**	−0.618**	−0.605**	−0.303†	−0.570***	−0.301†	−0.288†	−0.322†	−0.054	−0.290	−0.122	−0.101	−0.157
(employees)	(0.198)	(0.218)	(0.190)	(0.201)	(0.205)	(0.165)	(0.148)	(0.164)	(0.157)	(0.167)	(0.206)	(0.240)	(0.228)	(0.214)	(0.232)
Independent variables:															
OL: Market research	0.285					−0.091					0.679***				
	(0.176)					(0.147)					(0.183)				
OL: Research and		0.004					0.446***					0.287†			
development		(0.133)					(0.091)					(0.147)			
OL: Competition			0.435*					0.130					0.209		
tracking			(0.163)					(0.141)					(0.195)		
OL: Public				0.106					0.289*					0.475**	
information				(0.152)					(0.119)					(0.162)	
OL: Forecasting					−0.083					0.145					0.238
					(0.194)					(0.158)					(0.219)
ANOVA (*P*-value)	0.028	0.077	0.005	0.064	0.072	0.050	0.000	0.042	0.006	0.042	0.016	0.393	0.765	0.087	0.706
R^2	0.203	0.164	0.261	0.171	0.167	0.181	0.430	0.188	0.256	0.187	0.223	0.089	0.045	0.159	0.046
Adjusted R^2	0.129	0.087	0.193	0.095	0.090	0.105	0.378	0.112	0.188	0.112	0.151	0.005	−0.043	0.081	−0.042
Durbin - Watson	1.971	2.033	1.960	2.047	2.075	1.964	1.548	1.939	2.127	1.872	1.965	1.873	1.938	1.803	2.008

Note: ***P-value < 0.001, **P-value < 0.01, *P-value < 0.05, †P-value < 0.1.
$N = 82$. Standard errors in parentheses. Weighted least squares weight based on perception of open innovation success (implemented/identified OI practices).

Table 4
Organisational learning, open innovation and innovation output.

	Innovation output											
	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**
Control variables:												
Size (turnover)	0.371†	0.414*	0.551**	0.100	0.526**	0.366†	0.298	0.311†	0.358†	0.424*	0.439*	0.498**
	(0.192)	(0.198)	(0.186)	(0.191)	(0.180)	(0.192)	(0.204)	(0.173)	(0.185)	(0.188)	(0.172)	(0.181)
Industry (manufacturing)	0.362	0.417	0.156	0.273	0.302	0.325	0.284	0.246	0.223	0.166	0.227	0.236
	(0.679)	(0.683)	(0.631)	(0.620)	(0.619)	(0.682)	(0.683)	(0.613)	(0.658)	(0.608)	(0.582)	(0.620)
Internationalisation year	−0.320*	−0.359*	−0.328*	−0.219†	−0.556***	−0.311*	−0.327*	−0.505***	−0.353*	−0.460**	−0.640***	−0.542***
	(0.136)	(0.143)	(0.126)	(0.128)	(0.142)	(0.137)	(0.136)	(0.133)	(0.132)	(0.135)	(0.136)	(0.142)
R&D size (employees)	0.243	0.229	0.005	0.220	0.255	0.214	0.328	0.404*	0.272	0.232	0.377*	0.269
	(0.198)	(0.199)	(0.198)	(0.181)	(0.181)	(0.202)	(0.215)	(0.184)	(0.192)	(0.215)	(0.175)	(0.181)
Independent variables:												
OL: Market research		−0.159										
		(0.177)										
OL: Research and development			0.387**							0.209		
			(0.121)							(0.140)		
OL: Competition tracking				0.538**								
				(0.155)								
OL: Public information					0.476**						0.354*	0.412**
					(0.137)						(0.135)	(0.147)
OL: Forecasting						0.157						
						(0.191)						
Mediator:												
Inbound open innovation							0.160					
							(0.155)					
Coupled open innovation								0.712**		0.399*	0.423**	
								(0.192)		(0.175)	(0.147)	
Outbound open innovation									0.348*			0.134
									(0.155)			(0.115)
ANOVA (*P*-value)	0.003	0.005	0.000	0.000	0.000	0.005	0.004	0.000	0.001	0.000	0.000	0.000
R^2	0.253	0.264	0.372	0.390	0.390	0.262	0.268	0.404	0.317	0.428	0.472	0.405
Adjusted R^2	0.199	0.196	0.314	0.333	0.333	0.194	0.200	0.349	0.254	0.363	0.412	0.338
Durbin - Watson	2.211	2.252	2.265	2.228	2.267	2.237	2.246	2.168	2.175	2.258	2.150	2.256
Sobel test										2.067*	1.856*	1.082

Note: ****P*-value < 0.001, ***P*-value < 0.01, **P*-value < 0.05, †*P*-value < 0.1. $N = 82$. Standard errors in parentheses. Weighted least squares weight based on perception of open innovation success (implemented/identified OI practices).

innovation; research and development and publicly available information on coupled open innovation; and market research and publicly available information on outbound open innovation. For firms with high internationalisation organisational learning through market research affects inbound open innovation positively and forecasting negatively.

Finally, Table 6 presents the results of mediation of only previously significant relationships. It portrays that in low internationalisation firms coupled and outbound open innovation significantly predict innovation outcomes. Only one significant mediating role of open innovation was found in the outbound open innovation on the relationship between market research and innovation outcome. open innovation is not statistically significant for high internationalisation firms.

5. Conclusion

This research is based on the premise of network externalities that assist complementary innovation-internationalisation strategies. Research was performed on the Republic of Croatia's telecommunications industry which showcased a potentially successful innovative global industry in the setting of a transitional small open economy constrained by institutional regulatory changes and a recent accession into the European Union. The sample encompassed 82 firms which were predominantly small and medium-sized. The study showed that inbound open innovation do not influence innovation outcomes neither for low nor for high internationalisation firms. However, coupled and outbound open innovation are important predictors of innovation outcomes for low internationalisation firms. Furthermore, firms with low internationalisation organise learning through: (a) competition tracking to perform inbound open innovation; (b) research and development and publicly available information to induce coupled open innovation; and (c) market research and publicly available information to get the innovation successfully into the outside business environment. Firms with high internationalisation organise learning through: (a) market research only to successfully increase their inbound open innovation practices. Results of mediation analysis show that low internationalisation firms' coupled and outbound open innovation significantly predict innovation outcomes. Only one significant mediating role of open innovation was found in the outbound open innovation in the relationship between market research and innovation outcome. Open innovation is not statistically significant predictor in the sample of high internationalisation firms.

Table 5
Differences in open innovation and organisational learning between low and high internationalisation firms.

	Inbound open innovation				Coupled open innovation				Outbound open innovation			
	Low internationalisation		High internationalisation		Low internationalisation		High internationalisation		Low internationalisation		High internationalisation	
	M1	**M2**	**M1**	**M2**	**M1**	**M2**	**M1**	**M2**	**M1**	**M2**	**M1**	**M2**
Control variables:												
Size (turnover)	0.490* (0.194)	0.094 (0.245)	0.828 (0.495)	0.629 (0.479)	0.126 (0.213)	0.450† (0.237)	−0.093 (0.281)	0.285 (0.305)	0.172 (0.254)	0.536† (0.263)	−0.766* (0.323)	−0.387 (0.491)
Industry (manufacturing)	−1.183 (1.375)	−1.001 (1.261)	1.350 (0.849)	1.189† (0.591)	−1.233 (1.509)	−0.737 (1.220)	0.589 (0.483)	0.516 (0.377)	−0.896 (1.801)	0.401 (1.354)	0.253 (0.554)	0.115 (0.607)
Internationalisation year	0.213 (0.141)	0.168 (0.162)	−0.390 (0.332)	−0.319 (0.368)	0.332* (0.155)	0.123 (0.157)	0.438* (0.189)	0.233 (0.235)	−0.147 (0.185)	−0.211 (0.174)	0.895** (0.271)	0.638 (0.378)
R&D size (employees)	−0.321 (0.237)	−0.292 (0.228)	−0.936 (0.349)	−0.508 (0.305)	−0.260 (0.260)	−0.622** (0.221)	−0.268 (0.199)	−0.354† (0.195)	−0.709* (0.311)	−0.897** (0.234)	0.585* (0.228)	0.458 (0.313)
Independent variables:												
OL: Market research		−0.348 (0.223)		1.200** (0.306)		−0.402† (0.216)		0.401† (0.195)		0.745** (0.240)		0.154 (0.314)
OL: Research and development		−0.247 (0.158)		0.016 (0.294)		0.342* (0.153)		0.341† (0.188)		0.254 (0.169)		0.329 (0.302)
OL: Competition tracking		0.728** (0.239)		0.046 (0.335)		0.171 (0.231)		−0.304 (0.214)		−0.188 (0.256)		−0.090 (0.344)
OL: Public information		0.037 (0.200)		−0.031 (0.210)		0.409* (0.193)		−0.056 (0.134)		0.787** (0.215)		0.044 (0.216)
OL: Forecasting		0.080 (0.237)		−1.115** (0.336)		−0.055 (0.220)		−0.451† (0.214)		−0.145 (0.254)		−0.316 (0.344)
ANOVA (*P*-value)	0.079	0.017	0.073	0.001	0.224	0.003	0.079	0.005	0.146	0.000	0.001	0.018
R^2	0.230	0.497	0.336	0.787	0.163	0.575	0.330	0.730	0.192	0.645	0.584	0.672
Adjusted R^2	0.131	0.323	0.203	0.660	0.055	0.428	0.196	0.569	0.088	0.522	0.501	0.475
Durbin - Watson		1.416		2.585		1.106		1.612		1.065		2.036

Note: ***P-value < 0.001, **P-value < 0.01, *P-value < 0.05, †P-value < 0.1.
N (low internationalisation) = 35, N (high internationalisation) = 24. Standard errors in parentheses. Weighted least squares weight based on perception of open innovation success (implemented/identified OI practices).

Table 6
Differences in innovation output, organisational learning and open innovations between low and high internationalisation firms.

	Innovation output (Low internationalisation)				Innovation output (High internationalisation)			
	M1	**M2**	**M3**	**M4**	**M1**	**M2**	**M3**	**M4**
Control variables:								
Size (turnover)	0.238 (0.234)	0.431† (0.223)	0.140 (0.200)	0.101 (0.235)	0.162 (0.327)	0.024 (0.426)	0.102 (0.455)	−0.186 (0.397)
Industry (manufacturing)	−0.154 (1.726)	0.558 (1.145)	0.861 (1.302)	0.319 (1.072)	0.440 (0.562)	0.432 (0.526)	0.532 (0.636)	−0.140 (0.505)
Internationalisation year	−0.493** (0.177)	−0.715*** (0.147)	−0.657*** (0.147)	−0.615*** (0.148)	0.264 (0.220)	0.144 (0.327)	0.394 (0.388)	−0.080 (0.361)
R&D size (employees)	0.554† (0.298)	0.125 (0.207)	0.920** (0.240)	0.602* (0.253)	−0.017 (0.231)	0.172 (0.271)	−0.045 (0.349)	0.385 (0.278)
Independent variables:								
OL: Market research		−0.365† (0.203)		−0.653* (0.239)		−0.427 (0.272)		−0.939* (0.331)
OL: Research and development		0.345* (0.143)		0.057 (0.182)		−0.347 (0.262)		−0.632* (0.273)
OL: Competition tracking		0.541* (0.217)		0.786** (0.258)		0.357 (0.298)		0.555 (0.284)
OL: Public information		0.573** (0.182)		0.130 (0.228)		0.336† (0.187)		0.367* (0.160)
OL: Forecasting		−0.231 (0.215)		−0.130 (0.200)		0.271 (0.298)		0.834* (0.335)
Mediator:								
Inbound open innovation			−0.081 (0.198)	−0.304 (0.221)			0.046 (0.204)	0.194 (0.250)
Coupled open innovation			0.681** (0.174)	0.314 (0.204)			−0.261 (0.356)	0.613 (0.380)
Outbound open innovation			0.303* (0.138)	0.414* (0.177)			0.002 (0.257)	0.223 (0.204)
ANOVA (*P*-value)	0.004	0.000	0.000	0.000			0.533	0.036
R^2	0.380	0.788	0.691	0.844			0.269	0.747
Adjusted R^2	0.300	0.714	0.614	0.762			−0.032	0.495
Durbin - Watson		1.551		2.640				1.543
Sobel test				1.868*				

Note: ****P*-value < 0.001, ***P*-value < 0.01, **P*-value < 0.05, †P-value < 0.1.
N (low internationalisation) = 35, *N* (high internationalisation) = 24. Standard errors in parentheses. Weighted least squares weight based on perception of open innovation success (implemented/identified OI practices). Sobel test calculated for outbound open innovation and market research.

Croatian telecommunications firms "search", learn about and identify open innovation possibilities through firms' attempts to be more competitive. Due to the lack of internal innovations, they are looking for solutions outside of their internal organisational environments. The relationship between firms' search for innovation and internationalisation can be furthered with the organisational reward systems for knowledge diffusion, reproduction and the capture of the external knowledge (Foray, 2004). These incentives must be accompanied by appropriate institutional environments because they might fail its purpose in the markets with the lack of competition and low marginal cost of diffusion (Foray, 2004, p. 181), i.e., in the Croatian telecommunications market. However, for firms with high internationalisation level open innovation is not statistically significantly identified as a source of idea generation. These findings are consistent with the studies which found the mediating effect of knowledge sharing on innovation (e.g., Hu and Randel, 2014).

This paper contributes to the literature in which innovation and internationalisation are viewed as complementary strategies. Moreover, it engages in the contemporary debate about open innovation and its benefits in the global society in specific detail. Namely, while majority of studies explain organisational learning only through one open innovation practice, this study takes on a comprehensive role and explains organisational learning differences through all three open innovation practices and differs between two internationalisation levels. Herein, two types of knowledge (i.e., explorative and exploitative) correspond to the ways firms learn about and identify open innovation possibilities, and are meaningful for the interpretation of the empirical analysis' results in the international environment. Technological knowledge presents the critical knowledge component in the exploratory learning (Cohen and Levinthal, 1990), which might explain why firms fail to exploit what they have learnt. Moreover, a possible explanation why organisational learning is not channelled through open innovation practices can be found in the lack of appropriate product or service placement which is done in accordance with demands of the domestic customers. Gaps between technical requirements and design norms at home and abroad occur due to managers' inability to identify firms' global potentials and capitalise them (Bartlett and Ghoshal, 2000). Consequently, foreign customers' demands are not incorporated into products or services, and foreign customers do not benefit from the existing product or service lines that are designed for domestic consumers.

In terms of practical implications, this study offers a significant contribution to both low and high internationalising firms from emerging markets that have undergone several market transitions. Firms that adapted to international partners more

easily portray different organisational learning characteristics than those which did not. Hence, this study offers a meaningful tool for businesses striving to improve their international scope of operations, while providing their labour force with instruments that enable them to achieve internationalisation in assertive manner within open innovation umbrella. Finally, the main contribution of this study is an understanding of how organisational learning antecedents and open innovation practices interact in firms with different internationalisation levels, whereby firms with higher internationalisation level already have competitive advantage that lower internationalisation firms need to achieve.

Limitation of this study is its cross-sectional and one industry setting that might prevent generalisation of the findings. Nonetheless, these finding are important in the COVID-19 and post-COVID-19 era when telecommunications companies gain their momentum through changing market demands that require increasingly innovative products and services.

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