R. **Intan**, C.-H. **Chi**, H.N. **Palit**, L.W. **Santoso** (Eds.)

Intelligence in the Era of Big Data

4th International Conference on Soft Computing, Intelligent Systems, and Information Technology, ICSIIT 2015, Bali, Indonesia, March 11-14, 2015. Proceedings

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This book constitutes the refereed proceedings of the 4th International Conference on Soft Computing, Intelligent Systems, and Information Technology, ICSIIT 2015, held in Bali, Indonesia, in March 2015. The 34 revised full papers presented together with 19 short papers, one keynote and 2 invited talks were carefully reviewed and selected from 92 submissions. The papers cover a wide range of topics related to intelligence in the era of Big Data, such as fuzzy logic and control system; genetic algorithm and heuristic approaches; artificial intelligence and machine learning; similarity-based models; classification and clustering techniques; intelligent data processing; feature extraction; image recognition; visualization techniques; intelligent network; cloud and parallel computing; strategic planning; intelligent applications; and intelligent systems for enterprise, government and society.

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Proceedings

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Preface

This proceedings volume contains papers presented at the fourth International Conference on Soft Computing, Intelligent System and Information Technology (the 4th ICSIIT) held in Bali, Indonesia, during March 11–14, 2015. The main theme of this international conference is "Intelligence in the Era of Big Data," and it was organized and hosted by Informatics Engineering Department, Petra Christian University, Surabaya, Indonesia.

The Program Committee received 92 submissions for the conference from across Indonesia and around the world. After peer-review process by at least two reviewers per paper, 53 papers were accepted and included in the proceedings. The papers were divided into 14 groups: fuzzy logic and control system, genetic algorithm and heuristic approaches, artificial intelligence and machine learning, similarity-based models, classification and clustering techniques, intelligent data processing, feature extraction, image recognition, visualization technique, intelligent network, cloud and parallel computing, strategic planning, intelligent applications, and intelligent systems for enterprise government and society.

We would like to thank all Program Committee members for their effort in providing high-quality reviews in a timely manner. We thank all the authors of submitted papers and the authors of selected papers for their collaboration in preparation of the final copy.

Compared to the previous ICSIIT conferences, the number of participants at the 4th ICSIIT 2015 is not only higher, but also the research papers presented at the conference are improved both in quantity and quality. On behalf of the Organizing Committee, once again, we would like to thank all the participants of this conference, who contributed enormously to the success of the conference.

We hope all of you enjoy reading this volume and that you will find it inspiring and stimulating for your research and future work.

February 2015

Rolly Intan
Chi-Hung Chi
Henry N. Palit
Leo W. Santoso

Organization

The International Conference on Soft Computing, Intelligent System and Information Technology (ICSIIT) 2015 (http://icsiit.petra.ac.id) took place in Bali, Indonesia, during March 11–14, 2015, hosted by Informatics Department, Petra Christian University.

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Keynote and Invited Papers

Data Mining Model for Road Accident Prediction in Developing Countries

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Abstract. Human loss due to road traffic accident (RTA) in developing countries is a big challenge. It becomes more serious in those developing countries where road conditions are not good and due to several reasons government is not able to maintain roads on regular basis. Additionally, increasing number of vehicles, inefficient driving and environmental conditions are also some of the factors which are responsible for RTA. In this work we present architecture of a data mining model. The proposed model is applied on real data set of RTAs from a developing country. The analysis of data gives several useful results, which can be used for future planning to reduce RTAs in developing countries. This paper also presents that how data mining model is better than other models.

Keywords: Data mining, road accident, vehicles, clusters, traffic road.

Behaviour Informatics: Capturing Value Creation in the Era of Big Data

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Abstract. Under the era of Big Data, people have been exploring ways of realizing value from data that are at their fingertips. However, it is found that while collecting data is not difficult, value creation is often a big challenge. This makes the approach of "collecting data first before knowing what to do with them" questionable. In this presentation, we discuss the current challenges of big data analytics and suggest how behaviour analytics on trajectory data can help to realize value creation from Big Data.

1 Background and Challenges

As we move to the fourth paradigm of computing – data intensive scientific discovery, numerous research efforts have been spent in building huge big data repositories. Together with data mining and machine learning research, it is hoped that better and more intelligent decisions can be made in real time.

This movement is accelerated by the advance in at least three areas. The first one is social network, where people share their views and opinions in public. The second one is cloud computing, which is an on-demand infrastructure that facilitates sharing of data, collaboration among multiple parties, and support for on-demand computational and storage infrastructure services at low cost. The third one is the internet-of-things. With the maturity of sensor technologies, trajectory movement of entities (including human and things) can now be monitored in real time at low cost. However, gaining access to big data is only the starting point. There are still open issues that need to be addressed in the value creation process when dealing with big data.

One result of the big data mega trend is the building of huge data repositories around the world. In Australia, the government has been pushing for sharing bureau data through spatial information platforms. It is true that data are collected and can be made available to users, but how to make sense out of these data practically and economically is still a mystery to be explored. Without value creation, the high maintenance cost of these repositories cannot be justified, and the motivation for data providers to update their data inside will also disappear.

In the past few years, sensors and sensing techniques have been advancing rapidly for real time data collection with good enough accuracy. Cost of deploying these technologies is also becoming low enough to make real-time data tracking of human,

animals, and even insects (e.g. honey bees) possible. However, without efficient and effective ways to integrate and transform these trajectory data and their context information into manageable knowledge, these data are actually burdens instead of potentials to their owners.

It is true that there have been numerous research efforts in data mining and machine learning. However, most of them are focused on theoretical algorithmic study, and much less emphasis is put in the incorporation of semantic domain knowledge (in particular, the semantic definition of interdependence among various data sources) into the data mining and pattern discovery processes, and in the use of the behaviour interior dimensions such as loyalty and purchase power of customers to support self service analytics.

Related to the analytics platform, internet-of-things, service and cloud computing techniques are quite mature, and lots of machine learning algorithms are also widely available in both commercial (e.g. MatLib) and open source ("Project R") packages. However, how to put them together in a single service platform and how to compose them together automatically (this is called the vertical service composition) to provide "intelligence-as-a-service" for a given domain are still open for exploration.

2 Real Time Trajectory Data and Its Challenges in Value Creation

In the era of big data, one new important data source for analytics and value creation is the real-time behaviour trajectory data streams of entities (e.g. human) as well as their context dynamics (e.g. environmental such as air quality) that are captured through internet-of-things and sensors (in particular body sensors such as those from Android wears and location position sensors). Its value creation process is both complex and challenging because these data are in general heterogeneous and inter-dependent on each other. Furthermore, the potential number of data sources, each describing one measurement view of the behaviour dynamics of an entity/event, is in theory, infinite.

Traditional data mining and machine learning approaches from computer science often try to explore co-occurrence patterns and inter-relationship among trajectory data. However, this is usually done without making full use of the interdependence defined by their implicit semantic meaning and domain knowledge. Heterogeneity of data adds another level of complication because quantification measures such as distance are not uniformly and consistently defined across different data types. On the other hand, although domain experts have full knowledge on the semantics of data, they are often not as knowledgeable as computer scientists when dealing with the real time computation on trajectory data streams. This result in the first challenge, how to use data mining / machine learning techniques and domain knowledge together to effectively define and discover the inter-relationships among different trajectory data sources and to perform effective behaviour analysis.

As trajectory-driven behaviour analytics is gaining its recognition in different business and industry sectors, the expectation of decision makers also goes beyond what traditional analytics that mainly focus on statistical summaries and association/patterns discovery of transactional/measurable behaviour exterior dimensions often provide. Ultimately, what decision makers want is the deep insight about the behaviour interior

knowledge dimensions of entities, by incorporating domain knowledge into the knowledge discovery processes. As an example, the owner of an online shop wants to know not only the "bestselling products of the week", but also the "loyalty", "purchase power", "experience", and "satisfaction" of customers. This results in the second challenge, how to quantify behaviour interior dimensions from exterior transactional (or physically measured) trajectory data and to discover their inter-relationships and relative importance for effective and efficient behaviour analysis.

3 Research Topics in Behaviour Analytics

To achieve this goal, the following is a list of sample research topics for behaviour analytics:

- Effective and efficient deployment of high resolution location tracking network (using Blue-Tooth LE, WiFi-RFIDs, UWB, and Electromagnetic Field) for entities in both indoor and outdoor environment. This forms the basis for behaviour trajectory data tracking and capturing.
- Semantic enrichment of behaviour trajectory data of entities through aggregation of raw trajectory data with their contextual data dynamics, followed by domain knowledge-driven transformation to form behaviour interior dimensions knowledge. This is the data aggregation, integration, and transformation aspects of behaviour analytics; it incorporates domain knowledge into the behaviour trajectory data to create behaviour interior dimensions knowledge as well as to define the interdependence relationship among them.
- Discovery of interdependence relationship among trajectory-driven behaviour data (exterior) and knowledge streams (interior) using data mining techniques. This addresses the interdependence relationships of trajectory data and knowledge streams from the run-time dynamics aspect.
- Coupling interdependence relationships of behaviour trajectory data and knowledge streams into data mining and pattern discovery processes for deep behaviour understanding and prediction. This gives a much better understanding on why things occur; it also gives potentials for future behaviour prediction.
- Design and implementation of a behaviour analytics service system that serves as a publishing, management and operation platform for: (i) software services, (ii) raw trajectory data services, (iii) semantically annotated behaviour trajectory data services (both individuals and collective), (iv) behaviour knowledge services (both individuals and collective), and (v) infrastructure services. Tools to facilitate composition and orchestration of all these services with QoS assurance using public cloud infrastructure such as Amazon EC2 should be developed. Also, automatic matching of behaviour trajectory data/knowledge services with machine learning/data mining algorithms based on their features should also be supported on this platform.

On the Relation of Probability, Fuzziness, Rough and Evidence Theory

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Abstract. Since the appearance of the first paper on fuzzy sets proposed by Zadeh in 1965, the relationship between probability and fuzziness in the representation of uncertainty has been discussed among many people. The question is whether probability theory itself is sufficient to deal with uncertainty. In this paper the relationship between probability and fuzziness is analyzed by the process of perception to simply understand the relationship between them. It is clear that probability and fuzziness work in different areas of uncertainty. Here, fuzzy event in the presence of probability theory provides *probability of fuzzy event* in which fuzzy event could be regarded as a generalization of crisp event. Moreover, in rough set theory, a rough event is proposed representing two approximate events, namely lower approximate event and upper approximate event. Similarly, in the presence of probability theory, rough event can be extended to be *probability of rough event*. Finally, the paper shows and discusses relation among lower-upper approximate probability (probability of rough events), belief-plausibility measures (evidence theory), classical probability measures, probability of generalized fuzzy-rough events and probability of fuzzy events.

Keywords: Probability, Rough Sets, Fuzzy Sets, Evidence Theory.

Contents

Invited Paper

Fuzzy Logic and Control System

Genetic Algorithm and Heuristic Approaches

Artificial Intelligence and Machine Learning

Similarity-Based Models

Classification and Clustering Techniques

Intelligent Data Processing

Feature Extraction

Image Recognition

Visualization Techniques

Intelligent Network

Cloud and Parallel Computing

Strategic Planning

Intelligent Applications

Intelligent Systems for Enterprise, Government and Society

The Implementation of Customer Relationship Management: Case Study from the Indonesia Retail Industry

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Abstract. PD.Cemara Sewu is a company engaged in distributor and selling photography product. Nowadays, system of sales and storage of goods still be done manually. So, company needs a system in order to improve good relationship with customers, and storage goods could be more effective and efficient. In this research, the application process begins with the design to the implementation of the system. Designs are made include the manufacture of DFD and ERD. Application of Electronic Customer Relationship Management that have been implemented to make the buying and storage of goods in PD. Cemara Sewu become more organized, well-structured and have relationship with customers. The application of this system has been created with features that have been planned and tailored to the needs of previously so customer have loyalty to company and reports of sales, card stock and forecasting from the application are accurately, because have the same result with manual calculations. Based on the evaluation, 85% of users said that the features in the application made is considered good and in accordance with company needs.

Keywords: Customer relationship management, customer, implementation

1 Introduction

In the industrial world, the competition can not be separated from each company. Every company that is engaged in manufacturing or services in general, aims to get the maximum profit and reduce costs. Customer Relationship Management (CRM) is a business strategy that results are expected to optimize the level of profits and customer satisfaction. This is done by way of organizing customer segments, directing the organization so oriented to customer satisfaction and implement business processes that focus on the customer.

CRM is still relatively new in the world of marketing. CRM in the late 90s are felt discussed in many media. It's just that his approach is not much reviewed by the marketers. CRM is a key concept in managing the company's relationship with its customers to create value-added (Value Creation) for its customers. The goal is not to maximize the sales of a transaction, but rather to build ongoing relationships (continued) with its customers. Both buyers and sellers are willing to build ongoing relationships during the relationship is a reciprocal relationship that adds value for both parties.

Excellence competition is not solely based on the quality of the product, or the price, but also on the ability of the company to help customers create and develop value-added to them. So as to create customer loyalty, causing the customer will constantly consume products that are created.

Customer loyalty should be improved continuously, otherwise it could be that customers will use similar products of other companies. There is an expression that says, "the customer is king". The phrase fits perfectly with the concept of CRM is aimed at customer satisfaction. If customers are satisfied then it will create customer loyalty. In the business world customer satisfaction is very significant for the progress and survival of a company, many companies fail because it can not retain customers.
PD. Cemara Sewu is a company engaged in the distribution and sale of products for photographic purposes. A company based in Jakarta has several branches, among others, Surabaya, Semarang, Bandung and others. In the PD activity. Cemara Sewu sought in order to satisfy the customers so as to get the maximum benefit. We need a new model in Customer Relationship Management to manage the relationship between the distributor and the customer as well as the procurement of products that are more efficient and effective in its efforts to increase profits by reducing costs of logistics activities.

The purpose of this paper is to increase the income of the customer satisfaction with the use of electronic customer relationship management (e-CRM) in PD. Cemara Sewu.

The paper is organized as follows: Section 2 reviews the literature on CRM implementation. In Section 3 we have presented the CRM implementation in PD Cemara Sewu. Section 4 discuses the implementation and analysis of CRM implementation in PD Cemara Sewu. Finally Section 5 draws conclusions from the case study in terms of its practical relevance and lessons learned

2 CRM

Customer Relationship Management is used to define the process of creating and maintaining a relationship with a customer-customer business or customers. CRM is the process of identifying, attracting, and retaining customers differentiate [5]. According to Craig Conway, CRM is the ability to recognize the transaction experiences faced by customers for transactions with companies in which the CRM try to improve customer satisfaction to loyalty and tendency of customers to buy increasing [3]. CRM applications can allow management or setting a good relationship with customers effectively, supported by the availability of good leadership [3].

The purpose of the CRM business framework is as follows [4]:

1. Adding existing relationships to increase revenue. Enterprise wide views of customers to maximize the relationship between them so as to improve profitability companies to identify, attract, and retain potential customers.
2. Using the integrated information for the best service. By using customer information to provide better service for their needs, so customers do not

have to repeatedly ask for the information they need to companies that save time and reduce their frustration.

3. Introducing channel processes and procedures those are consistent and replicable. With the development of communication channels for customers, the more employees engaged in sales transactions, so companies need to improve the consistency of the process.

So the goal of CRM is to have a relationship with customers that can provide significant benefits to the company. To achieve these objectives, marketing, sales and customer service should work more closely in teamwork and sharing of information. CRM consists of the following phases [4]:

1. Getting new customers (Acquire)
2. Increasing customer value (Enhance)
3. Maintain existing customers (Retain)

Some types of CRM technologies include [6]:

1. Operational CRM
   Integrated automation of business processes, including customer touch points, channels, frontback office, integration
2. Analytical CRM.
   Analysis of the data generated by the CRM operations, including data mining applications.
3. Collaborative CRM.
   Collaboration applications including e-mail, personalized publishing, e-communities, and the like are designed for interaction between the customer and the organization.

2.1 Customer Profitability Analysis

From company's perspectives, the customer plays a very important role in addition to the growing importance of customer positions, companies face the fact that its resources are limited. It requires that companies are increasingly selective and effective in allocating these resources to customers who can provide benefits to the company.

Customer profitability analysis is an approach to cost management that identifies the cost and benefit of serving specific customer or customer type to improve overall profitability an organization [1].

Customer Profitability Analysis has two main objectives, namely:

1. To measure the profitability of existing customer. Customer profitability analysis can show the cost benefit analysis to identify profitable customers or not.
2. To effectively identifying whether or not consumer-related activities. This analysis provides information that can be used by organizations to decide which activities need to be maintained or reduced so as to improve profitability.

There are several stages in conducting Customer Profitability Analysis, namely:
1. Identifying customer
2. Calculate the cost of customer revenue and customer
3. Analyze where customers are profitable and which are not.

3 Design and Analysis of System

Based on the analysis of company's old system, there are a number of problems. It needs to solve the problems found in the old system, with the new system. The new system requirements are:

1. An integrated system for recording sales, procurement, stock, and all sorts of business activities.
2. Customer can see the information section of the company's warehouse and the amount of the price, so that customers can make their own, and direct sales order will be sent to the company and order status can be monitored.
3. Customer can do setting of the minimum stock of an item that is often ordered to the company so that if the customer has a minimum stock in the order will be immediately made.
4. Company and customer can do sales forecasting.

Design of the CRM at PD Cemara Sewu are as follows:

1. Getting new customers (Acquire)
   Getting new customers by:
   - Promoting the products produced by the company.
   - Provide comfort to the customers in buying the products they need. The goal is to offer a good product with satisfactory service.
   - Featured in the program are given a page gallery to display the latest photos of the products offered. And customers can create their own sales order via the web.
2. Increasing customer value (Enhance)
   Companies must create a close relationship with customers by the company to listen to complaints and improve services. Relationship with customers can be enhanced by:
   - Provide different prices according to the profitability of each individual customer.
   - There are features of profitability and customer rankings so that each customer gets different treatment according profits earned by the company.
3. Maintain existing customers (Retain)
   - Making time to listen to the needs of customers, including customer dissatisfaction towards the product or service company. So it can be used to improve services.

- There is a communication feature (both complaints and promotion) between the customer and company.
- There are a feature campaign and also alerts for purchasing patterns of each customer so that sales can follow-up customer orders that have exceeded their limits.
- There is also a feature of forecasting for the sale of each item.

The system is designed to involve three external entity, PD Cemara Sewu main office, customers, and branches of PD Cemara Sewu. Customer is the entity that is engaged in transactions with the company in sales activities ranging from sales order, the minimum stock, and others. PD Cemara Sewu main office is an entity that provides goods to be sold by the company in purchasing activities include the purchase invoice, and others. While branches of PD Cemara Sewu is the entity that receives financial statements and reports required by the company forecasting to determine the direction and policies of the company. Fig. 1 is a diagram of the design context of customer relationship management.

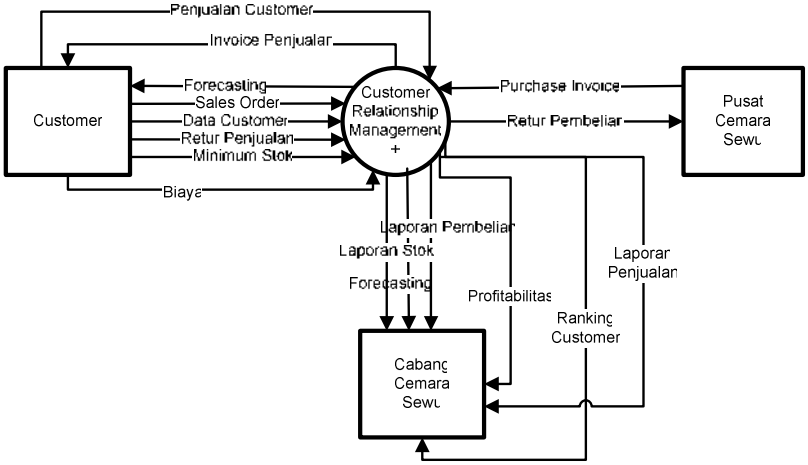

Fig. 1. The Context Diagram of the Application

The implementation primarily consisted of the major steps as given in Table 1.

Table 1. Major tasks during implementation process.

No	Tasks	Duration
1	**Infrastructure readiness**	**3 days**
	Server setting and installing	1 day
	PC and Notebook connecting	2 days
2	**Mapping process**	**5 days**
	Data gathering	3 days
	Database process mapping	2 days

3	**Data cleaning**	**15 days**
4	**User training**	**5 days**

4 Analysis

This chapter discusses the testing system has been created. The test system is implemented as a whole one by one according to the feature of the application.

This login page is the home page at the time the program is run. To be able to run the program/operate the program, users are required to login first to enter a username and password that was created earlier. The login page can be seen in Fig 2.

Fig. 2. Login Page

The customer profitability reports are used to see the profit from each customer so that the customer can be grouped where customers are making a profit and which are not. Reports for customer profitability can be seen in Fig. 3 and Fig. 4.

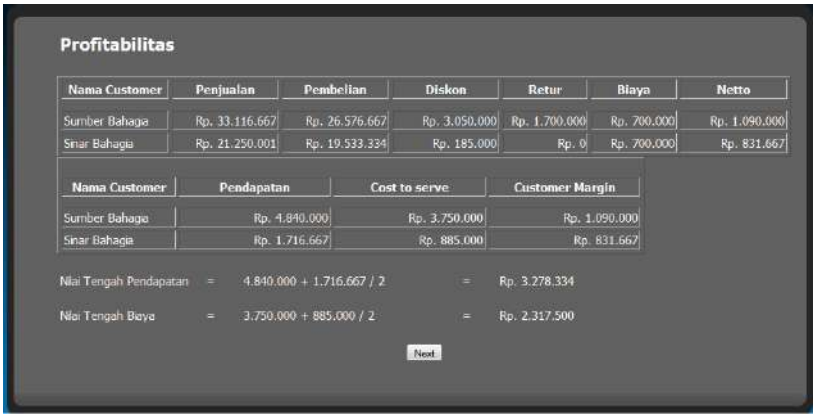

Fig. 3. Customer Profitability Report Page

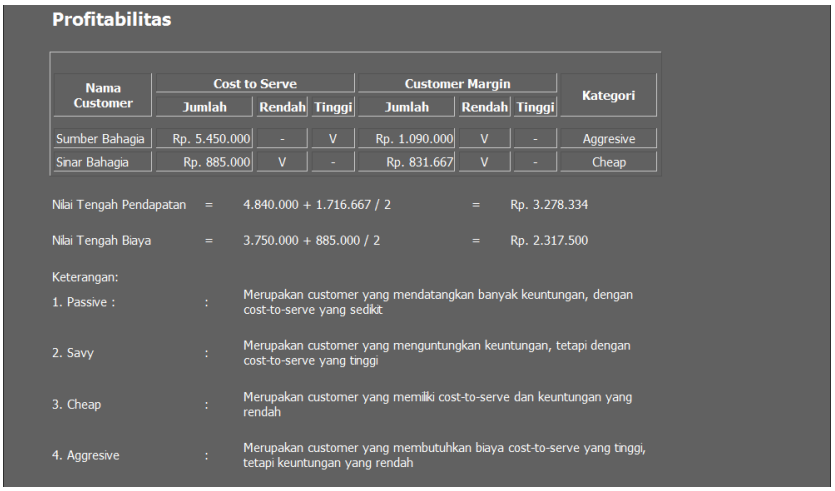

Fig. 4. Customer Profitability Report Page

5 Conclusion

From the results of implementation of CRM in PD. Cemara Sewu, some conclusions can be drawn, namely:

a. The application is considered to be able to answer the needs of the company. The relationship between the company and the customer can be established well.

b. The forecasting allows the company to forecast sales in the following months so out of stock could be eliminated in the company.

c. Based on the user questionnaire, it can be concluded that the system is able to be used properly and assist in the execution of daily business processes.

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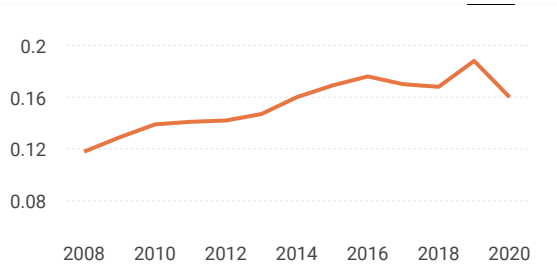

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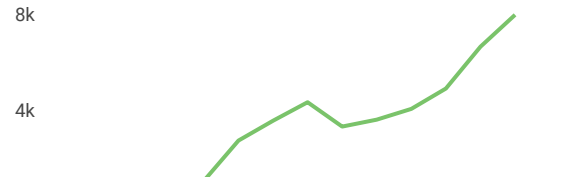

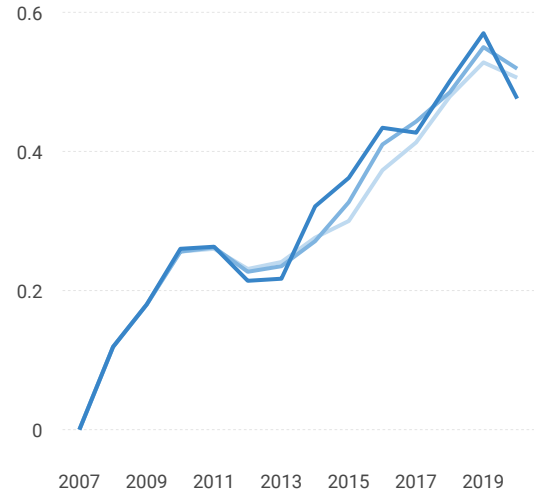

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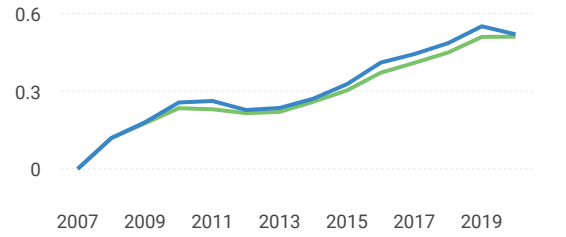

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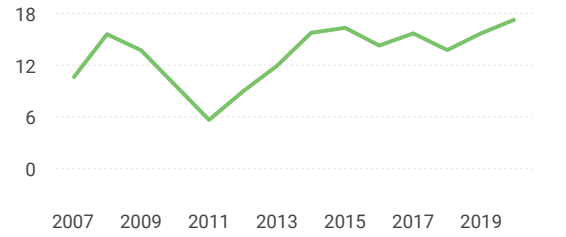

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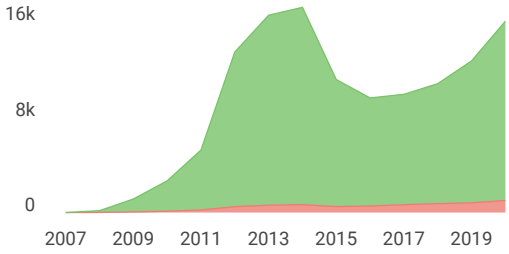

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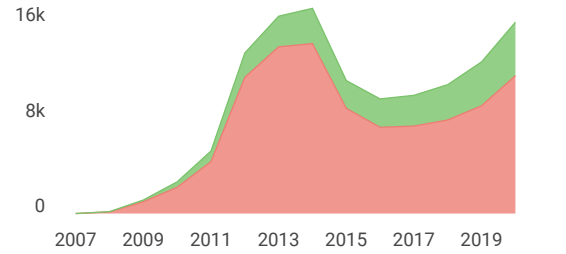

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