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Towards circular cities – exploring the circular economy approach in context of municipal solid waste[1]

W kierunku miast o obiegu zamkniętym – badanie podejścia gospodarki o obiegu zamkniętym w kontekście stałych odpadów komunalnych

Abstract

The objective of this research is to determine whether the city under investigation in a developing country is pursuing a "circular city" model based on various indicators and the city's current characteristics. The city under analysis was Xalapa, the capital city of the state of Veracruz in Mexico. To accomplish our research goals, we employed a qualitative methodology. We conducted interviews with the government representative responsible for municipal solid waste management during the designated period, as well as with the proprietors of the 18 most prominent private waste collection centers. Additionally, we obtained relevant information from the government through the transparency platform. For our assessment, we utilized the waste-focused indicators provided by L. Girard and F. Nocca. Our analysis indicates that the city under investigation is not on the trajectory towards adopting a "circular city" model. However, the context of municipal solid waste (MSW) offers valuable suggestions for future implementation of circular economy (CE) practices. The findings presented in this study offer valuable insights for researchers in other developing countries who are also engaged in exploring the issues discussed. Also, the lessons derived from this study hold relevance for cities in developing countries, as they grapple with environmental and economic degradation similar to the city studied.

Keywords:
circular economy, municipal solid waste, waste management

Streszczenie

Celem tego badania jest ustalenie – na podstawie różnych wskaźników i obecnej charakterystyki miasta – czy badane miasto w kraju rozwijającym się realizuje model „miasta o obiegu zamkniętym". Analizowanym miastem była Xalapa, stolica stanu Veracruz w Meksyku. Aby osiągnąć nasze cele badawcze, zastosowaliśmy metodologię jakościową. Przeprowadziliśmy wywiady z przedstawicielem rządu odpowiedzialnym za zarządzanie stałymi odpadami komunalnymi w wyznaczonym okresie, a także z właścicielami 18 najbardziej znanych prywatnych centrów zbiórki odpadów. Ponadto uzyskaliśmy odpowiednie informacje od rządu za pośrednictwem platformy przejrzystości. Do naszej oceny wykorzystaliśmy wskaźniki dotyczące odpadów dostarczone przez L. Girarda i F. Noccę. Nasza analiza wskazuje, że badane miasto nie znajduje się na ścieżce prowadzącej do przyjęcia modelu „miasta o obiegu zamkniętym". Jednak kontekst stałych odpadów komunalnych (MSW) oferuje cenne sugestie dotyczące przyszłego wdrażania praktyk gospodarki o obiegu zamkniętym (CE). Wyniki przedstawione w tym badaniu oferują istotne spostrzeżenia dla badaczy w innych krajach rozwijających się, którzy również są zaangażowani w badanie omawianych zagadnień. Ponadto wnioski wyciągnięte z tego badania mają znaczenie dla miast w krajach rozwijających się, ponieważ zmagają się one z degradacją środowiskową i gospodarczą podobnie jak badane miasto.

Słowa kluczowe:
gospodarka o obiegu zamkniętym, stałe odpady komunalne, gospodarka odpadami

JEL: Q01, Q53, O54

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Introduction

Municipal solid waste or MSW is a heterogenous (Hussieny et al., 2022; Mäkinen et al., 2019; Ndou & Rampedi, 2022; Siles-Castellano et al., 2021) subcategory of low liquid content waste, generated, collected, treated, transported or disposed of within the jurisdiction of a municipal authority (Periathamby, 2011; United Nations, 1997). Management of MSW is a part of Sustainable Development coverage which can contribute to sustain long-term growth and profitability in a competitive environment when value manifested by improving efficiency (Antonowicz & Jarzebowski, 2018; Noga et al., 2020).

The availability of scientific articles addressing the circular economy (CE) in Mexico is limited, with just over 50 articles identified in a quick review of the Scopus database from 2017 onwards. However, there is a noticeable increase in academic interest in this topic within the country, particularly since 2020. This presents a valuable opportunity for further research to be conducted in this area. Additionally, it is worth noting that there is currently no existing literature on the topic of CE specifically focused on the city of Xalapa, according to the Scopus database by the time of conducting this research.

The transition to a CE can yield a healthier urban environment and cities are in a prime position to help scale-up the circular economy. Additionally, the adoption of CE principles can lead to the creation of new jobs, new sources of income, cost savings, and reduced exposure to risk, with tangible advantages in terms of competitiveness (Enel Distribución Chile et al., 2023). Nonetheless, despite the recognized advantages, a research gap exists regarding the implementation and impact of CE principles within urban settings (Cavaleiro de Ferreira & Fuso-Nerini, 2019; Domenech & Borrion, 2022; Petit-Boix & Leipold, 2018; Vanhuyse et al., 2021). Therefore, further investigation is warranted to delve into the intricate dynamics of circular cities, enabling a comprehensive understanding of their potential and informing evidence-based strategies for their successful adoption.

The circular city is a metaphor for a new way of looking at the city and of organizing it which derives from CE. The idea is that in a city, linear processes can be at least partly replaced by circular processes and that long-term connections can be established between flows (Girard & Nocca, 2019; Kamińska, 2022; Ruimtevolk, 2015). These flows (i.e., people, food, waste) are at the basis of the city's metabolism that represents the engine for the functioning of the city and its economy (Girard & Nocca, 2019; Gravagnuolo et al., 2019; Ruimtevolk, 2015).

Some cities are defining themselves explicitly as circular city due their activities on CE and are starting to produce systematized reports on their strategies and indicators related to moving towards CE direction – i.e. Budapest, Freiburg, Genoa, Gent, Grenoble, Harlem, Hoje-Taastrup, Ljubljiana, Maribor, Marseille, Prague (Girard & Nocca, 2019; ICLEI Europe, 2022). The European Commission points out that developing and emerging countries face the same challenges as more developed economies to push CE but with less financial or institutional resources to overcome them (Langsdorf & Duin, 2022).

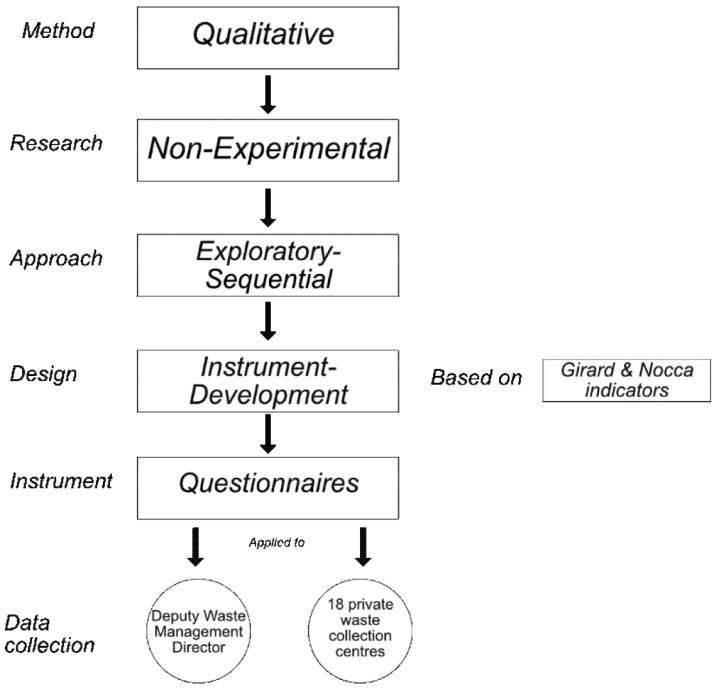
Xalapa, the main city of the state of Veracruz in Mexico, is facing environmental and economic degradation due a several problems related to MSW management (BID et al., 2014; Farfán, 2015; H. Ayuntamiento de Xalapa, 2019a; Topete, 2018). The Xalapa City Council and various national and international institutions, are making local investments in programs (Comunicación Social del H. Ayuntamiento de Xalapa, 2019) and infrastructure for the proper management of their waste (H. Ayuntamiento de Xalapa, 2019a) to contribute to change the habits of citizens and the implementation of new public policies for Xalapa (H. Ayuntamiento de Xalapa, 2018b).

Xalapa's scenario has not been widely researched using CE as a main subject, especially given the novelty of the concept in Mexico (Córdova Preciado et al., 2021; López Pérez et al., 2020; Munoz-Melendez et al., 2021). The situation of the city represents an opportunity to explore the implementation of the circular city model in a developing country context. Therefore, the goal of this work is to highlight the current state of Xalapa towards a circular city model using the information on MSW and based on the indicators of L. Girard and F. Nocca (2019). The hypothesis of this work states that Xalapa is not currently pursuing a circular city model.

Material and methods

This work is focused on the city of Xalapa, which is the capital of the state of Veracruz in Mexico. Its population is 457,928 inhabitants (Sistema de Información Municipal, 2016). According to the Xalapa City Council, the municipality generates three quarters of the solid waste in the region, collecting 95% of it, with approximately 84% being susceptible to recycling; of which, 34% are inorganic and 50% organic (H. Ayuntamiento de Xalapa, 2018a). In Xalapa, the public area in charge of the collection, transfer, recovery, separation, and use of urban solid waste is the sub-directorate of

Figure 1
Methodological path followed



Source: self-made based on: Edmonds & Kennedy, 2017.

Integral Management of Solid Waste (H. Ayuntamiento de Xalapa, 2019b), also known as GIRS (in Spanish), belonging to the City Hall of Xalapa.

This research was conducted during the period between 2019 and 2021 and it is of a mixed type (Edmonds & Kennedy, 2017). Given that semi-structured interviews allow the interviewers to ask each interviewee the same questions, while providing room to clarify and contextualize certain issues, we decided to use that approach (Walker et al., 2022). Also, we collected historical data about waste management by requesting it to the transparency platform of the Mexican government (Doyle et al., 2009). That information helped to fulfil de requirements of the indicators selected (Figure 1).

We obtained a database from the government to find the names and coordinates of the collection centers (INEGI, 2014; Lune & Berg, 2017). Then, the maps creation tool of Google Maps was used to geolocate them across the city (Figure 2). We used the quota sampling based on the activity of the private waste collection centers which was labeled by INEGI. Due the difficulties to access to all private waste collection centers, the refusal of most of the owners to provide information, and the outdated address catalog, out of the 54 private waste collection centers, we selected 18 based on their biggest facilities size and their availability to be interviewed (Table 1 and Figure 2). We addressed the owners of the collection centers for the interviews promising anonymity to avoid sanctions or organized crime actions.

A semi-structured interview was conducted with the Deputy Director of Waste Management of the city of Xalapa due his knowledge, expertise and his availability to provide relevant information and because he was the representative of the government area responsible for MSW during the period. A group of indicators related to MSW were selected from the paper of L. Girard and F. Nocca (2019). The indicators chosen mentioned waste management explicitly. These indicators were separated into three dimensions: environmental, economic-financial, and socio-cultural. Each indicator is listed in Table 2.

Two additional indicators were added due their importance for the municipal public administration (Universidad Veracruzana, 2019b): amount of waste collected by truck route and amount of waste collected by type. The questionnaire for the private waste collection center' owners was designed as a semi-structured interview to get information about their labor to fulfil the requirements of the indicators selected. The questionnaire had 8 questions related to the amount of waste collected by type, sale price, number of workers and

time this research was carried out, it was found that the concept of CE has not been adopted yet in Xalapa, therefore, the city is not in the path to transform into a circular city so far. There is a lack of favorable conditions provided by the municipal authorities to even approach CE. Xalapa and other cities in developing countries can benefit from the adoption of the CE as part of the philosophy of the environmental education departments of their councils, especially in developing countries since it is still in a nascent stage. The unification of approaches under the Government can facilitate the inclusion and participation of the private sector in the design, development, and application of circular strategies.

Due to the number of private waste collection centers that operate in the city, the volume of separation and the value of the materials, the analysis of the information collected suggests the existence of a potential market for separated waste. So, it is possible to attract future investors to continue the path towards circularity in the city. That situation highlights the potential of the private waste collection centers even though they operate with limited resources and no government support, which is common in developing countries. To take advantage of their potential market and their activity, it will be necessary to make periodic estimates on the value of the separated material and to update the database to include recently created ones and eliminate those that no longer exist. Also, the authorities must establish communication mechanisms with the owners of private waste collection centers, neighborhood leaders, and community centers to collect information periodically and provide support, advice, and training in economic and organizational matters.

Neither the state nor the local government have sufficient information on the characteristics and the state of use of the waste. Future research might be focused on quantifying the volume of waste, and finding ways to automate various processes. This is important since it allows, based on the composition and location of the waste, to determine the by-products of the waste that can be used or recovered, and which would be the most appropriate systems for it. The design of strategies to reduce the amount of waste in the city depends on the ability to measure adequately the waste that is produced, recovered, or turned into garbage and ends up in landfills.

This research was complicated firstly by the lack of official data to satisfy the indicators and secondly, by the absence of updated information about the private waste collection centers and the reluctance their owners to give information alleging security problems against organized crime. That situation that is common in developing countries cities, must be addressed with the council help because to transitioning to a circular city it is necessary to obtain information related to the number of workers, collection volume and specially, financial situation, since it is considered sensitive by the private waste collection centers owners, and it is difficult to obtain it through unofficial means. The issue of security is not explicitly considered as an aspect of interest in the CE literature consulted, therefore, future research could be focus on the violence phenomena in developing countries and its implications to CE.

Conclusions

The objective of the paper is to study the current state of Xalapa towards a circular city model by integrating the CE concept with MSW. The hypothesis suggests that Xalapa is not on the path towards a circular city model. Given the current situation in the city, it is possible to conclude that by the moment of this research was carried out, Xalapa is not pursuing a circular city model. CE has not been considered as an alternative by the Xalapa's Municipal Development Plan, so it has no impact in the government areas and in practice is null. To consider the adoption of CE in the future, it will be necessary to take steps considering the context of a city in a developing country.

First it is necessary to create the legal bases for the adoption of CE. The legislation consulted is focused on assigning responsibilities and endorsing them on waste management, however, it lacks a focus related to CE since it is not included in their plans up to now. For their part the private waste collection centers, particularly the personnel who work there, requires urgent attention and support from the authorities, since it is generally unhealthy and poorly regulated. In some cases, the partial appropriation of the street for their activities was observed, as well as the total absence of protective equipment and a notorious lack of organizational structure, for which reason government intervention is required, not to restrict their operation, since it is important for the city, but rather to support the adoption of appropriate equipment and practices.

We consider that it is necessary to thoroughly quantify the volume of waste by type, by route and by area. Also, it is important to automate various processes since the design of strategies to reduce the amount of waste produced in the city depends on it, as well such as, the amount of waste that is turned into garbage ending up in the sanitary landfill and the increase in the amount of reused waste.

The lack of official methods for collecting information periodically from the private waste collection centers makes the path towards circular city model. The intervention of the authorities can guarantee the security of the donor's information and serve to establish a support link. Similarly, it is important to update the database of collection centers and establish communication mechanisms with owners, neighborhood leaders and community centers by the councils, to periodically collect information and provide support, advice, and training in economic and organizational matters.

We identified the importance of carrying out periodic estimates on the value of the separated material and investigate the number of recycled products that are sold annually in the city and that come from local producers. This will provide an idea of the size of the market and will help to identify the most important players in this area to lay the foundations for future private sector investment. Also, it will be necessary to develop a training, advisory and consultancy program in the adoption of circular economy strategies as well as exhaustive measurement methods on the type of waste generated in the city, its flows, quantity, and potential value for the promotion and adoption of CE.

In Table 3, we provide a SWOT analysis of the waste management situation of the city considering the idea for a future adoption of a circular city model. We consider that portraying Xalapa's context in that way, can help other similar cities from developing countries to consider their own path towards CE based on their own waste management characteristics.

This study faced limitations that may affect the generalizability of the findings. First, accessing all the waste collection centers in the city was challenging due to their dispersed locations and restricted schedules. Second, the scope and depth of the research were constrained by the available time, financial resources, and personnel. Third, the case of Xalapa, a small city in Mexico, may not reflect the situation of other cities in developing countries with different social, economic, and environmental contexts. However, this study provides a valuable insight into the potential of circular economy practices for waste management in urban settings.

Further investigation into the dynamics of circular cities to enable a comprehensive understanding of their potential and inform evidence-based strategies for their successful adoption, especially in developing countries. Also, it would be valuable to research into the violence phenomena in developing countries and its implications for CE. We also suggest studies on the adoption of CE strategies on cities as well as measurement methods on the type of waste generated in cities, its flows, quantity, and potential value for the promotion and adoption of CE. Research about the estimations on the value of separated material and the number of recycled products sold annually in cities from local producers could be useful to provide an idea of market size and identify important players in this area to lay foundations for future private sector investment.

We believe that this paper can be useful for academics, practitioners, and policy makers. For the first, we think that this document provides a clarification about useful potential indicators to be used for CE measurement on cities based on MSW behavior. Also, this document highlights some of the challenges that researchers may face when conducting similar studies in their own context. For the second, it can help them to identify critical points on CE application on cities, especially in developing countries, and insights for potential application on their own businesses, especially on waste management sector. And for the last ones, this paper stresses the importance of unifying approaches under the authorities to facilitate the inclusion and participation of the private sector in the design, development, and application of circular strategies.

Notes/Przypisy

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Mgr Alejandro Guzmán Rivera

PhD student at Kozminski University, where he studies circular economy and supply chain efficiency. He has a master's degree in Organizations Management from Universidad Veracruzana, where he also completed a specialization in statistical methods. He has participated in several international seminars and congresses, where he presented his research on topics such as municipal solid waste management, competitiveness of SMEs, and business model analysis. He has also published his research in academic journals and magazines. He is proficient in various software tools for data analysis.

Mgr Alejandro Guzmán Rivera

Doktorant w Akademii Leona Koźmińskiego, gdzie zajmuje się gospodarką o obiegu zamkniętym oraz efektywnością łańcucha dostaw. Posiada stopień magistra z zarządzania organizacjami zdobyty na Universidad Veracruzana, gdzie ukończył również specjalizację z metod statystycznych. Uczestniczył w wielu międzynarodowych seminariach i kongresach, gdzie prezentował swoje badania na tematy związane z zarządzaniem odpadami komunalnymi, konkurencyjnością małych i średnich przedsiębiorstw oraz analizą modeli biznesowych. Publikował także swoje badania w czasopismach naukowych i magazynach branżowych. Posługuje się różnymi narzędziami oprogramowania do analizy danych.

Dr hab. Sebastian Jarzębowski, prof. ALK

Professor of economics and the director of the Center for Logistics and SCM at Kozminski University in Poland. Head of the Council of Supply Chain Management Professionals (CSCMP) in Poland and Research Fellow at Supply Chain Risk and Resilience Research (SCR3) Institute, University of Missouri – St. Louis. He has extensive experience in research and teaching in the fields of information technology in logistics, business process modeling and supply chain management. His research interests include enterprise efficiency, supply chain and logistics management. He has authored many publications, including international ones, and has received several scholarships and grants for his research projects. He has also been a visiting professor and a research fellow at leading universities in Australia, Austria, France, Germany, and the USA. Scholarship holder of the Deutscher Akademischer Austauschdienst (DAAD), the Schaumann Foundation and others. He was the coordinator of over 20 national and international projects, including: Horizon 2020, Interreg CE, POWER, POKL, RPO, FP7, NCN, NCBiR in the field of logistics and supply chains, in particular supply chain integration, digital transformation and purchasing management.

Dr hab. Sebastian Jarzębowski, prof. ALK

Profesor w Katedrze Ekonomii, Dyrektor Centrum Logistyki i SCM Akademii Leona Koźmińskiego, dyrektor Council of Supply Chain Management Professionals (CSCMP) w Polsce oraz pracownik naukowy Supply Chain Risk and Resilience Research (SCR3) Institute, University of Missouri – St. Louis. Posiada wieloletnie doświadczenie w działalności naukowej i dydaktycznej z zakresu technologii informacyjnych w logistyce, modelowaniu procesów biznesowych i zarządzaniu łańcuchem dostaw. Jego działalność naukowo-badawcza koncentruje się na efektywności przedsiębiorstw, zarządzaniu łańcuchem dostaw i logistyce. Jest autorem wielu publikacji, w tym międzynarodowych. Liczne zagraniczne pobyty naukowe na wiodących uniwersytetach w Australii, Austrii, Francji, Niemczech i Stanach Zjednoczonych. Stypendysta Deutscher Akademischer Austauschdienst (DAAD), Fundacji Schaumanna i innych. Był koordynatorem ponad 20 projektów krajowych i międzynarodowych, m.in. Horyzont 2020, Interreg CE, POWER, POKL, RPO, FP7, NCN, NCBiR z zakresu logistyki i łańcuchów dostaw, w szczególności integracji łańcucha dostaw, transformacji cyfrowej i zarządzania zakupami.

Mgr Katia Romero León

Full time Professor at the Universidad Veracruzana in Mexico. She holds a master's degree in Agricultural and Applied Economics from the University of Georgia and she is a candidate for PhD in Ecology at the Universidad Veracruzana. Her research focuses on consumer behaviour, environmental services valuation, and socio-environmental conflicts due to natural resources impacts. She has published several books and book chapters on topics such as poverty, human development, sustainability, energy, biodiversity, and chemical leasing.

Mgr Katia Romero León

Profesor na Universidad Veracruzana w Meksyku. Uzyskała tytuł magistra Rolnictwa i Ekonomii Stosowanej na University of Georgia, a obecnie ubiega się o stopień doktora w zakresie Ekologii na Universidad Veracruzana. Jej badania koncentrują się na zachowaniach konsumentów, wycenie usług środowiskowych oraz konfliktach społeczno-środowiskowych wynikających z wpływu na zasoby naturalne. Opublikowała kilka książek i rozdziałów w książkach na tematy związane z biedą, rozwojem człowieka, zrównoważonym rozwojem, energią, różnorodnością biologiczną oraz leasingiem chemicznym.

Prof. dr Michael Bourlakis

Professor and director of research at Cranfield School of Management, where he specializes in logistics, procurement, and supply chain management. He has extensive academic and industry experience in food, retail, and sustainable supply chains, and has won numerous research and consulting projects from various funding bodies and private companies. He has published over 250 publications, including 63 journal papers and 3 edited books, and serves on the editorial board of 15 journals. He is also an expert advisor, reviewer, and panel member for several national and international organisations, as well as a keynote speaker, external examiner and visiting professor at various universities. He is a recognised thought leader in logistics and supply chain management and has worked with most leading retailers in the world as well as multinational organisations.

Prof. dr Michael Bourlakis

Profesor i dyrektor ds. badań naukowych w Cranfield School of Management, gdzie specjalizuje się w logistyce, zaopatrzeniu i zarządzaniu łańcuchem dostaw. Posiada bogate doświadczenie akademickie i przemysłowe w obszarze łańcucha dostaw w sektorze spożywczym, handlowym oraz zrównoważonym łańcuchu dostaw. Wygrał liczne projekty badawcze i konsultingowe finansowane przez różne instytucje i prywatne firmy. Opublikował ponad 250 publikacji, w tym 63 artykuły w czasopismach naukowych i 3 redagowane książki, oraz zasiada w radach redakcyjnych 15 czasopism. Jest także ekspertem, recenzentem i członkiem panelu w kilku krajowych i międzynarodowych organizacjach, a także prelegentem na konferencjach, egzaminatorem zewnętrznym i profesorem wizytującym na różnych uniwersytetach. Jest uznawany za lidera opinii w zakresie logistyki i zarządzania łańcuchem dostaw, współpracował z większością wiodących detalistów na świecie, a także z wieloma międzynarodowymi organizacjami.

Redakcja naukowa Małgorzata Iwanicz-Drozdowska

UBEZPIECZENIA

Ubezpieczenia odgrywają coraz większą rolę w funkcjonowaniu zarówno przedsiębiorstw, jak i gospodarstw domowych. W książce – przygotowanej przez zespół autorów reprezentujących środowisko naukowe oraz praktykę ubezpieczeniową – przedstawiono podstawowe zagadnienia dotyczące ubezpieczeń. Omówiono w niej m.in. historię ubezpieczeń, podstawową terminologię i klasyfikację ubezpieczeń, regulacje prawne dotyczące działalności ubezpieczeniowej, nadzór nad sektorem ubezpieczeń, systemy gwarancyjne, zarządzanie finansami i działalność inwestycyjną zakładu ubezpieczeń. Wiele miejsca poświęcono ubezpieczeniom oferowanym zarówno przez sektor publiczny, jak i prywatny, w tym ubezpieczeniom emerytalnym, zdrowotnym, na życie, mienia, odpowiedzialności cywilnej, a także scharakteryzowano działalność reasekuracyjną. Podczas omawiania poszczególnych zagadnień Autorzy oparli się na obecnie obowiązującym stanie prawnym oraz uwzględnili zmiany, które zaszły w ubezpieczeniach w ostatnich latach. Książka jest przeznaczona dla studentów kierunków ekonomicznych, słuchaczy studiów podyplomowych, a także praktyków gospodarczych.

Więcej informacji na stronie www.pwe.com.pl