An Innovative IoT Based Financing Model for SMEs

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Abstract. Industry 4.0 and the developed technology of the Internet of Things are changing the global economy rapidly. Companies have completely new opportunities to sell their products and services. This creates new business models, such as p ay-per-use, in which billing is based on the data collected. In this paper, a way is being worked out how banks can use this data for themselves in order to offer their business customers new financing products. For this purpose, the requirements of companies wishing to offer pay-per-use were addressed qualitatively. A financing model was then developed on the basis of this, which in turn was qualitatively assessed by banking experts. In a final online survey, the financing model was assessed quantitatively by the target group. In addition, the risks associated with the changes are discussed and proposed solutions for eliminating them are presented.

Keywords: finance 4.0, IoT, banking, financial innovation, SME.

1 Introduction

Industry 4.0 is currently considered the fourth industrial revolution worldwide. Following the invention of the steam engine, the discovery of electricity and automation through electronics, and the invention of the personal computer, "smart" objects and the associated technology of Internet of Things (IoT) are now leading to a further paradigm shift [16].

However, this revolution is associated with enormous investment costs [3]. Shorter innovation cycles and constant cost pressure are putting increasing pressure on small and medium-sized enterprises (SMEs). But it is not only in industry that major changes are currently taking place. In the banking sector, the low interest rate period, new regulations and digitalisation mean that those involved will have to rethink and change their processes in order to remain competitive [4]. Industry 4.0 offers a great opportunity for banks in this context [14]: with the end-to-end networking of devices and the resulting data, new business models can be developed that are optimally tailored to the personal needs of customers [14]. In the following, a financing model will be presented that uses IoT to flexibly adjust the liquidity burden of investment loans to the respective situation of the company in order to take account of economic and seasonal fluctuations.

2 Conceptual basis and relevant literature

Kevin Ashton first described the Internet of Things (IoT) in 1998 as the ability to connect people and objects at any time, in any place, with anything and everything, and ideally through any network or service [1]. IoT should represent all devices and persons in the virtual world and connect them with each other with the help of a virtual footprint [9]. The development of IoT is divided into five phases: the networking of two computers, the introduction of the Internet, the development of smartphones and the associated mobile Internet, social networks and finally the networking of objects from daily life, such as cars, cash machines, lamps or refrigerators [14],[18].

In the banking sector, too, this concept is becoming increasingly important in order to offer bank customers benefit. According to Drinkwater, this includes not only the use of wearables and Bluetooth beacons but also the use of intelligent cars as mobile ATMs, block chain technology and the development of chatbots [5]. Wang complements these with the possibility of real-time analysis of the devices and the use of capacity utilization and idle time for better pricing of leasing offers [7]. In their study, Ramalingam and Venkatesan are working on an ATM 2.0 that enables the use of IoT to connect to smartphones. In this way, they make it possible to withdraw money without a bankcard [20].

When using intelligent objects, large amounts of data are generated that have to be stored, processed and analysed. This enormous data is summarised under the term Big Data. The use of large amounts of data also offers great advantages in banking. The application scenarios described in the literature can be divided into the following categories: security, risk management, customer relationship management (CRM) and other uses. The studies [10], [11], [19] and [21] provide a very good overview of Big Data in the banking sector. In the security category, Wongchinsri and Kuratach's [23] meta-study provides an overview of the current technologies in this area, especially with regard to error detection and new customer selection. They analyse 41 articles dealing with this topic area. The articles mentioned there are very well suited to gain a deeper understanding of the topic. Kharote [15] uses Big Data to detect money laundering. To make this possible, he has developed a framework that analyses transaction data using a new algorithm. Through this, he tries to detect anomalies and thus identify possible money laundering. In the CRM category, the researchers try to make statements and predictions about the banks' customers. A wide variety of approaches is used, each with different objectives. In their 2014 study [8], Fuschi and Tvaronaviciene make recommendations on how to deal with Big Data so that service quality can be guaranteed. They recommend that quality guidelines and the way data is collected to be constantly redefined. These should be adapted to the constantly changing requirements. Others try to analyse their customers with large amounts of data. In their study, Srivastava and Gopalkrishnan [22] use the example of an Indian bank to show how big data can be used to analyse customers and understand their behaviour. They focus on the output patterns of their customers, the sales channels used, customer segmentation and profiling, product cross-selling, mood and feedback analysis, and security and error detection. The data provided by the bank is processed and analysed using descriptive statis-

tics. In this way, the authors clearly show how Big Data can be used to analyse customers and thus generate significant benefit for banks. Other researchers try to use Big Data to analyse their customers' supply chains in order to identify potential customers and gain advantages over the competition. In their study, Hung and colleagues [25] were able to clearly show that the response and completion rates of potential customers previously analysed by Big Data were significantly higher. Risk management attempts to make predictions or assessments of the risk associated with the loan. The data is often included in the scoring of the customer. This can be done in various ways. Yadav and Thakur [24] have used past customer usage data to assess the risk of each customer. Calis et al. [26] use clustering and classification to assess the risk of customers. In his 2018 study [17], Odinet identified several frameworks that use large amounts of data to identify unfair credit to customers. Hurley and Adebayo [12] take a different approach. In their investigations, they uncover Big Data's problems in credit scoring and the gaps in legislation.

A review of the relevant literature on IoT and banking shows, that there are no studies and concepts that use the resulting data volumes for a financing model. Thus, provide the customer with innovative financing products. Therefore, this subject will be addressed in this paper. The focus is set mainly on small and medium-sized companies that offer their customers the pay-per-use business model or plan to offer it in the future.

3 Research methodology and study design

The following results were compiled using the mixed-method approach. This approach combines elements of qualitative and quantitative research and thus enables a deeper understanding of the interrelationships [13].

In qualitative research, verbal, visual and audio-visual data are collected, structured, and analysed in the course of the project. This approach attempts to understand the behaviour of the participants and then to transfer it inductively to the general public [2]. In this work, guideline-based interviews with decision-makers from small and medium-sized enterprises were conducted. These interviews aimed to gain new insights into the current situation and the challenges facing companies. In addition, requirements for banks and their products are defined. Based on this, a financing model is designed. This was analysed and improved in further interviews with banking experts. The focus here is primarily on the requirements for banks, to assess the feasibility and to identify problems that are likely to arise. The aim of the second qualitative study was to examine the feasibility from the banks' point of view. A total of eight interviews with bank representatives and SME decision-makers were conducted in March and April 2020.

The modified financing model was then presented in the form of a standardised survey to SME decision-makers, who were asked to evaluate the concept. The aim of the quantitative survey in April and May 2020 was to obtain an initial assessment of the acceptance of the developed financing model in the market and the willingness of companies to pass on customer data. With almost 30 decision-makers from SMEs having completed the survey, the sample is not representative due to the number alone, but it

does provide initial indications of the acceptance and possible weaknesses of the concept. The new financing model as well as challenges and evaluation have been developed and optimised directly from the interviews and the survey and will be presented in the following sections.

4   The IoT financing model

The target group for the developed financing model are SMEs that want to offer their customers the pay-per-use business model or already do so. With pay-per-use, the customer does not buy the product, but only pays for the use of the product. Since this model is designed to generate more money in the medium to long term, the SME must first make advance payments. They must make their products available without directly receiving the full sales price. This means an enormous capital requirement, especially when scaling up. After a successful launch, the recurring revenues will finance further development and production of new products.
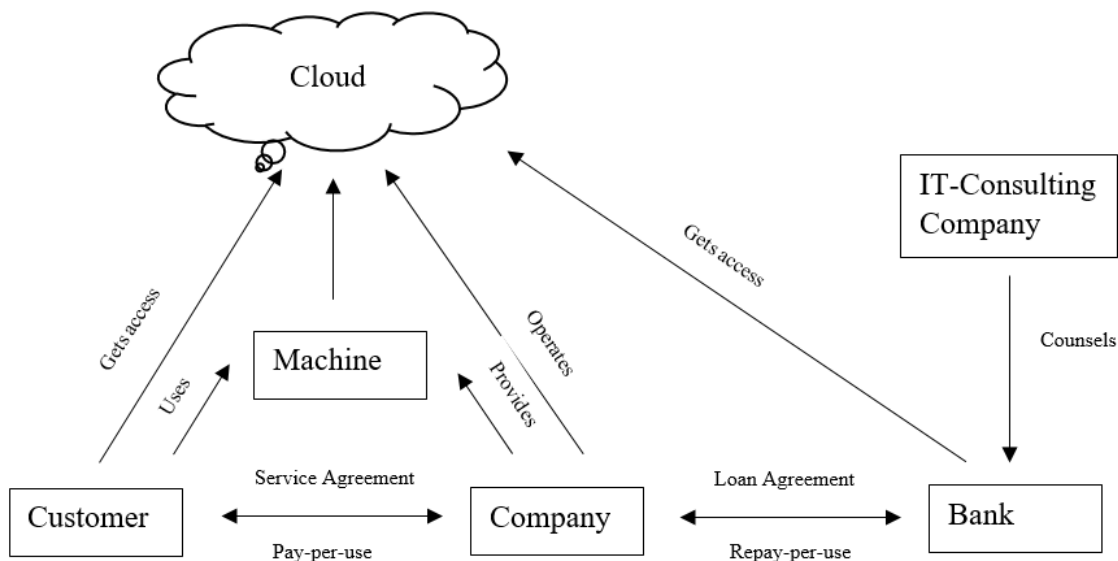

Fig. 1. Overview of the different roles

The financing model is based on the pay-per-use business model and therefore uses the same calculation basis as used previously mentioned. With the financing model, the repayment amount is calculated flexibly on the basis of the end customer's user data. In order to ensure that planning security is still required, a maximum financing period is agreed during which the loan must be paid off, if the financed product is not used. However, if the product is used, an additional, previously agreed amount is repaid for each unit. Thus, the more intensively the financed product is used by the end customer, the higher the manufacturer's repayment to his bank and the shorter the term.

The roles involved in the financing model are shown below and the respective relationships are clarified. The interaction of these roles is shown in Figure 1.

The SME plans to offer its products in the future with the pay-per-use business model. This products could be for example machines (Machine-as-a-Service), lamps (Light-as-a-Service) or cars (Mobility-as-a-Service). To this end, it will make its products available for use by its end customers and bill them on the basis of usage. In order to be able to offer the model across companies, they need a cloud in which they will consolidate, evaluate and automatically calculate their customers' usage data. This will be operated as part of his billing. By selling via service contracts, it will generate recurring income, but this only covers the costs incurred on a medium to long term. When scaling, this results in a significantly higher capital requirement for the products, which has to be covered with the help of a loan.

The end customer wants to avoid the risk of a capital-intensive purchase and still use the manufacturer's products. In addition, they want to have greater planning security and avoid unforeseen expenses for repairs or new investments, for example. For these reasons, they are looking for new business models with more planning security and less risk of default. He uses the new business model from the product manufacturer and uses his product without being the owner. Billing is based on the intensity of use.

The intelligent product is provided by the manufacturer and used by the end customer. It records a wide variety of data via sensors built into it, which is then transferred to the cloud operated by the manufacturer. From there, all participants can access data and analyse, evaluate and use it for billing.

The bank provides the manufacturer with the required capital and at the same time, it offers him an innovative, flexible financing model that will adjust the repayment rate to the end customer's usage. To do this, the bank is given access to the data stored in the cloud.

5 Challenges

When introducing pay-per-use or using the financing model, there are four challenges, which are explained in more detail below:

— Early repayment of the loan,
— Minimum redemption rate in the absence of turnover,
— Cluster risks,
— Change in the manufacturer's balance sheet.

Thanks to the design of the financing model, the early repayment of loans is no longer an exception, but has been deliberately brought about. However, this entails an increased risk for banks. They have to borrow money from other credit institutions, such as the European Central Bank (ECB), in order to grant loans to their customers. For private customers, this will generate costs. A good indicator of the costs incurred is the swap rate, which describes what fixed interest rate banks are prepared to pay for certain terms [6]. Due to a high utilization of the machine, the loans will most likely be repaid before the current financing term. As a result, the costs will continue to exist,

but on the other hand no income will be generated. If this is not taken into account in the calculation, it is possible that banks will suffer losses. In order to counteract this, banks must consciously plan and calculate risks. Early repayment interest rates, which are based on the swap rate, are suitable for this purpose. In this way, banks will protect themselves against a loss and the borrowers still will save parts of their costs (from a holistic perspective).

A further challenge is the dependence on customer benefit. In extreme cases, this can lead to the end customer not using the machine and thus not generating any income for the manufacturer. However, the manufacturer has to service the minimum redemption amount toward the bank. This situation can be life threatening for the manufacturer. In order to counteract this, the manufacturer should always agree a minimum purchase quantity or a monthly rental price with his end customer with which he can certainly cover the redemption payments. Regardless of this, an end customer can of course also become insolvent. However, this risk also exists with other types of credit. Moreover, the manufacturer has spread his risk over several customers and can make the product available to another customer as quickly as possible.

Another risk that was identified during the expert interviews is the cluster risk at banks. In the case of capital-intensive products, before the introduction of pay-per-use, the end customers were obliged to finance the products. As a result, the necessary amount of loan was spread over many companies and the bank was diversifying the existing risks. Furthermore, it is very unlikely that all end customers were at the same bank. As a result, the amount of credit was not only distributed among different customers, but also among different banks. Pay-per-use increases the risks for banks, since the manufacturers alone now need full financing. Although, it can be assumed that the manufacturing costs are significantly lower than the current sales price, the financing requirements of the manufacturer are significantly higher than those of individual end customers. In addition, there is no need for the manufacturer to distribute the loan among several banks, since the manufacturer normally wants to take out a loan with his house bank. In conjunction with the regulatory regime to which all banks are subject, this can mean that the loan cannot be guaranteed by just one bank. In addition, this leads to an increase in the risk and as a consequence also to an increase of the costs of the credit. In this case, the bank's action possibilities are limited due to the regulation controlled by the banking supervisory authorities. This means that to jointly cover the forthcoming large capital requirements, banks can only look for partner banks in advance.

The final challenge for the financing model is the change in the manufacturer's balance sheet and the resulting lower rating. Assessing the manufacturer's creditworthiness, calculating the risk and the associated premium is always a particular challenge with a new business model. According to the Basel 1, 2 and 3 resolutions, banks are required by the Banking Supervisory Authorities to carry out a rating for each borrower, in which they assess the borrower's creditworthiness. The worse the rating, the greater the risk and the higher the interest on the loan. In the calculation, a worst-case consideration must always be carried out and thus both qualitative and quantitative indicators are used. For example, the industry and the competitive position of the company are used as qualitative indicators. The annual financial statements and the balance sheet contained therein are used as quantitative characteristics for the rating. From these, key

figures are calculated that are used for the rating. A very important key figure in the rating is the equity ratio, which expresses the proportion of equity to total capital. The lower the equity ratio of a company, the worse is its rating. The introduction of the pay-per-use billing model has far-reaching effects on the provider's balance sheet and thus also on the key figures calculated for the rating. With pay-per-use billing, the products are no longer sold, but made available and leased using a service contract. As a result, the products manufactured are listed on the assets side of the balance sheet. These are typically, in the best case, financed by debt using the financing model developed here. This external financing is noticeable on the liabilities side of the balance sheet. As a result, the balance sheet total rises significantly and the equity ratio, which is important for the rating, deteriorates significantly. In turn, this will lead to higher risk interest rates, which will make the model unprofitable for manufacturers. This problem can be solved in two ways. The first option is to develop a new rating system that takes into account the exact conditions and might include data generated by the product. The other possibility is to spin off the company into a subsidiary. In this way, the manufacturer can continue to sell its products in the parent company as before and implement the pay-per-use business via a subsidiary.

This can then be rated by the bank in the role of a leasing company. Experience shows that these have a similar balance sheet structure.

6 Evaluation and Conclusion

The evaluation of the financing model by SME decision-makers provides initial indications of the acceptance, possible problems and opportunities of the model on the market.

Already 50 % of the companies surveyed are already recording data, and are using it for a variety of reasons. 10 % of the SME's already use the data for billing their services. Another 10 % use the data within the scope of service and maintenance contracts. Surprisingly, 25% of those surveyed record data but do not yet use it or only use it in individual cases. The most important finding is the possible potential of the financing model. 3 out of 4 companies consider recording the usage behaviour of their customers to be useful and are therefore also considered as a target group for the financing model.

Overall, it can be said that the IoT financing model has met with great interest among the test persons. On a scale of 5, ranging from very unattractive to very attractive, the test persons had to assess the attractiveness of the IoT financing model presented. 84 percent of the respondents rated the model as very attractive or attractive. Only 16 percent opted for the neutral middle. The survey participants saw the advantages of the idea of calculating the repayment participation on the basis of IoT data primarily in the flexible liquidity burden.

However, the survey also shows that many companies are still uncertain whether they are allowed to share the data with third parties from a data protection perspective and whether they need the consent of their customers to do so. For this reason, it is extremely important to sensitise customers to the topic of data protection from the start

and to explain to them in a comprehensible manner when the DSGVO takes effect, which regulations must be complied with and how this is implemented in the present financing model.

In addition, the lack of skilled workers is a major problem. The technical professions, which are also indispensable for the introduction of pay-per-use, are particularly affected. Companies have to think of suitable concepts for attracting talented and well-trained people and retaining them in the long term. Banks have to think about how they want to counter the conflict of objectives between the shortage of skilled workers and cost reduction in the long term. This is the only way to implement and change towards usage-based billing models.

In addition to the problems already mentioned, both the expert interviews and the online survey revealed that banking regulations are an enormous challenge. Here, it is of utmost importance for the success of the financing model that a new regulations are found that enables banks to provide a suitable rating for companies that act on the market as both product and service providers. Only in this way companies can take this innovative path without being put at an enormous disadvantage in future lending.

In summary, it can be said that the model presented here is suitable for companies who, in addition to selling their products, also want to position themselves as service providers in the market. This business model is less suitable for companies that want to act entirely as a service provider in the future, as banking regulations will push up risk costs too much. This is mainly due to the fact that there is no suitable rating model for the pay-per-use business model. This is precisely where further research will start.

References

1. Ashton, K. (2009): That 'Internet of Things' Thing. In: *RFID Journal*. https://www.rfidjournal.com/articles/pdf?4986, last accessed 19.12.2019.
2. 2. Berekoven, L.; Eckert, W.; Ellenrieder, P., A. (2009): Marktforschung Methodische Grundlagen und praktische Anwendung, Wiesbaden: Gabler.
3. Bitkom Research (2019): Industrie 4.0: Anwendungshemmnisse in deutschen Industrieunternehmen 2019 | Statista. https://de.statista.com/statistik/daten/studie/990517/umfrage/umfrage-zu-hemmnissen-bei-industrie-40-anwendungen-in-industrieunternehmen/, last accessed 03.12.2019.
4. Böhnke, W.; Rolfes, B. (Hg.) (2018): Neue Erlösquellen oder Konsolidierung? – Geschäftsmodelle der Banken und Sparkassen auf dem Prüfstand. Beiträge des Duisburger Banken-Symposiums. Wiesbaden: Springer Gabler.
5. Drinkwater, D. (2017): Eight examples of how IoT is improving retail bank ing | Internet of Business. https://internetofbusiness.com/eight-examples-iot-retail-banking/, last accessed 31.01.2020.
6. Durchblicker(2020):Swapsatz. https://durchblicker.at/immokredit/ratgeber/swapsatz, last accessed 29.05.2020.
7. Wang, E. (2017): IOT in Banking - Enabling Bank's Digital Future. Hg. v. Edgeverve. https://www.edgeverve.com/finacle/finacleconnect/trulydigital-2017/perspective/iot-banking-enabling-banks-digital-future/, last accessed 31.01.2020.
8. Fuschi, D. L.; Tvaronavičienė, M. (2014): Substainable Development, Big Data and supervisory control: Service quality in Banking Sector. In:*JSSI* 3 (3), pp. 5–14.

9. Govinda, K.; Saravanaguru, R. A.K. (2016): Review on IOT technologies. In: *International Journal of Applied Engineering Research* 11 (4), pp. 2848–2853.

10. Hassani, H.; Huang, X.; Silva, E. (2018a): Banking with block chained big data. In: *Journal of Management Analytics* 5 (4), pp. 256–275.

11. Hassani, H.; Huang, X.; Silva, E. (2018b): Digitalisation and Big Data Mining in Banking. In: *BDCC* 2 (3), p. 18.

12. Hurley, M.; Adebayo, J. (2017): Credit scoring in the era of big data. In: *Yale Journal of Law* and Technology 18 (1), p. 5.

13. Johnson, R. B.; Onwuegbuzie, A. J.; Turner, L. A. (2007): Toward a Definition of Mixed Methods Research. In: *Journal of Mixed Methods Research* 1 (2), pp. 112–133.

14. Khanboubi, F.; Boulmakoul, A.; Tabaa, M. (2019): Impact of digital trends using IoT on banking processes. In: *Procedia Computer Science* 151, pp. 77–84.

15. Kharote, M. (2014): Data Mining Model for Money Laundering Detection in Financial Domain. In: *International Journal of Computer Applications* (Volume 85), pp. 61–64. https://research.ijcaonline.org/volume85/number16/pxc3893337.pdf,[accessed22.06.2020].

16. Lasi, H.; Fettke, P.; Kemper, H.-G.; Feld, T.; Hoffmann, M. (2014): Industrie 4.0. In: Wirtschaftsinf 56 (4), pp. 261–264.

17. Odinet, C. K. (2018): Consumer Bitcredit and Fintech Lending. In: *International Political Economy: Investment & Finance eJournal*.

18. Perera, C.; Liu,. H.; Jayawardena, S.; Chen, M. (2014): A Survey on Internet of Things From Industrial Market Perspective. In: *IEEE Access* 2, pp. 1660–1679.

19. Prabhu, C.S.R.; Chivukula, A. S.; Mogadala, A.; Ghosh, R.; Livingston, L. J. M. (2019): Big Data Analytics for Financial Services and Banking. In: C. S. R. Parbhu, Aneesh Sreevallabh Chivukula und Aditya Mogadala (Hg.): Big data analytics. Systems, algorithms, applications. Singapore: Springer Singapore, pp. 249–256.

20. Ramalingam, H.; Venkatesan, V.P. (2019): Conceptual analysis of Internet of Things use cases in Banking domain. In: Proceedings of The TENCON 2019. Technology, Knowledge, and Society : 17-20 October 2019, Grand Hyatt Kochi Bolgatti, Kerala, India. TENCON 2019 - 2019 IEEE Region 10 Conference (TENCON). Kochi, India, 10/17/2019 - 10/20/2019. Piscataway, NJ: IEEE, pp. 2034–2039.

21. Sharma, S.; Sharma, T.; Kotak, B.; Hasotkar, A. (2019): Big Data Analysis in Banking Sector. In: *International Journal of New Technology and Research* 5 (10).

22. Srivastava, U.; Gopalkrishnan, S. (2015): Impact of Big Data Analytics on Banking Sector: Learning for Indian Banks. In: *Procedia Computer Science* 50, pp. 643–652.

23. Wongchinsri, P.; Kuratach, W. (2016): A survey - data mining frameworks in credit card processing. In: 2016 13th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON). 2016 13th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), pp. 1–6.

24. Yadav, S.; Thakur, S. (2017): Bank loan analysis using customer usage data: A big data approach using Hadoop. In: Balvinder Shukla (Hg.): 2nd International Conference on Telecommunication and Networks - TEL-NET 2017. 10th-11th August 2017, Amity University Uttar Pradesh, Noida, India. 2017 2nd International Conference on Telecommunication and Networks (TEL-NET). Noida, India, 8/10/2017 - 8/11/2017. International Conference on Telecommunication and Networks; Amity University; Institute of Electrical and Electronics Engineers; TEL-NET. Piscataway, NJ: IEEE,pp. 1–8.

25. Hung, Jui-Long; He, Wu; Shen, Jiancheng (2020): Big data analytics for supply chain relationship in banking. In: Industrial Marketing Management 86, pp. 144–153.

26. Calis, Asli; Boyaci, Ahmet; Baynal, Kasim (2015): Data mining application in banking sector with clustering and classification methods. In: International Conference on Industrial Engineering and Operations Management (IEOM), 2015. 3 - 5 March 2015, Hyatt Regency, Dubai, United Arab Emirates. 2015 International Conference on Industrial Engineering and Operations Management (IEOM). Dubai, 3/3/2015 - 3/5/2015. Industrial Engineering & Operations Management Society; Institute of Electrical and Electronics Engineers; International Conference on Industrial Engineering and Operations Management; IEOM. Piscataway, NJ: IEEE, S. 1–8.