

The influence of digitalisation on procurement efficiency

Florian Bauer (florian.bauer@hotmail.de)

Martin Göbl (martin.goebel@hs-kempten.de)

University of Applied Sciences Kempten, Germany

Summary

- Research question:** Are there any benefits of digitalisation on the efficiency in procurement and how does digitalisation influences efficiency in procurement?
- Methods:** After creating a questionnaire, a survey via internet was conducted through various procurement departments of companies about digitalisation in procurement and its relation to efficiency. With the answers, the influence of digitalisation on efficiency was analysed to understand how and if digitalisation has an impact on procurement.
- Results:** The analysis shows that procurement departments with a higher degree of digitalisation are benefiting of higher efficiency and the reduction of administrative and manual tasks. Especially procurement departments with integrated and universally connected systems have even a bigger benefit on efficiency. Also, the results of the analysis show that the age of the interviewees doesn't influences the expectations on digitalisation and has no any impact on the efficiency through digitalisation.
- Structure of the article:** Introduction; Literature Review; Research questions & methods; Empirical results; Conclusions; Bibliography

Introduction

Nowadays, digitalisation is a part of every aspect of life. For instance, in private life with a smart home device or in business life where components are delivered automatically to the production line. Google found out that the search for the term “digitalisation” has increased by ten times in the past three to four years. (Huth, Knauer, & Ruf, 2019)

Currently, the world’s economy is undergoing a new industrial revolution caused by digitalisation and Industry 4.0. The new given technologies offer businesses new potentials on efficiency, but the adoption is challenging and creates new competition in the market which threatens existing businesses. (Deloitte LLP, 2017) With the constant spreading of digitalisation and modern technologies, the functions of procurement departments are changing and time-consuming manual tasks will be reduced. (Vollmer, 2019) To keep up with the increasing pressure for innovations and the extremely high product development cycles, buyers need to be open for new technologies. It is expected that the job profile of buyers will change. But it is strongly expected that the ongoing digitalisation will improve procurement.

Researches show that procurement departments investing in digital technologies expect greater opportunities on the global markets. Thus enormous competitive advantages are projected with the interconnection between the buyer and the suppliers. (BME e.V., 2018)

Therefore, executives in procurement expect from digitalisation faster, higher and sustainable cost savings and an increase of efficiency in the whole supply chain. But the majority only supports digitalisation because they fear missing out. (Rüth et al., 2019)

In order to give executives a good reason to strongly tackle digitalisation, this article is intended to provide theoretical and empirical facts for a further introduction of digital technologies.

Literature Review

Digitalisation

In recent years’ digitalisation has had its peak in popularity, but it already started in 1833 with the invention of the telegraph. Around 1950 the digitalisation had a boom with the third industrial revolution and the increase in electronics and digital technology. Since then, with new data processing machines and the development of the internet, digitalisation has been gaining constant popularity. (Heuermann, Tomenendal, & Bressemer, 2018)

Today digitalisation is well known by everyone, but hardly anybody knows the exact meaning of it. In the German language, digitalisation (Digitalisierung) describes two things. On the one hand, the term describes the processing of information into digital data and on the other hand, the ongoing change of the economy caused by the introduction of digital technologies. (Kruse Brandão & Wolfram, 2018)

Whereas the German language uses one word, the English language uses two words with different meanings. The term digitisation describes the conversion of analogue to digital, while digitalisation describes the changes and integration of digital technologies. (Bloomberg, 2018)

A study of the European Economic and Social Committee states that due to digitalisation, workers in the EU can perform their work more efficiently. Digitalisation promotes innovation and economic growth, which raises new methods and technologies. In the end, digitalisation creates and at the same time destroys jobs, but the overall impact cannot be foreseen yet. (Groen, Lenaerts, Bosc, & Paquier, 2017)

Industry 4.0

Industry 4.0 nowadays is often discussed and regularly used together with digitalisation.

In 2011 at the Hannover Industrial Exhibition, the concept of Industry 4.0 was strongly promoted which resulted in a global vision of a new industrial revolution and so created a hype about the future working environment. (Pfeiffer, 2017)

The term originated from the German Federal Government when they started a future project to ensure the sustained international competitiveness

of the German industry. (Hofmann, 2017) The “Plattform Industrie 4.0” which is a German association of federal ministries, unions, science and corporations, defines Industry 4.0 as follows.

“Industry 4.0 refers to the intelligent networking of machines and processes for industry with the help of information and communication technology.” (Plattform Industrie 4.0, 2019)

With the rise of Industry 4.0 various new technological elements like Big Data, Internet of Things and Services, Smart Factory, Augmented Reality (AR) or Artificial Intelligence (AI) will be developed. (Gretzinger, 2018) Not the digitalisation is the revolution of Industry 4.0, but rather the new possibility of communicating between the various systems. (Bauernhansl, 2017)

Procurement

Procurement like production, sales and logistics, is one of the core functions in a company. (Kummer, Grün, & Jammernegg, 2013) By comparing the various cost factors of industrial sectors or companies, the material costs are a significant part of the total cost. Whereas personnel expenses usually vary between 20% and 30%, material costs generally account for 50% to 70%. Therefore, to achieve significant benefits for a company, procurement must have the priority for cost optimisations. But the main task of a procurement department is to ensure a company’s supply of consumption factors and resources by planning, controlling, executing and supervising. It takes responsibility for all input factors needed in production. (Krampf, 2012)

For many years several IT systems have been in use to support procurement. By and by operational and analytical systems have been developed, but future generations will go beyond the current functionalities. The current systems do only support specific operational and strategic tasks because they are limited to various areas. In the future, modern intelligent systems have the computing power, connectivity and logic to be able to analyse historical and future-oriented data. Due to this, procurement will be able to offer holistic, autonomous and real-time task completions. (Kleemann & Glas, 2018)

Nowadays MRP and ERP systems are no longer revolutionary. Electronic procurement (eProcurement) and Procurement 4.0 are the current state of the art. (Glas & Kleemann, 2016)

The following figure shows the current stages of digitalisation in procurement and how they influence the operational processes and the strategic elements of each stage. The stronger the degree of digitalisation the higher is the influence on the processes and strategic elements. (Kleemann & Glas, 2017)

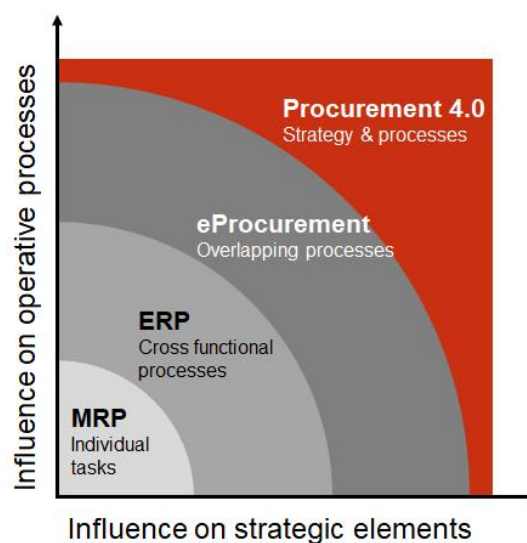


Figure 1
Demarcation of IT systems in procurement.
(Kleemann, 2019, p. 9)

Electronic procurement (eProcurement) is created to support the procurement process with electronic solutions and is the first step to digitalisation to give procurement departments operational and tactical support. (Kleemann & Glas, 2017)

“eProcurement is a subarea of e-Business and generally stands for the electronic purchasing of products and services by companies via digital networks.” (Weigel & Ruecker, 2017, p. 181)

E-Business is understood as an electronic business which initiates, arranges and supports business processes. This happens by using digital information technology between economic business partners via open or private communication networks. (Meier & Stormer, 2012)

eProcurement covers the strategic (eSourcing) and operational (eOrdering) purchasing process. eOrdering intends to reduce the process costs by supporting administrative and operational tasks, for example with an electronic catalogue system.

eSourcing aims to reduce production costs by supporting the sourcing process, for instance with the use of a database for identifying new suppliers. (Weigel & Ruecker, 2017)

Despite the advantages of eProcurement, the systems are not yet well established in all companies. A 2018 study of Bogaschewsky & Müller states that 56% of the interviewees have to overcome resistances for proceeding with digitalisation in their procurement department. (Bogaschewsky & Müller, 2018)

Electronic procurement supports and executes procurement functions with electronic technology. One step further of eProcurement is Procurement 4.0.

Three of the core facts of Industry 4.0 are automatization, connectivity and Big Data. These facts can be transformed into procurement and describe the difference between Procurement 4.0 and eProcurement systems. With these new possibilities, operational processes can almost completely be automated and decision making processes can be supported through Big Data analyses. (Kleemann, 2016) Therefore the main difference is that eProcurement has interfaces compared to Procurement 4.0 which aims at autonomous processes and universal connectivity. (Kleemann, Glas, & Friedinger, 2016)

The introduction and implementation of Procurement 4.0 requires a fundamental rethink in business organisations. Procurement 4.0 is not just a technical term. It is an entirely new organisation because several operational processes have to be adjusted according to the demand of Procurement 4.0. Procurement, logistics and IT departments must strongly be connected to accounting and controlling. The interaction within the management has to be completely reorganised with new structures. (Adam, Glunz, & Kost, 2018)

Moreover, it is expected that the role of buyers in procurement will change with Procurement 4.0. The operational tasks will be significantly reduced or even completely abolished. For the future, it is expected that buyers will have more analytical tasks where they control and design processes. For the systems, they define parameters and are trained to identify potential improvements. Therefore a higher IT and process knowledge is required to ensure that

automated processes and systems run smoothly. (Kleemann & Glas, 2017)

In summary, based on the previous references, Procurement 4.0 is expected to be the “next big thing” in procurement. With the possibilities given by Industry 4.0 new potentials in procurement can be created. Through highly automatized and universally connected systems operational procurement processes are expected to be totally automatized. The interaction with internal and external shareholders will increase and provide more reliable data. To support decision-making processes, Big Data will provide up to date information and new ways of analysis. This is handled by buyers who have a new focus on their tasks.

This results in expectations in cost savings and efficiency increment in procurement departments.

Efficiency

With the growing competition and the urge to be successful in the market, companies nowadays need to be as much efficient as possible. Sooner or later inefficient companies will fail. In general, efficiency implies to reach goals with as little as possible resources in the shortest possible time. (Gründerküche, 2017)

Efficiency is very commonly referred to as the optimal relationship between input and output. Increasing production in relation to the input leads to increasing efficiency, while the input can be replaced by various resources (e.g. people’s work, machines, energy etc.). (Brunsson Holmblad, 2017) In textbooks several definitions of efficiency are available which are similar to the explanation of Brunsson Holmblad. In the following two examples of efficiency definitions are shown.

- “Efficiency means producing a good or service at the lowest cost possible while maintaining a constant level of quality” (Rainey, 2014, p. 102)
- “... a ratio between input and output, effort and results, expenditure and income, costs and the resulting pleasure” (Slichter, 1923, p. 437)

Often efficiency is commonly interchanged with the word effectiveness. While effectiveness is about the achievement of a goal, efficiency is about the achievement of a goal in a best possible way. (Kjurchiski, 2014)

To be successful, the right goals with an excellent use of resources have to be defined. In business, companies will minimize costs and receive a high return on their investment. (Goh, 2013)

The following 2x2 grid shows how effectiveness and efficiency influences the costs of a producing company.

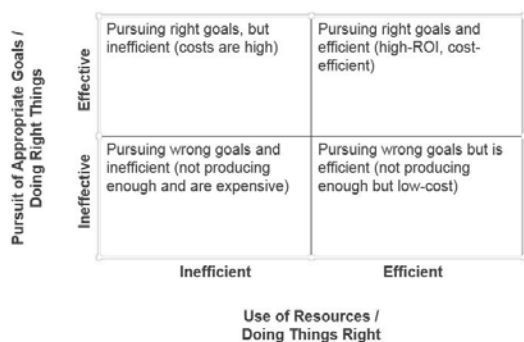


Figure 2
Efficiency and Effectiveness grid (Goh, 2013)

To be successful efficiency needs to be measured. "It is important to know how far a given industry can be expected to increase its output by simply increasing its efficiency, without absorbing further resources". (Farrell, 1957, p. 11) In the Data Envelopment Analysis (DEA) efficiency is defined as a ratio of the weighted sums of the outputs to the weighted sums of the inputs. The outputs are products and services produced by the units and the inputs are the resources which are needed to produce the outputs. (Thanassoulis, Dyson, & Foster, 1987)

For example, if it takes a complaint department 16 hours to process ten complaints, they will have an efficiency of .625. After internal improvements, they now will be able process 12 similar complaints in the same time with an efficiency of .750. This means the complaint department has increased its efficiency by 20%. (CONELO GmbH, 2015)

This example of how to measure efficiency can easily be transferred to procurement and business organisations.

In general, for procurement there are over 160 key figures available in literature. The journal Technik+Einkauf has defined ten important key figures in procurement. Three of these ten key figures are related to the evaluation of efficiency in procurement.

1. *Procurement cost in per cent of the procurement volume.*

This key figure shows direct the efficiency of the processes in the procurement department. The higher the volume and the lower the cost, the more efficient is a procurement department.

2. *Procurement volume of each employee in procurement.*

Another alternative to provide information about the efficiency is the relation of the procurement volume of each employee in procurement. A higher procurement volume of the buyers shows a higher efficiency of each buyer.

3. *Demand rate of framework contracts and catalogues.*

This key figure shows the increasing efficiency through automatization as more products can be unrolled via framework contracts and catalogues. (Neitzel, 2017)

To evaluate the key figures in procurement, they must be viewed holistically. The evaluation of one single specific figure does not make sense. It is important how they develop over the years and that the changes must be constantly documented. (Neitzel, 2018)

Contemporary research

After analysis, no substantial study was available which combines efficiency, digitalisation and procurement.

A study from Staufen AG in 2018 describes that 80% of the participants in this survey claim that the main reason for digitalisation is the increment of the internal efficiency. (Staufen AG, 2018)

There are a number of studies which provide information about the expectations on digitalisation in procurement.

For example, in Deloitte's CPO survey from 2018 it is shown that 48% of the participants expect an improvement of process efficiency which will be gained due to digitalisation. (Umbenhauer & Younger, 2018)

Another survey of the BME from 2018 shows that 60.2% of the interviewees expect that the operational procurement processes will almost be completely automated. (Bogaschewsky & Müller, 2018)

In 2006 the BME started an annual survey to gather various key figures of procurement departments around Europe

(„BME-Benchmark Top-Kennzahlen im Einkauf). With this survey, companies can evaluate and benchmark themselves, based on a standardised questionnaire about procurement. The results of the survey show the development over the years and provide an evaluation of how companies are developing in various key figures in comparison to other companies. In the 2017 survey, further questions were added to analyse which processes were already digitalised, in order to gain information about the development of digitalisation within procurement. (BMEnet GmbH, 2017)

Looking into other business areas, it is shown that digitalisation has positively influenced the efficiency. A study from KPMG and the Ludwig-Maximilians-University (LMU) Munich shows that accounting has gained 78% of efficiency and controlling 67% because of digitalisation. (KPMG, 2018)

Research Questions & Methods

Five hypotheses were proposed to question the purpose of this article. All hypotheses are in relation to procurement, digitalisation and efficiency to be able to provide a clear picture how digitalisation influences the efficiency in procurement.

Hypothesis 1: Procurement departments with a high degree of digitalisation are more efficient, compared to those with a low degree of digitalisation.

Hypothesis 1 generally intends to question the influence of digitalisation on the efficiency in procurement. The questionnaire asks the interviewees specifically about the degree of digitalisation in their respective procurement department and its efficiency.

Hypothesis 2: Procurement departments with integrated and universally connected systems are more efficient.

One benefit of digitalisation is the possibility to connect various systems with each other. Because of this, the question arises whether a higher degree of digitalisation in procurement also provides a better connectivity between the systems thus leading to higher efficiency. Stand-alone systems have different platforms and user surfaces, which could

result in a lack of efficiency. Hypothesis 2 evaluates the efficiency about the connectivity and the integration of the systems which might provide a substantial benefit on efficiency.

Hypothesis 3: Procurement departments with a high degree of digitalisation have fewer administrative and manual tasks.

With an ongoing digitalisation and automatization, a steady increase in efficiency is expected. Due to this, administrative and manual labour are supposed to be reduced. Hypotheses 3 questions the above topics and depicts the influence on efficiency in digitalisation on administrative and manual tasks.

Hypothesis 4: Younger generations have higher expectations on the improvements in procurement efficiency through digitalisation.

Faced nearly daily with digitalisation in their professional life, expectations are aroused on the influence of efficiency through digitalisation. Hypothesis 4 researches the expectations in procurement on digitalisation in different age groups.

Hypothesis 5: The younger the generation, the higher the influence on efficiency in procurement through digitalisation.

The last hypothesis is intended to find out how digitalisation influences efficiency in relation to age. Generally, it is expected that younger generations are more familiar and open to the topic of digitalisation and due to this a higher efficiency of the younger generation can be expected with the steady progress of digitalisation in procurement departments.

To either confirm or reject the proposed hypotheses a survey has been created which was conducted via the internet. In total 102 valid answer sheets have been provided for the evaluation. The survey was conducted within various positions in procurement departments around the world, whereas the majority of the survey participants were located in Germany. The main industrial sectors of the interviewees were working in the mechanical sector. As targeted, the survey reached out to various positions in procurement and not only to the management. The strategic and technical buyers (44%) represent the majority of the participants followed by the management and executives (26%).

In general, 91.2% of the participants of the survey have stated that the introduction of eProcurement is

sensible. Additionally, 71.6% of the participants expect that digitalisation will improve efficiency in their daily working routine.

Since it was not possible to do a long-term evaluation over several years, only the current situation of the interviewees is considered with a subjective perception of their current situation in procurement. The survey was conducted by using the online survey tool Umfrageonline.com. This tool provided the possibility to create a questionnaire in the English and German language to be able to reach a wider range of potential survey participants.

Unfortunately, the questionnaire was a little bit bloated and therefore a high-non conversion rate of 20.3% occurred. With a better questionnaire design more reliable data could have been created.

Empirical results

For the evaluation either an independent t-test or a one-way ANOVA analysis was used to test the

Table 1

Condensed result of independent t-test - Impact of digitalisation on procurement efficiency

Question:	Degree of digitalisation	N	M(efficiency)	SD	Sig.
Q. 3.1	High	28	3.82	.612	.026*
	Low	74	3.49	.687	
Q. 3.2	High	28	3.36	1.026	.108
	Low	74	3.00	.844	
Q. 4.5.3	High	28	3.75	1.206	.009**
	Low	74	3.11	1.042	
Q. 4.5.5	High	28	3.71	1.150	.014*
	Low	74	3.08	1.132	

*p < .05 **p < .01

results on significance with a significance value of 5%.

Hypothesis, 1, 2 and 3 can be all confirmed and supported, but hypothesis 4 and 5 have to be rejected.

Hypothesis 1 states that procurement departments with a higher degree digitalisation are more efficient compared to those with a lower level of digitalisation. An independent t-test evaluated all questions in relation to digitalisation. While one of the questions showed that there is statistically no significant difference between a lower and a higher degree of digitalisation another t-test was performed with the combined mean values of all questions. This t-test shows that there is a statistically significant difference and therefore Hypothesis 1 cannot be rejected but supported. The following tables (Table 1 & Table 2) show the results of the two executed t-tests.

Table 2

Condensed result of independent t-test - Impact of digitalisation on procurement efficiency by the mean values

Degree of digitalisation	N	M (efficiency)	SD	Sig.
High	28	3.66	.885	.004**
Low	74	3.16	.699	

*p < .05 **p < .01

Hypothesis 2 proposes that procurement departments with highly integrated and universally connected systems are more efficient compared to those with a lower level connectivity. With the use of an independent t-test (Table 3) a significant difference in efficiency is shown between the two

groups. Thus, Hypothesis 2 can be strongly supported.

The following table shows the compromised results of the independent t-test.

Table 3

Condensed result of independent t-test - Impact of integrated and connected systems on procurement efficiency

Question:	Degree of connectivity	N	M (efficiency)	SD	Sig.
Q. 3.1	High	16	3.94	.680	.021*
	Low	86	3.51	.664	
Q. 3.2	High	16	3.81	.750	.001**
	Low	86	2.97	.874	
Q. 4.5.3	High	16	4.13	.806	.001**
	Low	86	3.13	1.104	
Q. 4.5.5	High	16	4.13	1.025	.001**
	Low	86	3.09	1.123	

*p < .05 **p < .01

Hypothesis 3 indicates that a higher degree of digitalisation in procurement leads to less administrative and manual tasks in contrast to those with a lower degree of digitalisation. Hypothesis 3 was also analysed with an independent t-test

showing a significant difference between the two groups. Therefore, this hypothesis is supported, too. The following *table 4* shows the results of the t-test for Hypothesis 3.

Table 4

Condensed result of independent t-test - Impact of digitalisation on administrative and manual tasks

Question:	Degree of digitalisation	N	M	SD	Sig.
Q. 2.6	High	28	3.29	1.084	.010*
	Low	74	2.70	.975	
Q. 4.5.1	High	28	3.89	.956	.001**
	Low	74	3.05	1.121	
Q. 4.5.2	High	28	3.50	1.232	.009**
	Low	74	2.84	1.086	

*p < .05 **p < .01

The following graph shows the average means of efficiency between the higher and lower degrees. For Hypotheses 1 and 3, the results are in relation to digitalisation and efficiency and for Hypothesis 2 the result is in relation to connectivity between the systems and efficiency.

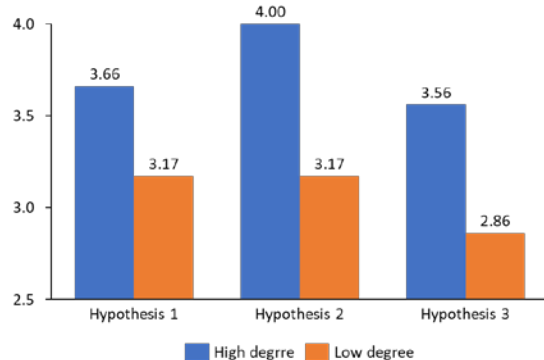


Figure 3

Comparison of the means for Hypotheses 1, 2 and 3

Hypothesis 4 proposes that the expectations of the younger generations on the improvements in efficiency due to digitalisation are higher compared to those of older generations. An independent t-test was executed by classifying the survey participants into a younger and an older group. The result shows that there is no statistically significant difference between the two groups, which can be seen in the following Table 5.

Table 5

Condensed result of independent t-test - Expectations on digitalisation between younger and older generations

Question:	Age Group	N	M	SD	Sig.
			(expectations)		
Q. 4.1.	Old	61	4.33	.790	.082
	Young	41	4.37	.767	
Q. 4.2	Old	61	4.31	.827	.929
	Young	41	4.24	.860	
Q. 4.3	Old	61	4.39	.822	.984
	Young	41	4.27	.867	

Additionally, a second one-way ANOVA analysis with all age groups was done to underline the first result. This ANOVA had the same outcome as the t-

test. Because of that this hypothesis had to be rejected.

The following two Tables 6 & 7 show shortened the result of the ANOVA for Hypothesis 4.

Table 6

Condensed results of one-way ANOVA - Expectations on digitalisation to different age groups, comparison of means and standard deviations by the mean values

Age	N	M	SD
< 25	6	3.78	1.129
25 -35	35	4.38	.637
36 – 45	29	4.30	.507
46 – 55	27	4.41	.770
> 55	5	4.27	.894
Total	102	4.32	.690

Table 7

Results of one-way ANOVA - Expectations on digitalisation to different age groups by average

	Sum of Squares	df	Mean Square	F	Sig.
Age	2,126	4	.532	1.122	.351

The following graph shows the different expectations on digitalisation by the age groups.

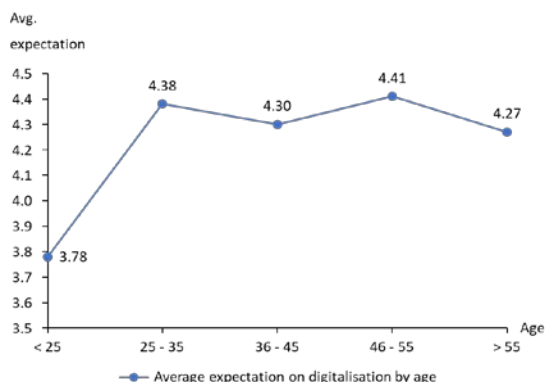


Figure 4

Expectations on digitalisation in efficiency to different age groups

Hypothesis 5 states that the influence of digitalisation on efficiency in procurement departments in younger generations is higher compared to those with the older generations. An independent t-test was performed with the same groups as in Hypothesis 4. The results again showed that there is no statistically significant difference between the age groups. Therefore, a one-way ANOVA analysis through all groups was executed which provided the same results as the t-test. Thus Hypothesis 5 can be denied, too.

The Tables 8 & 9 show the condensed results of the executed t-test and the ANOVA analysis.

Table 8

Condensed result of independent t-test - Impact of digitalisation between younger and older generations in relation to efficiency

Question:	Age Group	N	M	SD	Sig.
Q. 3.2	Old	61	3.05	.902	.536
	Young	41	3.17	.919	
Q. 4.5.3	Old	61	3.21	1.185	.583
	Young	41	3.39	1.022	
Q. 4.5.5	Old	61	3.13	1.258	.202
	Young	41	3.44	1.001	

Table 9

Condensed results of one-way ANOVA - Impact of digitalisation between different ages, comparison of means and standard deviations

Question	Age	N	M	SD
Q. 3.2	< 25	6	3.17	.983
	25 -35	35	3.17	.923
	36 – 45	29	3.24	.872
	46 – 55	27	2.89	.934
	> 55	5	2.80	.837
	Total		102	3.10
Q. 4.5.3	< 25	6	3.00	1.265
	25 -35	35	3.46	.980
	36 – 45	29	3.52	1.090
	46 – 55	27	2.96	1.224
	> 55	5	2.80	1.304
	Total		102	3.28
Q. 4.5.5	< 25	6	3.67	.816
	25 -35	35	3.40	1.035
	36 – 45	29	3.45	1.213
	46 – 55	27	2.93	1.207
	> 55	5	2.40	1.517
	Total		102	3.25

The following graph (Figure 5) shows the average impact on efficiency by the different age groups. It can be seen that the biggest efficiency improvement lies with the age group between 36 and 45 years.

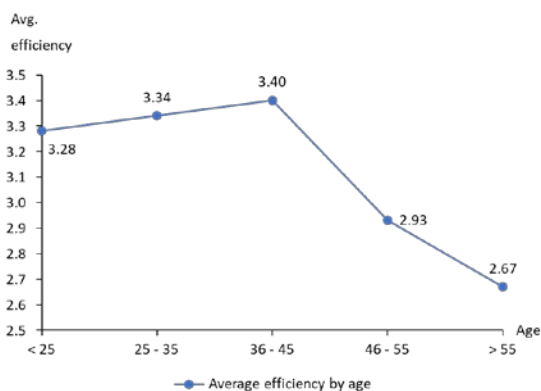


Figure 5
Impact of digitalisation in efficiency by different age groups

Conclusions

The purpose of this article was to investigate the relation of digitalisation on procurement efficiency. With the new capabilities arising from digitalisation and Industry 4.0, procurement departments are getting more and more attention thus playing a leading and even more important role in companies. eProcurement was the first step to support the execution of procurement functions. Due to Industry 4.0 new doors are opening for Procurement 4.0 where processes and tasks will be automatized and carried out by systems. Several studies show that the expectations on the improvement of eProcurement and Procurement 4.0 are high, but so far no study has yet been able to prove the predicted expectations.

Therefore, a study was created to analyse the current situation within procurement departments. The results show that in general digitalisation has a positive influence on procurement efficiency. Procurement departments with a higher degree of

digitalisation are more efficient compared to those having a lower degree of digitalisation and having fewer administrative and manual tasks. The highest efficiency can be found in procurement departments with highly integrated and universally connected systems.

Furthermore, an evaluation in regard to the age of the participants was carried out which shows that age does not influence the expectations on digitalisation and its impact on efficiency through digitalisation, which means that younger generations have no higher expectations on digitalisation and also no advantages on their efficiency through digitalisation.

In general, it can be noted that digitalisation definitely does have a positive influence on procurement efficiency. Digitalisation is already of vital importance in everyone's life and it cannot be ignored that it will be spreading even more in the future.

Various researches prove that digitalisation is highly expected to improve the efficiency in procurement departments. The results of this empirical analysis underline the expectations and shows that digitalisation by all means provides a positive impact on the efficiency in procurement.

Therefore, it can be stated that companies which are investing in digital technologies can directly benefit from this article if they are interested in evaluating how digitalisation influences procurement efficiency in their own department.

Limitations

A limitation of this research is that the empirical studies and analysis were only done on the objective opinions of the survey participants. For the evaluation of the degree of digitalisation, there is no common understanding of how it is perceived by the survey participants. Therefore, it must be taken into account that in the past years there has been a constant development of digitalisation and it can be assumed that the interviewees are able to evaluate how digitalisation and also their individual efficiency has changed in their daily work life.

The second limitation is that the analysis is based on a single survey and no long-term evaluation could

be done. The results are based on a single snapshot where neither the situation before or after the introduction of new digital systems could be monitored.

Future research

The result provides the opportunity for future researches. Based on the findings in the empirical analysis and the mentioned limitations, a constant evaluation of efficiency in relation to digitalisation is feasible. Having created a combination of subjective and objective ratings for digitalisation based on a common understanding for all survey participants, a sustainable result could be achieved. With an ongoing and repetitive evaluation of pre-defined key figures, set in relation to the degree of digitalisation, widespread statements of the influences of digitalisation on procurement efficiency can be created in the future.

Based on the idea of this research, future research can be created. Either in procurement or other areas, the evaluation of efficiency in general is sensible. Rising digitalisation will impact efficiency and apart the high expectations on improvements the outcome is not yet clear in every business sector.

About the authors

Florian Bauer studied International Engineering Management at the University of Applied Sciences in Esslingen and graduated as Bachelor of Engineering. He then joined the Mugele Technik GmbH, a mid-sized business, where he was responsible for the C-Parts Management business. In 2017, he entered a part-time MBA program at the Professional School of Business and Technology in Kempten. During that time, he joined the Alfred Kärcher SE & Co. KG as a Technical Buyer for electronic components.

Prof. Dr. Martin Göbl has been lecturing in Logistics and Business Management at the University of Applied Sciences in Kempten, Germany since 2006. After graduating as an industrial engineer, he worked in different functions and positions in the area of logistics management. While working he graduated as a PHD. His research interests are the evaluation of services, strategic logistics management and logistics service providers.

Bibliography

- Adam, D., Glunz, F., & Kost, K. (2018). Digitalisierung und Krise. In F. Schupp & H. Wöhner (Eds.), *Digitalisierung im Einkauf* (pp. 63–80). Wiesbaden: Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-16909-1_5
- Bauernhansl, T. (2017). Industrie 4.0. *Organisations Entwicklung*, (2), 32–38.
- Bloomberg, J. (2018). Digitization, Digitalization, And Digital Transformation: Confuse Them At Your Peril. Retrieved from <https://www.forbes.com/sites/jasonbloomberg/2018/04/29/digitization-digitalization-and-digital-transformation-confuse-them-at-your-peril/#bddd77c2f2c7>
- BME e.V. (2018). Globalisierung und Digitalisierung fordern Einkauf heraus. Retrieved from <https://www.bme.de/bme-globalisierung-und-digitalisierung-fordern-einkauf-heraus-2736>/<https://www.bme.de/bme-globalisierung-und-digitalisierung-fordern-einkauf-heraus-2736/>
- BMEnet GmbH. (2017). *BME-Umfrage TOP-Kennzahlen im Einkauf: Durchschnittswerte 2017*. Frankfurt.
- Bogaschewsky, R., & Müller, H. (2018). *BME - BAROMETER „ELEKTRONISCHE BESCHAFFUNG“*.
- Brunsson Holmblad, K. (Ed.). (2017). *SpringerBriefs in Business. The teachings of management: Perceptions in a society of organizations*. Cham: Springer. <https://doi.org/10.1007/978-3-319-56120-2>
- CONELO GmbH. (2015). Wie messe ich Effizienz? Retrieved from <https://www.conelo.ch/wie-messe-ich-effizienz/>
- Deloitte LLP. (2017). *The Fourth Revolution is now: are you ready? Future of Operations*. Retrieved from <https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Strategy/gx-strategy-ops-the-fourth-revolution-now.pdf>
- Farrell, M. J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society. Series A (General)*, 120(3), 253–290. <https://doi.org/10.2307/2343100>
- Glas, A. H., & Kleemann, F. C. (2016). The Impact of Industry 4.0 on Procurement and Supply Management: A Conceptual and Qualitative Analysis. *International Journal of Business and Management Invention*, (5), 55–66. Retrieved from [https://www.ijbmi.org/papers/Vol\(5\)6/I0506055066.pdf](https://www.ijbmi.org/papers/Vol(5)6/I0506055066.pdf)
- Goh, G. (2013). The Difference Between Effectiveness and Efficiency Explained. Retrieved from <https://www.insightsquared.com/2013/08/effectiveness-vs-efficiency-whats-the-difference/>
- Gretzinger, N. (2018). Industrie 4.0 – Grundlagen und aktuelle Entwicklung. Retrieved from <https://www.ingenieur.de/technik/fachbereiche/industrie40/industrie-4-0-grundlagen-und-aktuelle-entwicklung/>
- Groen, W. P. de, Lenaerts, K., Bosc, R., & Paquier, F. (2017). *Impact of digitalisation and the on-demand economy on labour markets and the consequences for employment and industrial relations: Study*. Bruxelles/Brussel, Belgique/België: European Economic and Social Committee, "Visits and Publications" Unit.
- Gründerküche. (2017). 8 Schritte zur Effizienzsteigerung – So organisiert ihr euer Startup effizienter. Retrieved from

- <https://www.gruenderkueche.de/fachartikel/8-schritte-zur-effizienzsteigerung-so-organisiert-ihr-euer-startup-effizienter/>
- Heuermann, R., Tomenendal, M., & Bressemer, C. (Eds.). (2018). *Digitalisierung in Bund, Ländern und Gemeinden*. Berlin, Heidelberg: Springer Berlin Heidelberg.
<https://doi.org/10.1007/978-3-662-54098-5>
- Hofmann, J. (Ed.). (2017). *Industrie 4.0 Die digitale Fabrik: Auf dem Weg zur digitalen Produktion* (1. Auflage). Berlin, Wien, Zürich, Berlin: Beuth Verlag GmbH; VDE Verlag GmbH.
- Huth, M., Knauer, C., & Ruf, T. (2019). *BME-Logistikumfrage Digitalisierung in Supply Chains*. Retrieved from https://www.bme.de/fileadmin/_horusdam/9533-BME_Logistikumfrage_Digitalisierung_in_Supply_Chains.pdf
- Kjurchiski, N. (2014). *Public Administration Efficiency in Resource Economies*. Retrieved from http://ion.ranepa.ru/upload/images/2_140521_Public-Administration-Efficiency-in-Resource-Economies.pdf
- Kleemann, F. C. (2016). Einkauf 4.0: Beschaffung und die digitale Revolution. *POOL4TOOL Inside*. (Ausgabe 13), 42. Retrieved from https://issuu.com/pool4tool/docs/p4t_inside_1603
- Kleemann, F. C. (2019, February). *Einkauf 4.0: Roadmap oder Sackgasse?*, Kempten.
- Kleemann, F. C., & Glas, A. H. (2017). *Einkauf 4.0*. Wiesbaden: Springer Fachmedien Wiesbaden. <https://doi.org/10.1007/978-3-658-17229-9>
- Kleemann, F. C., & Glas, A. H. (2018). Big Data und Einkauf 4.0: Analyse und Konzeption. *Industrie 4.0 Management*, 2018(2), 17–20. Retrieved from https://www.wiso-net.de/document/IM__F6B1F69DD67BAC473BC904CACBA6903F
- Kleemann, F. C., Glas, A. H., & Friedinger, R. (2016). Einkauf 4.0 und E-Procurement. *Beschaffung aktuell*. (08), 22–23. Retrieved from https://www.researchgate.net/profile/Robert_Friedinger/publication/305776894_Einkauf_4_0_und_e-Procurement/links/59fc4f71458515d07062b850/Einkauf-40-und-e-Procurement.pdf
- KPMG (2018, July). *IFRS-FORUM: Rechnungslegung und Berichterstattung im digitalen Wandel: KPMG Studie zur Digitalisierung im Rechnungswesen*, Ruhr-Universität Bochum. Retrieved from http://www.ifu.rub.de/mam/content/pdf/fohlen/irs_ss18_ufer.pdf
- Krampf, P. (2012). *Beschaffungsmanagement: Eine praxisorientierte Einführung in Materialwirtschaft und Einkauf. Management competence*. München: Vahlen.
- Kruse Brandão, T., & Wolfram, G. (2018). Digitalisierung. In T. Kruse Brandão & G. Wolfram (Eds.), *Digital Connection: Die bessere Customer Journey mit smarten Technologien - Strategie und Praxisbeispiele* (pp. 21–89). Wiesbaden: Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-18759-0_2
- Kummer, S., Grün, O., & Jammerneegg, W. (Eds.). (2013). *Always learning. Grundzüge der Beschaffung, Produktion und Logistik* (3., aktualisierte Aufl.). München: Pearson.
- Meier, A., & Stormer, H. (2012). *eBusiness & eCommerce*. Berlin, Heidelberg: Springer

- Berlin Heidelberg. <https://doi.org/10.1007/978-3-642-29802-8>
- Neitzel, D. (2017). Die 10 wichtigsten Kennzahlen im Einkauf. Retrieved from <https://www.technik-einkauf.de/ratgeber/die-wichtigsten-kennzahlen-im-einkauf/>
- Neitzel, D. (2018). Kennzahlen im Einkauf: So schneidet der Einkauf 2018 ab. Retrieved from <https://www.technik-einkauf.de/news/kennzahlen-im-einkauf-so-schneidet-der-einkauf-2018-ab/>
- Pfeiffer, S. (2017). The Vision of "Industrie 4.0" in the Making-a Case of Future Told, Tamed, and Traded. *Nanoethics*, 11(1), 107–121. <https://doi.org/10.1007/s11569-016-0280-3>
- Plattform Industrie 4.0. (2019). Industrie 4.0 – What is it? Retrieved from <https://www.plattform-i40.de/I40/Navigation/EN/Industrie40/WhatIsIndustrie40/what-is-industrie40.html>
- Rainey, H. G. (2014). *Understanding and Managing Public Organizations* (5th ed.). *Essential Texts for Nonprofit and Public Leadership and Management*. Hoboken: Wiley. Retrieved from <http://gbv.ebib.com/patron/FullRecord.aspx?p=1595184>
- Rüth, W., Oliveira, J., Watson, S., Wetherill, P., Laypang, & Layisha. (2019). *EINKAUF 2025: WIRD DER EINKAUF DURCH DIE DIGITALE TRANSFORMATION LEISTUNGSFÄHIGER?*
- Slichter, S. H. (1923). Efficiency. In E. R. A. Seligman & A. Johnson (Eds.), *Encyclopaedia of The Social Sciences* (5th ed., p. 437). New York: The MacMillan Company.
- Staufen AG. (2018). *DEUTSCHER INDUSTRIE 4.0 INDEX 2018*. Retrieved from <https://www.staufen.ag/fileadmin/HQ/02-Company/05-Media/2-Studies/STAUFEN.-Studie-Industrie-4.0-Index-2018-Web-DE-de.pdf>
- Thanassoulis, E., Dyson, R. G., & Foster, M. J. (1987). Relative Efficiency Assessments Using Data Envelopment Analysis: An Application to Data on Rates Departments. *Journal of the Operational Research Society*, 38(5), 397–411. <https://doi.org/10.1057/jors.1987.68>
- Umbenhauer, B., & Younger, L. (2018). *Global CPO Survey 2018: Leadership: Driving innovation and delivering impact*. Retrieved from <https://www2.deloitte.com/de/de/pages/operations/articles/cpo-survey-2018.html>
- Vollmer, M. (2019). Die neue Aufgabe des Einkaufs. Retrieved from <https://www.allaboutsourcing.de/de/die-neue-aufgabe-des-einkaufs/>
- Weigel, U., & Ruecker, M. (2017). *The Strategic Procurement Practice Guide*. Cham: Springer International Publishing. <https://doi.org/10.1007/978-3-319-57651-0>