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The impact of workplaces and self-management practices on the productivity of knowledge workers

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Abstract

Purpose – This paper aims to explore the impact of (1) workplaces, which support concentration and communication, and (2) self-management practices on individual and team productivity. The underlying hypothesis is that the impact of these variables on the two levels of productivity (individual and team) and the two dimensions of productivity (quantity and quality) may be different.

Design/methodology/approach – The paper is based on survey data from 998 Finnish knowledge workers. Factor analysis was used to test the dimensions of the conceptual model. Insights into the impact of workplaces for concentration and communications and self-management practices on productivity were obtained by multiple-regression analyses.

Findings – The findings show that self-management practices have a larger impact on the quality and quantity of individual output and the quantity of team output than workplaces for communication and concentration. Improving self-management skills is key to increase all productivity dimensions and in particular the quality of the output.

Practical implications – This paper contributes to a better understanding of the impact of workplace characteristics and self-management practices on different levels and dimensions of productivity. It offers valuable lessons for managers, as they are able to recognize how productivity can be approached from several perspectives. Different dimensions can be enhanced using different workplace settings. For example, the quantitative output of employees can be increased by adding more space for concentration while quantitative team productivity can be increased by providing appropriate space for collaboration. An important means to enhance a higher quality of the output is to improve self-management skills. The findings also suggest that collaboration between different disciplines – corporate management, corporate real estate management, human resource management and IT – is needed to optimize individual and team productivity.

Originality/value – This paper explores work environment experiences of Finnish office workers and connects both workplace appraisal and work practices to perceived productivity support, on individual level and team level. It also adds insights into the different impacts on quantity and quality.

Paper type – Research paper

Keywords – productivity, workplace, workplace management, knowledge workers, self-management, office

1 Introduction

Knowledge workers are the most important wealth creators in the current economy (Drucker, 1999; Bakker, 2014; Appel-Meulenbroek, 2014; Kastelein, 2014). The shift from an industry-based society to a knowledge-oriented society is going on for some decades. Private and public organizations are still searching for ways how to cope with this structural change. The workplace is one of the factors that may influence knowledge workers' productivity. According to Bakker (2014), in order to ensure that a knowledge worker is optimally productive, it is important that he or she can attain personal objectives and that facilities and services fit with personal needs. An appropriate physical environment should

optimally facilitate different job activities, communication and concentration, informal and formal meetings, and different moods such as being calm and relaxed or being stressed or excited. Strategic decisions about workplaces can have a long-term impact on the experience and use of real estate. In 2015 the Finnish Government updated its real estate strategy and adopted activity-based working to increase flexibility and productivity (Ministry of Finance, 2015). The role of Senate Properties, which is a state-owned real estate management organization with a real estate portfolio of EUR 4.4 billion and profiled as a work environment expert (Senate Properties 2016), is to implement the strategy across the nation and across the governmental branches of administration. The aim of this paper is to explore how the Finnish employees working for the government respond to their work environment, if/how this environment influences their productivity, and what lessons can be learned from these experiences.

1.1 Individual and team productivity - quantity and quality

The origins of measuring productivity are in industrial manufacturing and agriculture (Tangen, 2005). In the fields of facilities management (FM) and corporate real estate management (CREM), productivity of knowledge workers has gained a lot of attention as well (e.g., Morgan and Anthony 2008; Appel-Meulenbroek et al. 2011; Jensen et al. 2012). Most authors define productivity as the ratio between output and input (Tangen, 2005). According to Misterek et al. (1992), the ideal form of productivity improvement is to increase the output while decreasing the input. Other ways to increase productivity are managing growth by increasing both output and input in such a way that the increase in output is larger than in input, working smarter by increasing the output with the same input, or establishing greater efficiency by decreasing input but having the same output,. The focus here is on quantity. However, another dimension of productivity i.e. quality matters as well (Drucker, 1991; Parasuraman, 2002; Ramirez and Nembhard, 2004; Laihonon et al., 2012). In the current research, a distinction is made between quantitative and qualitative output of the employees. In addition, a distinction is made between two productivity levels – individual productivity and team productivity.

This is considered to be crucial, because a FM intervention may have a positive impact on team productivity but at the same time have a counterproductive impact on individual productivity and vice versa. For instance, an open setting makes it easier to exchange knowledge, but it also results in more distractions.

1.2 Independent variables in this research

In addition to the workplace, other factors may have an impact on knowledge workers' productivity, such as technology, leadership, team spirit, self-management practices and the workers intrinsic motivation (Van der Voordt, 2003; Vartiainen, 2007; Bosch-Sijtsema et al., 2009). It is impossible to include all possible impact factors in one study. As part of an ongoing PhD study of the first author, self-management was chosen as the second independent variable for this paper.

1.3 Research questions

This paper focuses on answering three research questions:

1. What is the impact of workplaces (in particular space for concentration and space for communication) and self-management practices on productivity?
2. Is this impact similar or different for individual versus team productivity?
3. Is this impact similar or different for quantitative versus qualitative output?

The next section presents the findings of a literature review on the impact of workplaces on labour productivity. It is concluded that too little attention is being paid to the role of the worker itself. The literature review results are visualized in a conceptual model that is tested empirically. The empiric part includes a description of the research methods and the research findings. The paper ends with reflections and conclusions from an academic and a practical point of view and some suggestions for future research.

2 Findings from the literature

2.1 Impact of the physical environment on productivity

Most research papers in the fields of Environmental Psychology, Corporate Real Estate Management (CREM) and Facilities Management (FM) discuss productivity and employee performance from a workplace perspective. Early studies showed that open plan offices support ease of communication and social interaction (e.g. Allen and Gertsberger, 1973; Ives and Fedinands, 1974), whereas the physical environment may also hinder employee performance through various psychological processes such as stress, arousal, distraction, lack of privacy and fatigue (e.g. Sundstrom et al., 1980; Sundstrom, 1986; Wineman, 1986). Crouch and Nimran (1989) disseminated a questionnaire among managers and asked them to list three aspects of their work surroundings that help to carry out their work effectively, and three aspects that they believe to limit their work effectiveness. Of all 263 responses, 141 referred to performance facilitators and 122 to inhibitors. Support of social interaction was one of the most important positive impact factors, whereas poor workplace experiences contributed most to the hindering aspects. Brill and Weidemann (2001) collected data from 13.000 respondents and concluded that the physical workplace contributes 5 per cent to individual performance and 11 per cent to team performance. Haynes (2007a, 2007b, 2008) made a distinction between a physical dimension (environmental services, office layout, designated areas and comfort) and a social dimension of the workplace (distraction, interaction and informal interaction points). He found that the behavioural environment has the largest impact on office productivity. In particular, the dynamic elements of the office environment, interaction and distraction, are perceived as having the greatest positive and negative influences on self-assessed productivity. Many other researchers investigated the impact of workplaces with regard to various topics e.g.:

- office lay-out and activity-based workplaces (Mawson, 2002; Van der Voordt, 2004; Peponis, Bafna, Bajaj, Bromberg, Congdon, Rashid, Warmels, Zhang, & Zimring, 2007; Maarleveld & De Been, 2011; De Been & Beijer, 2014; Riratanaphong & Van der Voordt, 2014; Bodin-Danielsson, Chungkham, Wulff, & Westerlund, 2014; Appel-Meulenbroek, 2014; Kastelein, 2014; Brunia, De

Been, & Van der Voordt, 2016; Candido, Zhang, Kim, De Dear, Thomas, Strapasson, & Joko, 2016; De Been, Van der Voordt & Haynes, 2017);

- facilities and services (Batenburg & Van der Voordt, 2008; Von Felten, Böhm, & Coenen, 2015);
- indoor climate, indoor air quality and thermal comfort (Leaman & Bordass, 1999; Clements-Croome, 2000; Wargocki, Wyon, & Fanger, 2000; Roelofsen 2002; Seppänen, Fisk, & Faulkner, 2004; Dorgan & Dorgan, 2005);
- energy-efficient lighting (Katzev, 1992);
- noise (Sundstrøm, Town, Rice, Osborn, & Brill, 1994; Furnham & Strbac, 2002; Roelofsen 2008; Kaarlela-Tuomaala, Helenius, Keskinen, & Hongisto, 2009);
- plants (Larsen, Adams, Deal, Suk Kweon, & Tyler, 1998; Bakker & Van der Voordt, 2010);
- color (Bakker, Van der Voordt, Vink, & De Boon, 2013);
- materials (Mckoy & Evans, 2002; Gutnick, 2007);
- windows and environmental cues (Stone, 1998);
- green buildings (Thatcher & Milner, 2014)

Overall the findings suggest a top ten of most important factors to support employee productivity:

1. Appropriate spatial conditions for concentration i.e. opportunities to work alone without being distracted (quiet places, quiet zones)
2. Appropriate spatial conditions for communication and social interaction such as favourable conditions for side-by-side work and a quick chat, visual and auditory accessibility, proximity, central location, shared facilities, and spaces for meetings and distraction-free group work
3. Proper areas to take a break
4. Workplace ergonomics (e.g. well-designed furniture)
5. Access to advanced technology
6. Sufficient and appropriate storage space
7. High indoor air quality, high quality lighting and natural daylight
8. Personal control over the indoor climate, temperature and air quality

9. Fit with psychological needs such as privacy and the ability to personalize the workplace
10. A well-considered implementation process, including appropriate leadership, clear information and communication, and well-thought change management.

2.2 Self-management practices

The focus on physical characteristics limits our understanding of supportive and hindering influences on productivity. People's function, personality and work style may have a substantial influence on the relationship between workplace characteristics and productivity. According to Van Diemen and Beltman (2016), the right fit with individual work styles and personal needs of employees seems to be a critical factor in successfulness of New Ways of Working. Haynes (2011) emphasized the impact of generational differences on workplace preferences and creativity. Greene and Myerson (2011) made a distinction in four different types of employees – anchors, connectors, gatherers, and navigators – with different levels of social interaction and mobility. They suggest that anchors are very much dependent of places for concentration to be productive, whereas connectors, gatherers and navigators may suffer from productivity loss when they are bound to quiet zones.

According to Drucker (1999) appropriate self-management is also crucial for knowledge workers success. Planning and prioritizing are very important in a world where available time is limited (Claessens, Van Eerde, Rutte, & Roe, 2004; Kearns & Gardiner, 2007). Knowledge workers are expected to be able to cope with the high pressure of many activities at the same time and as such need high self-management skills. So far, self-management has not got a lot of attention in the field of FM and CREM. Therefore, self-management is included as an additional independent variable to search for its impact on individual and team productivity.

It is assumed that both well-designed workplaces for concentration and communication and self-management skills have a positive impact on individual knowledge workers' productivity and team productivity, both quantitatively and qualitatively. Figure 1 shows a conceptual model that visualizes the hypothesized relationships. The hypothesized relationship with the quality of team productivity is

left out of the conceptual model. The reason for this is that respondents are better able to evaluate their personal productivity than the productivity of their colleagues. Quite often the response to questions about perceived support of team productivity and even more regarding organizational productivity are marked as “neutral” and much less as positive or negative (Maarleveld, Volker, & Van der Voordt, 2009). To collect reliable data, only the quantity of the team productivity was included in the questionnaire.

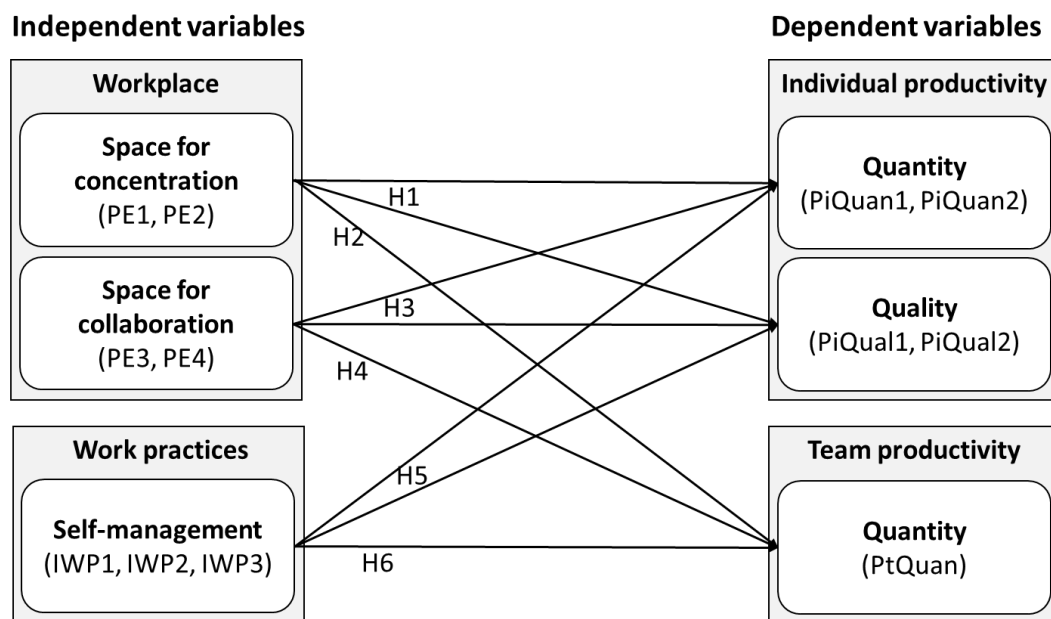


Figure 1. Conceptual model and related variables. Note: Important workplace characteristics to support productivity.

3 Research methods

Survey research was selected as a research strategy to collect appropriate quantitative data that allows regression analysis with the independent and dependent variables. The empirical data was collected among nine Finnish organizations, mainly public organizations, in 2015. The data were collected as a part of bigger study from the participating organizations that were interested in developing their work environment. The questionnaire was sent to the participants by email. The respondents had two weeks of time to respond. In total, 998 responses were collected, the response rate was 47 per cent.

Table 1. Respondent characteristics: age, gender and dominant workspaces.

Sex	n	%
Female	602	60.3
Male	384	38.5
Missing	12	1.2
Age	n	%
<35	150	15.0
35-44	241	24.1
45-54	332	33.3
>54	265	26.6
Missing	10	1.0
Work space	n	%
Personal room	369	37.0
2-person room	147	14.7
3-6 person room	94	9.4
Open-plan office	205	20.5
Multiuse office	179	17.9
Missing	4	0.4

The online questionnaire has been developed by Palvalin et al. (2015) and validated by Palvalin (2017). It includes 49 Likert-Scale statements with responses ranging from (strongly) disagree to (strongly) agree. The statements are clustered in six dimensions (physical environment, virtual environment, social environment, individual work practices, well-being at work and productivity). For the purpose of this paper, 12 survey questions were selected for further analysis. These questions and the basic statistics are presented in Table 2. Space for concentration is measured with two items (PE1, PE2) and space for collaboration with also two items (PE3, PE4). The independent variable self-management was measured with three items (IWP1, IWP2, IWP3). On Individual level, the quantity of the productivity was measured with two items (PiQuan1, PiQuan2) and quality with two items as well (PiQual1, PiQual2). On team level, quantity was measured with one item (PtQuan). All items regard respondents' own perceptions.

Table 2. Key variables used in this study

Code	Variable	Mean	Std. dev	Skew -ness	Kur- tosis
PE1	There is a space available for tasks that require concentration and quietness at our workplace when needed	3,82	1,44	-0,89	-0,70
PE2	There are generally no disruptive factors in my work environment (like sounds or movements)	2,99	1,40	0,02	-1,37
PE3	There are enough rooms at my workplace for formal and informal meetings	3,32	1,44	-0,29	-1,35
PE4	The facilities at my workplace enable spontaneous interaction between workers	3,79	1,20	-0,78	-0,43
IWP1	I prepare in advance for meetings and negotiations	4,06	0,84	-0,98	1,16
IWP2	I regularly plan my working day in advance	3,32	1,11	-0,40	-0,67
IWP3	I actively seek out and test better tools and ways of working	3,50	1,01	-0,38	-0,37
PiQuan1	I can take care of my work tasks fluently	4,04	0,83	-0,91	1,00
PiQuan2	I can use my working time for matters which are right for the goals	3,62	0,99	-0,61	-0,07
PiQual1	I can fulfil clients' expectations	4,01	0,79	-0,78	1,00
PiQual2	The results of my work are of high quality	4,11	0,72	-0,52	0,20
PtQuan	The group(s) of which I am a member work efficiently as an entity	3,53	1,00	-0,56	-0,15

PE = physical environment; IWP = individual work practices; PiQuan = productivity on individual level, quantity; PiQual = productivity on individual level, quality; PtQuan = team productivity, quantity.

The data analysis includes three different methods, which are applied using SPSS 23. First, Explorative factor analysis (EFA) was used to test if the data supports the structure of the conceptual model. Second, Pearson correlations were calculated to gain an overall view of the assumed relationships. Finally, regression analysis was conducted to point out whether the assumed relationships are supported by the data. The three methods set certain requirements that the data needs to fulfil. According to West, Finch, & Curran (1995), there are three criteria for factor analysis: sample size, continuity of the items, and a normal distribution of the items. First, the required sample size is over 200 respondents while this study has 998 respondents, so the sample size criterion is fulfilled. Regarding the second criterion, i.e. the items should be continuous. Lubke & Muthen (2004) have

shown that Likert-scale items can be used in factor analysis, if other assumptions are met. Finally, regarding the last criterion about the items normal distribution, according to West et al. (1995) the normal distribution of the items can be achieved, if skewness is less than 2 and kurtosis is less than 7. In this research, this criterion is also fulfilled (see Table 2). The Pearson correlations and the regression analysis require that the items are continuous. These analyses are executed using sum variables created from the factor analysis and sum variables are continuous. Regression analysis also requires that the independent variables are not multi-collinear which can be tested using the variance inflation factor (VIF). This criterion is achieved in every regression analysis as all the VIF values are below 2,5 (see Tables 6, 7, 8, 9).

4 Findings

4.1 Testing the structure of the conceptual model

Exploratory Factor Analysis (EFA) was conducted to test the structure of the conceptual model (Figure 1).

The 998 responses were analysed via maximum likelihood (ML) extraction methods including Equimax Rotation method and Kaiser Normalization. In the analysis, the number of factors was defined to be six which corresponds with the number of variables in the proposed conceptual model. Table 3 presents the EFA pattern matrix.

Table 3. EFA Pattern matrix.

Factor	1	2	3	4	5	6
PE2: There are generally no disruptive factors in my work environment (like sounds and movements).	.827					
PE1: There is a space available for tasks that require concentration and peace at our workplace when needed.	.538					
PE3: There are enough rooms at my workplace for formal and informal meetings.		.711				
PE4: The facilities at my workplace enable spontaneous interaction between the workers.		.472				
IWP2: I regularly plan my working day in advance.			.772			
IWP1: I prepare in advance for meetings and negotiations.			.513			
IWP3: I actively seek out and test better tools and ways of working.			.487			
PiQuan1: I can take care of my tasks fluently.				.919		
PiQuan2: I can use my working time for matters which are right for the goals.				.522		
PiQual2: The results of my work are of high quality.					.924	
PiQual1: I can fulfil client's expectations.					.524	
PtQuan The groups of which I am a member work efficiently as an entity.						.578

Maximum Likelihood extraction, Equimax Rotation with Kaiser Normalization.

The variables form the factors as expected and, thus, the EFA confirms that the structure of the conceptual model is valid. In some of the groups, the variables correlate only on a moderate but still an acceptable level (~0.50).

Based on total variance, the six factors cover 56.9 per cent. The KMO (Kaiser-Meyer-Olkin) value is 0.79 which is adequate according to Hair, Anderson, Tatham, & Black (2006).

4.2 Correlations between factor scores

The relationships between the factors were analysed with Pearson correlation, see Table 4. All correlations are positive and significant at the level of 0.01.

Table 4. Means, standard deviations and correlations (Pearson, two-tailed).

	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)
(1) Space for concentration	3.41	1.25						
(2) Space for collaboration	3.56	1.10	.490**					
(3) Self-management	3.63	.75	.160**	.121**				
(4) Individual productivity (quantity)	3.83	.83	.238**	.183**	.296**			
(5) Individual productivity (quality)	4.06	.69	.150**	.141**	.270**	.584**		
(6) Team productivity (quantity)	3.53	1.00	.190**	.229**	.175**	.410**	.401**	

**Correlation is significant at the 0.01 level (two-tailed).

The correlations presented in Table 4 indicate two things. First, based on the results, the data confirm that there are connections between the independent variables and dependent variables as all correlations are positive and significant, though not very strong. Second, the results show that there are some differences in the strengths of the connections. While the overall correlation is weak, some of the items have stronger connections than others. The quality of the individual output has the strongest correlation with self-management (0.270) and the least strong correlation with space for collaboration. Also space for collaboration (0.229) seems to be most important for team productivity compared to the other two independent variables.

4.3 Test of the assumed relationships in the conceptual models

Due to the promising results, the analysis was continued and the assumed relationships were tested using regression analysis. The analysis included three separate analyses, for each of the three dependent variables: qualitative output on individual level, quantitative output on individual level, and quantitative output on team level. In all three analyses, the analysis was conducted for all three independent variables: space for concentration, space for collaboration and self-management.

Dependent variable - Quantity of the individual output

According to the results, all independent variables have significant (0.05 level) positive correlations with the quantity of the output, see Table 5.

Table 5. Regression analysis, quantity of the individual productivity.

	Standardized β	t-value	Significance	Collinearity statistics (tolerance/VIF)
Space for concentration	.160	4.678	.000	.750/1.334
Space for collaboration	.074	2.164	.031	.758/1.319
Self-management	.261	.701	.000	.972/1.029
Constant		16.043	.000	
F	48.970		.000	
Adjusted R ²	.126			

The results also show notable differences between the strength of the correlation. Self-management has the highest impact (0.261) on the dependent variable. Space for concentration has the second highest impact (0.160), although it is 2/3 of the impact of self-management. The impact of space for collaboration on the quantity of output is even less (0.074) - half of the impact compared to space for concentration. This makes sense, because the dependent variable here is individual productivity, not team productivity.

The overall coefficient of determination (Adjusted R²), which refers to how well the independent variables can explain the dependent variable, is low, only reaching 12.6 per cent. The low R² indicates that there are also other variables that have an impact on quantity of the individual output.

Dependent variable - Quality of the individual output

As can be seen from Table 6, all correlations are positive and significant at the level of 0.05. As in the previous analysis, also here notable differences between the correlations were found. Self-management has again the highest impact (0.249). The other two independent variables - space for concentration and space for collaboration - have a similar impact (0.073 and 0.075). Remarkably, both space related attributes have the same impact whereas in the previous analysis, space for

concentration had a bigger impact. When comparing the correlations, the results show that self-management has a more than three times higher impact on the dependent variable than space for concentration or space for collaboration.

In this analysis, the coefficient of determination is also low (0.086) and, thus, it can be assumed that there are also other variables, that are not included in this study, but that have impact on the quality of individual output.

Table 6. Regression analysis, quality of the individual productivity.

	Standardized β	t-value	Significance	Collinearity statistics (tolerance/VIF)
Space for concentration	.073	2.099	.036	.750/1.334
Space for collaboration	.075	2.143	.032	.758/1.319
Self-management	.249	8.110	.000	.972/1.029
Constant		24.911	.000	
F	32.232		.000	
Adjusted R ²	.086			

Dependent variable – Quantity of the team output

All independent variables have significant (0.05 level) positive correlations with team productivity, see Table 5. In this analysis, space for collaboration (0.172) has the highest influence and it seems to be the most important factor for team productivity. Self-management has a bit smaller impact on team productivity (0.140) and space for concentration has clearly the least impact (0.083) on team productivity.

As in the previous analyses, the coefficient of determination is low (0.077) which indicates that there are other factors that also impact on team productivity, see table 7.

Table 7. Regression analysis, quantity of the team productivity.

	Standardized β	t-value	Significance	Collinearity statistics (tolerance/VIF)
Space for concentration	.083	2.373	.018	.750/1.334
Space for collaboration	.172	4.914	.000	.758/1.319
Self-management	.140	4.552	.000	.972/1.029
Constant		12.079	.000	
F	28.715		.000	
Adjusted R ²	.077			

Based on the analyses, all hypothesized relationships between the independent and dependent variables in the conceptual model are supported. All independent variables have positive relationship (standardized beta) and all relationships are significant at 0.05 level. A summary of the regression analysis results is presented in Figure 2.

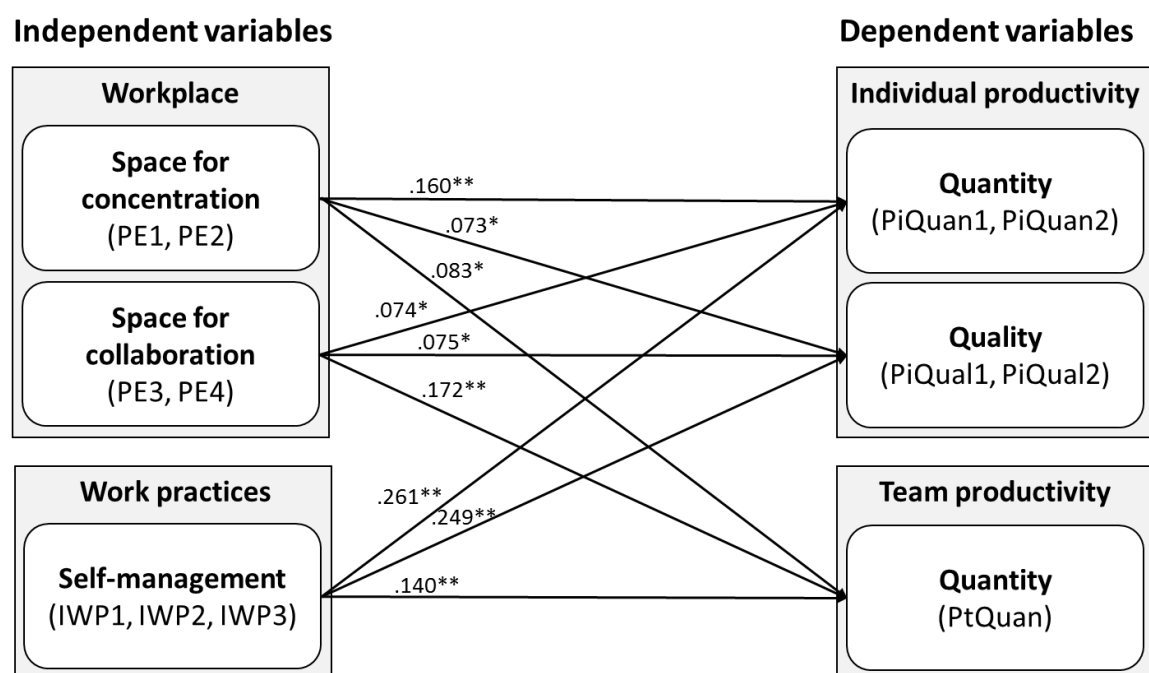


Figure 2. Summary of the regression analysis results.

4.4 Test of which independent variables are most vital for the results

In order to find out if the amount of independent variables is vital for the results, a fourth regression analysis was conducted. In this analysis, only two independent variables, namely space for

concentration and space for collaboration, are included and the third variable, self-management, is excluded. Quantity of the output on individual productivity level is selected as dependent variable giving the possibility to compare the results. The results of the analysis, with only two independent variables are presented in Table 8.

Table 8. Regression analysis, individual productivity (quantity), excluding self-management.

	Standardized β	t-value	Significance	Collinearity statistics (tolerance/VIF)
Space for concentration	.195	5.524	.000	.760/1.316
Space for collaboration	.088	2.505	.012	.760/1.316
Constant		34.072	.000	
F	33.118		.000	
Adjusted R ²	.061			

The results are similar to the results of the former analyses. Space for concentration (0.195) has a larger impact on the dependent variable than space for collaboration (0.088); the standardized β values are at the same level in both analyses. However, in this additional analysis the coefficient of determination has dropped from 12.6 per cent in the former analysis (Table 5) to only 6.1 per cent in the additional analysis (Table 8). This indicates that the model used in the first analysis, including the three variables, is better than the one used in the second analysis including only the space variables. This supports our underlying hypothesis that the impact of space for concentration and collaboration and self-management skills is different for the two levels and two dimensions of productivity that were included in the analysis.

5 Discussion and conclusions

The purpose of this paper was to explore the impact of workplaces for concentration and communication and self-management practices on individual and team productivity and two dimensions of productivity: quantity and quality. The findings have shown that workplaces that support concentration and communication and self-management practices have an impact on both individual and team productivity. The findings confirm the findings from literature that both

concentration and communication opportunities are important. In addition to existing knowledge, the findings have shown that self-management has a larger impact on individual and team productivity than workplaces. Whereas the beta-factors are statistically significant, the contribution to the explained variance in productivity is rather low. This shows that many other factors have an impact on productivity, for instance technology and work satisfaction.

From the results of this research three other interesting conclusions can be drawn. First, space for concentration is an important factor to increase the quantity of the output on individual level. Although space for concentration also has a positive relationship with the quality of the output on individual level and on the quantity of the output on team level, space for collaboration and self-management are significantly more important. Second, space for collaboration seems to be most important to increase team productivity. It does not seem to play a key role in improving individual productivity. Third, in this study, self-management has the highest, positive relationship with individual productivity. This means that improving self-management skills may lead to an increase in the individual productivity, both quantitatively and qualitatively. Self-management also has the second highest positive connection with team productivity, after space for collaboration.

The underlying hypothesis was that the impact of these variables on the two levels of productivity (individual and team) and the two dimensions of productivity (quantity and quality) may be different. The results of correlation and regression analyses confirmed that the impact of these variables is different for the two levels and the two dimensions of productivity. The contribution of this paper for future research is that productivity needs to be defined more precisely and needs to be measured on different levels and two dimensions. If not, it is hardly possible to evaluate the results. For example the space for collaboration may seem to be near useless in order to increase the quantity of the output on individual level, while it could be very important for the quantity of the output on team level.

5.1 Practical implications

The findings show that managers should pay attention to both individual productivity and team productivity in addition to two dimensions of productivity (quantity and quality). Depending on which type of productivity is mainly aimed to be increased, different solutions are needed.

To increase individual productivity, in particular spaces for concentration need to be improved. To increase team productivity, spaces for collaboration need to be improved. Because collaboration is partly conducted in virtual environments, appropriate spaces for concentration are important as well. Appropriate support of self-management skills is even more important. This shows that a more integrative approach and collaboration between corporate real estate managers, facility managers and human resource managers is of utmost importance. The finding also supports the current trend in consulting to pay more attention to the effective use of space and the role of training, abilities and change management.

5.2 Limitations of the research and follow-up research

The coefficient of determination i.e. how much the conceptual model can explain the variance in the dependent variables (productivity) is low. It would be interesting to study what variables would increase the coefficient of determination to a satisfactory level. Probably other variables that have not been measured here – for instance intrinsic motivation, health of the employees, leadership, inspiring colleagues, availability of advanced information and communication technology, and contextual factors such as the labour market – could contribute to a larger level of explained variance. Furthermore it would be interesting to extend the survey to non-governmental employees in order to explore if employees of commercial organisations cope differently with workspaces and self-management practices, or to cultural contexts other than the Nordic countries. Finally, a closer look at the impact of individual differences regarding type of person (e.g. being an anchor, connector, gatherer or navigator, or being part of generation X, Y, Z) could add to a better understanding of influencing factors on knowledge worker productivity as well. This pleads for more interdisciplinary

research to connect different focus points into a more holistic research design. Another next step could be to apply additional research methods, such as individual and groups interviews or diary research, to record stimulating and hindering factors to optimise individual and team productivity.

In the selected questionnaire format, team productivity is only measured in connection to quantity. It could be considered to add qualitative output measures for team productivity as well. Former research showed that employees find it difficult to make a clear connection between the workplace and team or organizational productivity (Maarleveld et al., 2009). This topic could be explored furthermore by means of expert interviews or a group session with a mix of academics, practitioners and employees.

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