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The role of internal change agent in developing the relationship between knowledge sharing and performance in virtual team

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The last decade has seen a distinct increase in the frequency of the appearance of virtual teams within contemporary organizations. As knowledge sharing within the virtual team leads to better team performance, a deeper understanding of enabling organizational capabilities is highly relevant to both researchers and managers. Therefore, in this paper we focus on the concept of "internal change agent support". More specifically, we use a qualitative research design to study the role of internal agent support within the relationship between knowledge sharing and virtual team performance. A theoretical model was built and verified by means of structural equation modelling (PLS-SEM). The authors found that internal change agent support has a moderating effect on relationship between knowledge sharing and the virtual team performance and the knowledge sharing within the virtual team influences positively virtual team performance. These results add to the emerging academic discussion on continuous change management within dispersed teams. Our findings are also relevant to managerial practice as they suggest how to facilitate the process of knowledge sharing in a team, thus improving its efficiency.

The last decade has seen a distinct increase in the frequency of the appearance of virtual teams within contemporary organisations[1]. There are a few constituent parts which play a role in whether or not to choose team forms of work, for example, more complex conditions of development, new requirements in competition, and a rise in both the number of innovations, speed of changes and turbulent surroundings or technological advancement. Virtual teams are a phenomenon which joins people of disparate disciplines, functions or cultures. Those teams are created by cooperating individuals regardless of geographical distribution. Members of virtual teams communicate using information and communication technologies much more often than teams in face to face setting. They are obliged to act quickly and efficiently which, in turn, requires a high level of technological assistance. Because of that, technology has become absolutely indispensable in order for virtual teams to function. Various tools (video conferences, e-mails, on-line chatting or instant messaging) facilitate communication flexibility in virtual teams[2], which in turn aids the process of making decisions; certain things are made easier, like cooperation, individual and team learning, and knowledge sharing.

Members of virtual teams establish business connections with individuals representing other cultures much better than at any time earlier. Cross-cultural connections in culturally diverse teams are unavoidable and they affect the knowledge sharing process[3]. Employees, who are capable of sharing their knowledge with other members of their team are, in terms of cultural diversity, a rare, valuable and unique resource, which can affect the performance of a team and, in consequence, ensure its competitive advantage. However, only few empirical studies have paid attention to virtual teams in the context of direct and indirect effect of sharing knowledge on team performance. The majority of analyses carried out to date concentrate on identifying the above-mentioned relation in traditional work teams operating in business organisations[4]. This study on the effect of knowledge sharing among the members of a virtual team on the performance of such a team aims to close the research gap in this field.

As knowledge might be seen as the key source of competitive advantage, the idea of its sharing in order to improve performance of a team becomes a priority[5]. In this context, the interest of researchers

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[2] A.R. Dennis, R.M Fuller, J.S. Valacich, *Media, Tasks, and Communication processes: A Theory of Media Synchronicity*, „MIS Quarterly" 2008, Vol. 32, No. 3, pp. 575–600.
[3] Ch. Mei-Liang, L. Chieh-Peng, *Assessing the Effects of Cultural Intelligence on Team Knowledge Sharing From a Socio-Cognitive Perspective*, „Human Resource Management" 2013, Vol. 52, No. 5, pp. 675–695, http://dx.doi.org/10.1002/hrm.21558.
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[5] R.M. Grant, *Toward a Knowledge Based Theory of the Firm*, „Strategic Management Journal" 1996, Vol. 17, pp. 109–122, http://dx.doi.org/10.5465/AMJ.2006.23478718.

shifted towards the internal change agent. Internal change agent support could potentially strengthen the relation between knowledge sharing among members of a virtual team and its performance. Internal change agents are members of the organisation, and so they know them and understand the way they work[6]. They could use their knowledge and the expertise they possess to help virtual teams through the processes of change, simultaneously facilitating knowledge sharing. Internal change agent's role in increasing the efficiency of a team through creating conditions of knowledge sharing has a special meaning, because the increase in popularity of virtual teams does not mean that they are always beneficial[7].

Unfortunately, there is none up-to-date research where researchers attempt to explain the relationship among knowledge sharing and support stemming from internal change agents and the performance of virtual teams. Thus, the analysis of the relationships among the mentioned constructs with the use of the moderation effect is the first research initiative of its kind in the context of virtual teams.

Because of that, the main goal of this research is to understand and explain the relationship between knowledge sharing within the virtual team versus virtual team performance in the conditions of a moderating variable the assumed relation, that is, internal change agent support. This research aims to better understand the role of internal change agent in shaping the performance of a virtual team.

Literature review

Knowledge sharing within virtual team and virtual team performance

Knowledge is a basic component of every organisation. It is perceived as one of the most important sources of strong competitive advantage[8]. It also refers to virtual teams[9], which became an indispensable element of the worldwide economy quite abruptly. The fact that they are more and more common results from the benefits of virtual forms of cooperation. The benefits undoubtedly include the lack of geographical limitations when employing specialists of various disciplines and the ability to lower the costs both by an organisation creating a virtual team and by the members of such a team. It also means more active ways of supporting creativity and originality of the whole team resulting in a higher level of innovativeness as well as better flexibility and efficiency in comparison to traditional teams[10].

A virtual team, according to Jarvenpaa and Leidner[11] is a temporary, geographically dispersed, culturally diverse work group which uses electronic devices to communicate. Jarvenpaa and Leidner's definition considers cultural diversity. Such a feature is indispensable when one wants to explain the notion of a global virtual team. However, in this study the question of perceiving the term 'virtual team' does not include cultural diversity as one of the obligatory criteria of defining of such terms. Kanawattanachai and Yoo[12] dealt with the problem similarly, deciding that virtual teams can be both global and domestic. When it comes to knowledge sharing within the team, such a notion should mean actions taken by members of a team in order to share acquired knowledge with another team members[13], as well as the transfer of the category of the resource among the specific members of the team.

Knowledge sharing has been recognized a valuable immaterial resource, which is key to gain competitive advantage[14]. Apart from that, according to what Jarvenpaa and Staples[15] suggest, superiors cannot order their subordinates to share their knowledge. Subordinates should also understand that knowledge sharing is not part of their duties, because such actions are voluntary and, according to Grant[16], such actions cannot be gratified because of their immaterial character. Meanwhile, knowledge sharing dramatically increases resources of virtual teams and, accordingly, an entire

[6] N. Tichy, *How Different Types of Change Agents Diagnose Organizations*, „Human Relations" 1975, Vol. 28, No. 9, pp. 771–799, http://dx.doi.org/10.1177/001872677502800901.
[7] D.M. DeRosa, R. Lepsinger, *Virtual Team Success: A Practical Guide for Working and Leading from a Distance*, Jossey-Bass, USA 2010, pp. 3–14.
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[10] G.R. Berry, *Enhancing Effectiveness on Virtual Teams: Understanding Why Traditional Team Skills Are Insufficient*, „Journal of Business Communication" 2011, Vol. 48, No. 2, pp. 186–206, http://dx.doi.org/10.1177/0021943610397270.
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[13] S., S.H. Ho, I. Han, *Knowledge Sharing Behavior of Physicians in Hospitals*, „Expert Systems with Applications" 2003, Vol. 25, No. 1, pp. 113–122, http://dx.doi.org/10.1016/S0957-4174(03)00011-3.
[14] R.M. Grant, op.cit., pp. 109–122.
[15] S.L. Jarvenpaa, D.S. Staples, *Exploring Perceptions of Organizational Ownership of Information and Expertise*, „Journal of Management Information Systems" 2001, Vol. 18, No. 1, pp. 151–183.
[16] R.M. Grant, op.cit., pp. 109–122.

organisation benefits from it. Consequently, it reduces the time devoted to trial and error methods[17]. The intellectual strength of such teams is dispersed specialized knowledge and the ability to put together the experience of different individuals in order to create common knowledge[18]. If one is a member of a virtual team and is able to use the knowledge of other members, he or she can develop his or her own knowledge. In addition, according to the assumptions of the transitive memory theory[19] a team functions better, if members are conscious of both knowledge and experiences of other members of a team. Moreover, the research results of Jarvenpaa and Majchrzak[20] prove that knowledge on 'who knows what and who knows who knows' is essential within a team.

Within virtual teams, it is possible for individuals from different parts of the world to cooperate using the knowledge they have acquired and present their own point of view. The more effective the knowledge sharing will be among them, the better they can perform their tasks[21]. Some of the problems may be their reluctance to share this resource with other members of a team and the lack of trust connected for the most part with the danger of 'stealing' the acquired knowledge and using it by the potential competitors[22]. Due to the fact that knowledge sharing affects the performance, reluctance to share it can threaten a team's existence. Knowledge sharing is a factor that plays a significant role in creating team's performance, which has been observed in traditional teams[23]. Thus an attempt to recognize and explain the relationship between knowledge sharing and performance in virtual teams plays a vital role because knowledge in this respect is scant and incomplete.

The results of contemporary research show that knowledge sharing among members of global virtual teams is a mediator of relationships between diversity and satisfaction of working in such teams. Global virtual team member satisfaction and global virtual team performance were the two constructs comprising global virtual team effectiveness[24]. The proposed research model considered performance, and none of the tested hypotheses referred to the relationship between knowledge sharing and this variable. Nevertheless, the analysis of descriptive statistics shows that knowledge sharing is statistically significant correlated by a moderately strong and positive relationship with the global virtual team's effectiveness. Kanawattanachai and Yoo (2007) do not concentrate on the knowledge sharing itself, but they draw attention to task-knowledge coordination as one of the dimensions of transactive memory systems. Task-knowledge coordination became less significant at the onset of 38 virtual teams' existence. However, after eight weeks of observation, it emerged as a factor playing the key role in shaping the performance of the teams, at the same time mediating the impact of all the other constructs on the performance changes in time[25]. On the other hand, in previous, theoretical, discussions researchers described a concept of mutual knowledge, where they pointed to an existing research gap concerning the potential impact of mutual knowledge on a virtual team's performance[26]. They described mutual knowledge as the knowledge shared by individuals communicating with one another where each and every party knows that the knowledge is mutual.

In relation to the above, the following hypothesis has been formulated:

[17] C.P. Lin, *To Share or Not to Share: Modeling Knowledge Sharing Using Exchange Ideology as a Moderator*, „Personnel Review" 2007, Vol. 36, No. 3, pp. 457–475, http://dx.doi.org/10.1108/00483480710731374; C.P. Lin, Y.J. Wang, Y.H. Tsai, Y.F. Hsu, *Perceived Job Effectiveness in Coopetition: A Survey of Virtual Teams within Business Organization*, „Computers in Human Behavior" 2010, Vol. 26, No. 6, pp. 1598–1606, http://dx.doi.org/10.1016/j.chb.2010.06.007.

[18] S. Gao, Y. Guo, J. Chen, L. Li, *Factors Affecting the Performance of Knowledge Collaboration in Virtual Team Based on Capital Appreciation*. „*Information Technology & Management" 2016, Vol. 17, No. 2, pp.* 119–131, http://dx.doi.org/10.1007/s10799-015-0248-y.

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H1: Knowledge sharing within the virtual team will positively influence virtual team performance.

The role of internal change agent support as a moderator

The development of team work may be part of far-reaching organisational changes. If it deals with a virtual team, advanced information and communication technologies play an important role[27]. Thanks to such technologies themselves, after considering their functional and technical complexity, such teams may be in a dynamically changing position. The changes that are the result of redesigning business processes and structures involve significant social redesign. Such changes are open to potential disturbances and dangers, so their reliable implementation requires understanding and familiarity with the processes of change[28]. The processes of changes do not always lead to the desired results. However, sometimes these changes tend to be inert and not forward-moving[29]. Considering this, the capacity to manage change becomes a key strategic capability, the development of which is largely dependent on the internal change agent support[30]. Because of that making use of an organisation employees' potential through the involvement of either an internal change agent in the process of changes or a team's manager playing such a role can potentially increase the efficiency of leading the team through the intended changes.

Internal change agents are internal consultants employed by an organisation. Because of this, such individuals better understand their organisation and the way it functions, so they know what kind of changes is necessary and where they should be implemented[31]. An internal change agent is believed to be a specialist in the scope of managing the change. The task of such individuals is to create conditions facilitating the process of implementing changes, support the realisation of such changes and assess their effectiveness. In other words they take up actions for changes to take effect and are responsible for providing conditions that would enable the desired changes to be effectively carried out[32]. Change agents generate proven and specifically prepared information on the basis of which they help make reasonable choices for those to whom the changes refer. They stimulate active involvement of the team members and develop support for a change. Without it carrying out the change and achieving its permanent results would be very difficult if possible at all[33]. Consequently, the role of internal change agents in teams is to optimize actions of such teams considering the changes that take effect. They facilitate implementing effective changes and protecting team members from the side effects of such changes.

Changes that occur in and around contemporary organisations result in the change of conditions of team work, so the life cycle of a virtual team is dynamic and includes relatively strong phases of turbulence. The projects being executed are in many cases highly complex. Very often, such projects turn out to be much more difficult than planned so it negatively affects the time necessary for carrying out planned work as well as the need to implement ongoing changes. Many times customers change their expectations (also during the execution of the project) so unexpected problems occur randomly. Both feedback amplified by knowledge sharing among the team members and support from the internal change agent play a significant role in such cases[34]. They help teams overcome occurring problems efficiently and function effectively without any significant impact on the time and cost of the project's execution. Because of that, the need to implement changes can occur when problems in functioning and cooperation appear. Changes in virtual teams are connected as well with the changeability of aims and high group dynamics. Other generators of change are the willingness of further development and starting various new projects. Apart from many challenges connected with the necessity to implement changes, a virtual team faces a whole array of problems. In many cases, their source lies in weak social interactions, cultural differences (observable in the style of communication, hierarchy of values or the way work is conducted), low dynamics of non-verbal communication, limited

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[31] H. Pathak, *Organisational Change*, Pearson Education, New Delhi 2011, pp. 117–139.

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[33] A. Saka, *Internal Change Agents' View of the Management of Change Problem,* „Journal of Organizational Change Management" 2003, Vol. 16, No. 5, pp. 480–496, http://dx.doi.org/10.1108/09534810310494892.

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trust and problems connected with monitoring and work supervision[35].

However, it is known that team work effectiveness is influenced by various changes[36]. Rarely are employees capable of absorbing a large number of changes within a particular period of time. It seems that the involvement of an internal change agent can potentially increase the effectiveness of leading a team through the process of changes, thus improving the team's performance. According to Gomez-Mejia et al. (2001) internal change agents have to take actions, which will make the workers feel more comfortable concerning the changes that take place[37]. Consequently, the internal change agent should assure proper communication among the employees[38]. The communication itself plays a vital role in the process of knowledge sharing. Liang et al. (2016) proved that communication significantly affected on-line knowledge sharing. Members of virtual teams with high level of communication had significantly better knowledge sharing than members with medium or low level of communication[39]. Winkler and Chmielnicki also pointed to a strong relation between communication and knowledge sharing in multicultural teams[40].

Thus, it is crucial for an internal change agent take care for effective communication in a virtual team, because such communication shapes online knowledge sharing. So, the internal change agent's support can be seen as the variable which is chronologically earlier in relation to knowledge sharing. That is why the internal change agent's support will appear before the emergence of relation between an independent variable and a dependent one. Thus, assuming that there is a certain correlation between knowledge sharing and a virtual team's efficiency, such a correlation will depend on the strength and direction of an internal change agent's support. The internal change agent is assumed to be a moderator of relation between knowledge sharing and a virtual team's performance. It can be expected that in the analyzed case a moderation effect will take place. Therefore, the strength and direction of the relation between two variables (dependent and independent) will change depending on the level of the third variable – the internal change agent's support. The moderator, which is the causative regulator of changes, will make it possible for the cause and effect hypothesis to be tested.

Assuming that knowledge sharing plays a significant role in shaping the effectiveness of a virtual team, support from an internal change agent as a factor strengthening this relation seems exceptionally important. Based on this, a hypothesis has been formulated:

H2: Internal change agent support will moderate the relationship between knowledge sharing within the virtual team and virtual team performance

Therefore, to test hypotheses stated, the authors developed a model presented in following section.

Measurement model

This study tries to explain the relationship between knowledge sharing in a virtual team and the performance of such a team, while considering an internal change agent support. On the basis of the results of the analyses, verification of components of the conceptual model and the relationships between them will be carried out (Figure 1).

The exogenous latent variable is knowledge sharing within the virtual team and the endogenous latent variable is the virtual team performance. The relationship between the variables will be analysed in the context of moderation effect. The authors assume that the moderator (change agent support) changes the strength of a relationship between exogenous and endogenous latent variables in the model. A dependent variable is the performance of a virtual team, whereas an independent variable is knowledge sharing among members of a virtual team.

This study deals with the problem of causality. A theoretical model has been built, which aspires to explaining the examined phenomenon and its empirical verification with the use of Structural Equation Models (SEM). By using such a model, it will become

[35] P. Shachaf, *Cultural Diversity and Information and Communication Technology Impacts on Global Virtual Teams: An Exploratory Study*, „Information & Management" 2008, Vol. 45, No. 2, pp. 131–142, http://dx.doi.org/10.1016/j.im.2007.12.003; S. Sarker, M. Ajuja, S. Sarker, S. Kirkeby, *The Role of Communication and Trust in Global Virtual Teams: A Social Network Perspective*, „Journal of Management Information Systems" 2011, Vol. 28, No. 1, pp. 273–310, http://dx.doi.org/10.2753/MIS0742-1222280109; M. Hoegl, M. Muethel, *Enabling Shared Leadership in Virtual Project Teams: A Practitioners' Guide*, „Project Management Journal" 2016, Vol. 47, No. 1, pp. 7–12, http://dx.doi.org/10.1002/pmj.21564.

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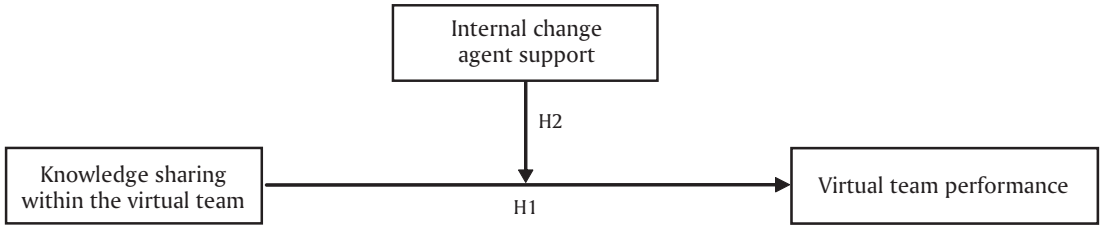
Figure 1. Conceptual model of research



Source: own research

possible to carry out a multidimensional and multivariable precise analysis of empirical data, which refers to the examined aspects of reality. The method was selected because of the fact that SEM helps to: 1) enrich the traditional research hypotheses with an aspect of causality, 2) confront the "theory" and "empiricism" more directly and effectively. The choice of the PLS-SEM (variance-based partial least squares technique) was driven by exploratory research objectives and by ensuring convergence[41]. Moreover, this method copes better with multicollinearity between the construct's indicators[42]. Richter et al.[43] state that the PLS-SEM should have a higher priority on the international research agenda, as it copes with changing and complex research environments.

Data collection

The objects of the research are virtual teams created within information technology industry. In spring of 2016, the empirical study was conducted. The focus was on IT-engineers working for contractors posting their outsourcing bids an online work platform. The typical bids present on the platform are software development, website development, mobile apps, and IT support. The authors chose IT-specialists as they are more likely to work in international virtual teams[44]. Such teams develop internal structures very dynamically, they create both the new ways of operation in IT solutions implementation conditions and the necessities of functioning in changeable and complex environments. As this platform does not provide the number of IT-specialists registered, we could not estimate the whole population. The authors posted a link on a message board three times to the online survey available for all registered users. Over four weeks 349 different users clicked on the link and we received 188 completed surveys. Each user was allowed to take a survey only once, but he or she was able to continue the survey if interrupted. The total response rate was 53.87%.

The authors adapted scales from previous studies to measure knowledge sharing[45], virtual team performance[46] and the role of the change agent[47]. To measure the relationship between knowledge sharing, the efficiency of a virtual team and an internal change agent support a survey has been used. The five point Likert scale has been used in the research, ranging from "1: strongly agree" to "5: strongly disagree". As all measures were reflective, they highly correlated. The authors asked responders to 'think about a virtual team in which you currently spend the majority of your time'. Knowledge sharing has been measured using the tool designed by Staples and Webster[48]. The Cronbach's alpha of the initial scale was 0.710. As the scale was reflective, and the item-to-total correlation of one item was low, the authors decided to delete one item ("People in my virtual team don't keep their best

[41] K.G. Jöreskog, H.O.A. Wold, *The ML and PLS Techniques for Modelling with Latent Variables: Historical and Comparative Aspects*, [in:] H.O.A. Wold, K.G. Jöreskog, (eds.), *Systems Under Indirect Observation*, Part I, Amsterdam 1982, pp. 263–270; J.F. Hair, M. Sarstedt, C.M. Ringle, J.A. Mena, *An Assessment of the Use of Partial Least Squares Structural Equation Modeling in Marketing Research*, „Journal of the Academy of Marketing Science" 2012, Vol. 40, No. 3, pp. 414–433, http://dx.doi.org/10.1007/s11747-011-0261-6.

[42] Ch.M. Ringle, M. Sarstedt, D.W. Straub, *A Critical Look at the Use of PLS-SEM in MIS Quarterly*, „MIS Quarterly" 2012, Vol. 36, No. 1, pp. 3–14.

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[48] D.S. Staples, J. Webster, op. cit, pp. 617–640.

ideas to themselves."), regarding the construct quality criteria and the content validity of the construct.[49] After deleting one item from the initial scale, the Cronbach's alpha of 0.844 was reached. To measure the efficiency of a virtual team a tool designed by Chudoba et al.[50] has been used. The Cronbach's alpha for the original reflective scale with 10 items was 0.705, and the item-to-total correlation of the three items was low. The authors decided to delete these three items, without risking of changing the scale content.[51] Deleted items were: "Work is fairly distributed across the team", "I really enjoy working with other team members", and "Quality of deliverables is excellent". The Cronbach's alpha of the new scale was 0.859. In case of an internal change agent support the measurement model developed by Dückers et al.[52] was used,. The Cronbach's alpha reached 0.899. The wording of the initial scale was modified to connect it to a role of the internal change agent in virtual team.

As all latent variables in our study were collected from a single source, we needed to establish whether common method bias was an issue in our data. We followed common recommendation through all research stages, including research design, data collection and the analysis phase[53]. In order to guarantee the research effectiveness and questionnaire quality, we conducted a pre-test with ten IT-specialists working for an international high-tech company from Germany (TecDAX-listed). At least, we made a formal questionnaire according to their suggestions.

The analysis was carried out using IBM SPS Statistics 23 and SmartPLS 3[54]. To establish the discriminant validity of scales and to assess the potential influence of common method bias we performed a confirmatory factor analysis. In order to rule out issues of multicollinearity, we calculated the regression model[55]. Following KMO and Bartlett's test, high multicollinearity was not a problem in our data.

Results

Within our total sample, 70.03% were men, and their average age was 31. The majority of our respondents were located in the USA or India and collaborated, in total, with team members from more than 50 different nations from all over the word. Each responder works within the same virtual team in average since 17.2 months (median: 12 months). The majority of respondents works in teams with three or more team members. Only 9% of respondents work in virtual teams within one country. Table 1 shows the descriptive statistics for the latent variables in the study.

We calculated reliability and validity of the measurement models using Crombach's alpha, composite reliability, and AVE (average variance extracted). The threshold value for the first two indicators should be over 0.700 and for the AVE 0.500, as recommended by Fornell and Larcker[56]. Convergent validity has been established by the examination of factor analysis results displayed, as Table 2 shows.

Each item was loaded above 0.500 to the related latent variables and most indicator loadings were above 0.70. Only two indicators showed lower loadings but as the corresponding constructs present satisfactory levels of internal consistency reliability and convergent validity, the analysis follows[57] and retains the indica-

Table 1. Descriptive statistics for latent variables

Latent Variable	Mean	Variance	SD	N of items
Knowledge Sharing (KS)	16.15	10.056	3.171	4
Virtual Team Performance (VTP)	23.46	36.368	6.031	7
Change Agent Support (CA)	19.95	18.992	4.358	5

Source: own research.

[49] R. Weiber, D. Mühlhaus, *Strukturgleichungsmodellierung – Eine anwendungsorientierte Einführung in die Kausalanalyse mit Hilfe von AMOS, SmartPLS and SPSS*, Springler Gabler, Berlin-Heidelberg 2014, pp. 127–172.
[50] K.M. Chudoba, E. Wynn, M. Lu, M.B. Watson-Manheim, op. cit, pp. 279–306.
[51] R. Weiber, D. Mühlhaus, op. cit., pp. 136–141.
[52] M. Dückers, C. Wagner, P. Groenewegen, op. cit., pp. 1–9.
[53] E.g: P.M. Podsakoff, S.B. MacKenzie, J.Y. Lee, N.P. Podsakoff, *Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies*, „Journal of Applied Psychology" 2003, Vol. 88, No. 5, pp. 879––903, http://dx.doi.org/10.1037/0021-9010.88.5.879; C.A. Schriesheim, K.J. Powers, T.A. Scandura, C.C. Gardiner, M.J. Lankau, *Improving Construct Measurement in Management Research: Comments and a Quantitative Approach for Assessing the Theoretical Adequacy of Paper- and -Pencil Survey – Type Instruments*, „Journal of Management" 1993, Vol. 19, No. 2, pp. 385–417, http://dx.doi.org/10.1177/014920639301900208.
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Table 2. Reliability and validity of measurement models

Latent Variable	Factor loadings	Cronbach's alpha	Composite reliability	AVE
Knowledge Sharing (KS)		0.844	0.895	0.680
KS2	0.807			
KS3	0.812			
KS4	0.866			
KS5	0.812			
Virtual Team Performance (VTP)		0.859	0.887	0.531
VTP1	0.821			
VTP2	0.798			
VTP3	0.786			
VTP4	0.579			
VTP6	0.645			
VTP7	0.722			
VTP9	0.721			
Change Agent Support (CA)		0.899	0.925	0.712
CA1	0.833			
CA2	0.853			
CA3	0.859			
CA4	0.815			
CA5	0.856			

Source: own research.

tors. Accordingly, our measurement model has met requirements for internal consistency.

For the purpose of the globally evaluated structural model, a SRMR (standardized root mean square residual) was computed[58]. The SRMR allows assessing the average magnitude of the discrepancies between observed and expected correlations as an absolute measure of model fit criterion. SRMR in the model as represented in Figure 1, was 0.073. A value less than 0.1 is considered a good fit[59].

When the final power of the model is considered, the coefficient of determination – R^2 for Virtual Team Performance was 0.161, indicating that 16.1% of variance is explained by the model. This coefficient is a measure of a model's predictive power and ranges from 0 to 1, with higher levels indicating higher levels of predictive accuracy. Hair et al. state that it is difficult to provide rules of thumb for acceptable R^2 values as this depends on the model complexity and the research discipline.[60] Whereas R^2 values of 0.2 are considered high in disciplines such as consumer behaviour, in marketing research R^2 values of 0.75 can be described as substantial. Regarding the low complexity of the model and the explorative approach of the research, it is assumed that R^2 values of 0.161 indicate moderate predictive power of the model. Path coefficients (β) and t-values were calculated as shown in Table 3. Both the β and the R^2 are sufficient for analysis, and β values between 0.10 and 0.30 yield meaningful interpretations[61]. Furthermore, the effect size (f^2) in both cases has a medium impact on the virtual team performance[62].

Table 3. Significant testing results of the structural model path coefficients

Structural path	β	t-value	p-value	f^2
Knowledge sharing -> Virtual Team Performance (H1)	0.278	3.054	0.002	0.041
Change Agent Support as Moderator (H2)	0.166	2.116	0.035	0.053

Source: own research.

[58] Ibid.
[59] P.M. Bentler, D.G. Bonett, *Significance Tests and Goodness-of-Fit in the Analysis of Covariance Structures*, „Psychological Bulletin" 1980, Vol. 88, No. 3, pp. 588–606.
[60] J.F. Hair, D.T.M. Hult, C.M. Ringle, M. Sarstedt, op. cit, p. 199.
[61] W.W. Chin, *The Partial Least Squares Approach to Structural Equation Modeling*, [in:] G.A. Marcoulides (ed.), *Modern Methods for Business Research*, Erlbaum, Mahwah, NJ 1998, p. 11; J.B. Lohmöller, *Latent variable Path Modeling with Partial Least Squares,* Physica, Heidelberg 1989, p. 60.
[62] W.W. Chin, op.cit., p. 317.

As the PLS-SEM does not assume that the data is normally distributed, we had to apply a bootstrapping procedure to test whether coefficients such as outer weights, outer loadings and path coefficients are significant[63]. The bootstrapping procedure (1000 bootstrap samples, no sign changes) provides the t-values for paths in the model (see Table 3). They support the model's predictive relevance in terms of out-of-sample prediction, as they are higher than 1.96[64]. Similarly, results from blindfolding with an omission distance of 7 yield Stone-Geisser's values (Q^2) above zero (0.063).

The impact of the knowledge sharing on virtual team performance is positive and significant, as well the impact of the moderator (change agent support) on the relationship between the knowledge sharing and the virtual team performance ($p < 0.05$). The empirical results support all hypothesized path model relationships among the constructs. Most notably, change agent support moderates the relationship between the knowledge sharing in the team and the virtual team performance. The findings from the results of the path analysis are discussed in following section.

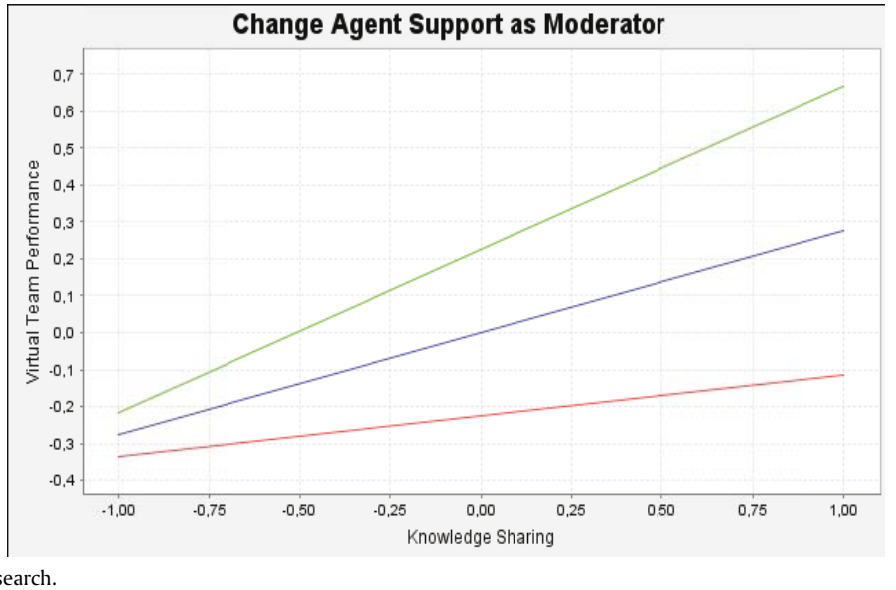
Discussion

Fitting with existing previous studies, our results support the hypothesized relationships. This study contributes to the literature by analysing the change agent support on team performance in virtual setting. Although there are obviously other factors influencing the relationship, the knowledge sharing within the team is responsible for better team performance in terms of better trust, communication, team participation and coordination. The moderating role of change agent support is statistically significant but its impact is weak. To better comprehend the impact of moderator, we present the simple slope plot in Figure 2.

It visualizes the two-way interaction effect between the knowledge sharing (x-axis) and the virtual team performance (y-axis).The three lines represent how the variables influence each other depending on the levels of moderator. The middle line represents the relationship for an average level of the moderator variable change agent support (CA). The other two lines represent this relationship for higher (i.e., mean value of CA plus one standard deviation unit) and lower (i.e., mean value of CA minus one standard deviation unit) levels of moderator variable CA. Hence, higher levels of knowledge sharing go hand in hand with higher levels of virtual team performance. In addition, higher change agent support levels entail a stronger relationship between knowledge sharing and virtual team performance, while lower levels of change agent support lead to a weaker relationship between both constructs.

To extend the path analysis, an importance-performance map analysis (IPMA) might be performed[65]. We run this analysis on the indicator level to identify relevant and more specific areas for improvement. The result of this analysis is shown in Figure 3. The x-axis represents the unstandardized total effects of manifest variables on the target construct – virtual team

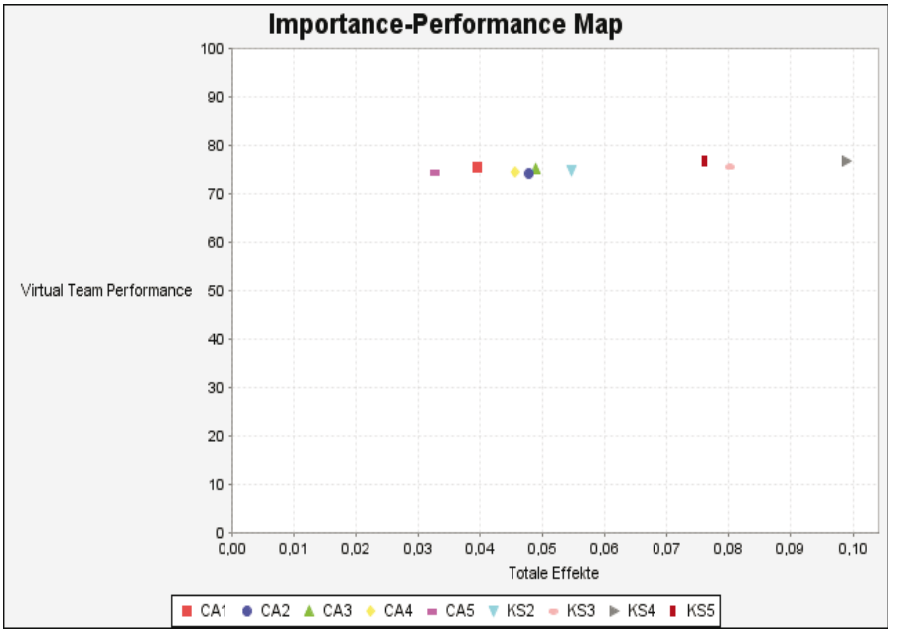
Figure 2. Simple slope plot for moderating effect



Source: own research.

[63] A.C. Davison, D.V. Hinkley, *Bootstrap Methods and Their Application*, Cambridge University Press, Cambridge 1997.
[64] J.F. Hair, D.T.M. Hult, C.M. Ringle, M. Sarstedt, op.cit. 149–187.
[65] Ibid., p. 276.

Figure 3. Importance-performance map for Virtual Team Performance



Source: own research.

performance. Constructs with low importance are positioned on the left side of the importance-performance map. Although they show good performance, they have a low importance for the target variable VTP. The manifest variables on the right side of the map show the contrary in terms of importance for the virtual team performance. Hence, there is a relative high potential for improving the virtual team performance by improving the performance of constructs KS4, KS3, and KS5.

Value details of the IPMA are shown in Table 4.

Table 4. Importance-performance map for Virtual Team Performance with values of exogenous latent variable knowledge sharing

Manifest Variable	Total effects	Performance on VTP
KS2	0.055	74.734
KS3	0.080	75.532
KS4	0.099	76.729
KS5	0.076	76.862

Source:

These three relatively important indicators are: KS4: "People in my virtual team with expert knowledge are willing to help others in this team", KS3: "People in my virtual team share their ideas openly", and KS5: "My virtual team is good at using the knowledge/ideas of employees". By improving knowledge sharing in the virtual team, even better virtual team performance might be expected.

Managerial implications

The practical implication of the research carried out is to provide a leader of a virtual team with an idea of how to perceive knowledge sharing in a team and actions taken up by an internal change agent in terms of the mechanisms that shape the effectiveness of a virtual team. Managers need to be aware of the meaning and the consequences of direct and indirect effect of internal change agent support activities on a team's effectiveness.

In order to fully use the potential of geographically dispersed members of a virtual team, an internal change agent should get acquainted with unique characteristic features of every one of them, which can potentially contribute to improving a team's efficiency in the context of ongoing changes. Consequently, persuading each member of a team to present their knowledge and skills to other members will make it easier for an internal change agent to effectively manage the flow of the knowledge andfacilitate the process of knowledge sharing in a team, thus improving its efficiency.

One needs to remember that the role of an internal change agent should not be connected with prescriptive and bossy managing of change. Internal change agents should, above all, support the process of knowledge sharing, and they should build the atmosphere of change in a team. Their task is to persuade members of a virtual team to learn from one another through knowledge sharing, because in this way they can increase the efficiency of the whole team.

Because knowledge sharing is the factor that facilitates building a high level of efficiency of a virtual

team, an internal change agent should also encourage members of his/her team to create a knowledge repository in the virtual work space. Such a repository will enable other members of a team to access documents and resources. It will also be helpful in creating a culture of knowledge sharing.

Limitations and future research

There are some limitations to this study that constraint the generalizability of the results. Even though our respondents constitute a middle sample (N=188), no statistical generalizations can be made. Our sample includes only responders from one particular online work platform and only one industry (IT-support services). This industry is well known for its strong affiliation to knowledge and technology know-how and its transfer. Respondents working for other industries might apply different strategies to reach better virtual team performance.

The other limitation of the study is that we have not checked how the bids from contractor to the virtual team are completed. It means that we do not know if our respondents work as freelancers or in small enterprises, which consist of our respondent and other virtual team members. Both the length of the stated relationship between team members and the low geographical dispersion of the team suggest that they are more probably engaged in more formal and long-term relationships within a virtual team. But if they work as freelancers, according to Taylor and Boraie[66], they might tend to share only minimum knowledge within a team, since it could erode the preservation of their livelihood. The future research should deal with this uncertainty and check if knowledge workers with a long-term contract with a company are more willing to share knowledge within the virtual team, and what is the impact on virtual team performance in this setting. Moreover, the role of internal change agent could have a different focus, for example facilitating communication or diversity management.

Another potential limitation is that our analysis is based on self-reported behaviour and outputs. Thus, we cannot exclude self-satisfying or biased responses, since we do not know if a respondent is actually pushed to work in virtual teams, or whether – in the light of later satisfaction with the work in virtual team – just started to be thought of as a skilled virtual worker.

For future research, it would be interesting to conduct a longitudinal study of virtual teams and the determinants influencing their economic success. The model could be expanded by adding financial success factors as well as considering the influence of the social networks of the virtual teams, social integration mechanism, and activation triggers.

Moreover, it would be interesting to estimate the direct impact of the change agent support on knowledge sharing in virtual teams. Although we have not hypothesized this relationship, our data shows the strong relationship between these both constructs.

In sum, although this study allows no generalizations, it does appear to be worthy of further refinement in understanding the complexities of the change agent's role in virtual teams' context.

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