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Computational Science and Its Applications – ICCSA 2024 Workshops

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Preface

These 11 volumes (LNCS volumes 14815–14825) consist of the peer-reviewed papers from the 55 Workshops of the 2024 International Conference on Computational Science and Its Applications (ICCSA 2024) which took place during July 1–4, 2024 in Hanoi (Vietnam). The peer-reviewed papers of the main conference tracks are published in a separate set consisting of two volumes (LNCS 14813–14814).

The conference was held in a hybrid form, with some participants present in person, hosted in Hanoi, Vietnam, by the Thuy Loi University. We enabled virtual participation for those who were unable to attend the event, due to logistical, political and economic problems, by adopting a technological infrastructure based on open source software (jitsi + riot), and a commercial Cloud infrastructure.

ICCSA 2024 was another successful event in the International Conference on Computational Science and Its Applications (ICCSA) conference series, previously held in Athens, Greece (2023), Malaga, Spain (2022), Cagliari, Italy (hybrid with few participants in presence in 2021 and completely online in 2020), whilst earlier editions took place in Saint Petersburg, Russia (2019), Melbourne, Australia (2018), Trieste, Italy (2017), Beijing. China (2016), Banff, Canada (2015), Guimaraes, Portugal (2014), Ho Chi Minh City, Vietnam (2013), Salvador, Brazil (2012), Santander, Spain (2011), Fukuoka, Japan (2010), Suwon, South Korea (2009), Perugia, Italy (2008), Kuala Lumpur, Malaysia (2007), Glasgow, UK (2006), Singapore (2005), Assisi, Italy (2004), Montreal, Canada (2003), and (as ICCS) Amsterdam, The Netherlands (2002) and San Francisco, USA (2001).

Computational Science is the main pillar of most of the present research, industrial and commercial applications, and plays a unique role in exploiting ICT innovative technologies, and the ICCSA conference series have been providing a venue to researchers and industry practitioners to discuss new ideas, to share complex problems and their solutions, and to shape new trends in Computational Science. As the conference mirrors society from a scientific point of view, this year's undoubtedly dominant theme was the machine learning and artificial intelligence and their applications in the most diverse economic and industrial fields.

The ICCSA 2024 conference is structured in 6 general tracks covering the fields of computational science and its applications: Computational Methods, Algorithms and Scientific Applications – High Performance Computing and Networks – Geometric Modeling, Graphics and Visualization – Advanced and Emerging Applications – Information Systems and Technologies – Urban and Regional Planning. In addition, the conference consisted of 55 workshops, focusing on very topical issues of importance to science, technology and society: from new mathematical approaches for solving complex computational systems, to information and knowledge in the Internet of Things, new statistical and optimization methods, several Artificial Intelligence approaches, sustainability issues, smart cities and related technologies.

In the Workshops proceedings we accepted 281 full papers, 17 short papers and 2 PhD Showcase papers. In the Main Conference Proceedings we accepted 53 full papers, 6 short papers and 3 PhD Showcase papers from 207 submissions to the General Tracks of the conference (acceptance rate 30%). We would like to express our appreciation to the workshops chairs and co-chairs for their hard work and dedication.

The success of the ICCSA conference series in general, and of ICCSA 2024 in particular, vitally depends on the support of many people: authors, presenters, participants, keynote speakers, workshop chairs, session chairs, organizing committee members, student volunteers, Program Committee members, Advisory Committee members, International Liaison chairs, reviewers and others in various roles. We take this opportunity to wholehartedly thank them all.

We also wish to thank our publisher, Springer, for their acceptance to publish the proceedings, for sponsoring part of the best papers awards and for their kind assistance and cooperation during the editing process.

We cordially invite you to visit the ICCSA website https://iccsa.org where you can find all the relevant information about this interesting and exciting event.

July 2024

Osvaldo Gervasi
Beniamino Murgante
Chiara Garau

Welcome Message from Organizers

After the very hard times of COVID, ICCSA continues its successful scientific endeavors in 2024, hosted in Hanoi, Vietnam. This time, ICCSA moved from the Mediterranean Region to Southeast Asia and was held in the metropolitan city of Hanoi, the capital of Vietnam. Hanoi is a vibrant urban environment known for the hospitality of its citizens, its rich history, vibrant culture, and dynamic urban life. Located in the northern part of the country, Hanoi is a bustling metropolis that combines the old with the new, offering a unique blend of ancient traditions and modern development.

ICCSA 2024 took place in a secure environment, allowing for safe and vibrant in-person participation. Combined with the active engagement of the ICCSA 2024 scientific community, this set the stage for highly motivating discussions and interactions regarding the latest developments in computer science and its applications in the real world for improving communities' quality of life.

Thuyloi University, also known as the Water Resources University, is a prominent institution in Hanoi, Vietnam, with a strong reputation in engineering and technical education, particularly in water resources and environmental engineering. In recent years, the University has expanded its academic offerings to include computer science, reflecting the growing importance of technology and digital skills in all sectors. This year, Thuyloi University had the honor of hosting ICCSA 2024. The Local Organizing Committee felt the burden and responsibility of such a demanding task and put all necessary energy into meeting participants' expectations and establishing a friendly, creative, and inspiring scientific and social/cultural environment that allowed for new ideas and perspectives to flourish.

Since all ICCSA participants, whether informatics-oriented or application-driven, realize the tremendous advancements in computer science over the last few decades and the huge potential these advancements offer in coping with the enormous challenges of humanity in a globalized, 'wired,' and highly competitive world, the expectations for ICCSA 2024 were high. The goal was to successfully match computer science progress with communities' aspirations, achieving progress that serves real, place- and people-based needs and paves the way towards a visionary, smart, sustainable, resilient, and inclusive future for both current and future generations.

On behalf of the Local Organizing Committee, I would like to sincerely thank all of you who contributed to ICCSA 2024.

Nguyen Canh Thai

Organization

ICCSA 2024 was organized by Thuyloi University (Vietnam), the University of Perugia (Italy), the University of Basilicata (Italy), Monash University (Australia), Kyushu Sangyo University (Japan), the University of Minho (Portugal), and the University of Cagliari (Italy).

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Econometrics and Multidimensional Evaluation of Urban Environment (EMEUE 2024)

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Environmental, Social, Governance of Energy Planning (ESGEP 2024)

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Ecosystem Services in Spatial Planning for Resilient Urban and Rural Areas (ESSP 2024)

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Ethical AI Applications for a Human-Centered Cyber Society (EthicAI 2024)

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14th International Workshop on Future Computing System Technologies and Applications (FiSTA 2024)

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Geographical Analysis, Urban Modeling, Spatial Statistics (Geog-An-Mod 2024)

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Geomatics for Resource Monitoring and Management (GRMM 2024)

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International Workshop on Information and Knowledge in the Internet of Things (IKIT 2024)

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Regenerating Brownfields Enhancing Urban Resilience Appeal (INFERENCE 2024)

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International Workshop on Territorial Planning to Integrate Risk and Urban Ontologies (IWPRO 2024)

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MaaS Solutions for Airports, Cities and Regional Connectivity (MaaS 2024)

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Development of Urban Mobility Management and Risk Assessment (MAINTAIN 2024)

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Multidimensional Evolutionary Evaluations for Transformative Approaches (MEETA 2024)

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Building Multi-dimensional Models for Assessing Complex Environmental Systems (MES 2024)

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Models and Indicators for Assessing and Measuring the Urban Settlement Development in the View of Zero Net Land Take by 2050 (MOVEto0 2024)

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Carmen Guida	University of Naples Federico II, Italy
Chiara Di Dato	University of L'Aquila, Italy

4th Workshop on Privacy in the Cloud/Edge/IoT World (PCEIoT 2024)

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Scientific Computing Infrastructure (SCI 2024)

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Alexander Bogdanov	St. Petersburg State University, Russia
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Downscale Agenda 2030 (SDGscale 2024)

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Socio-Economic and Environmental Models for Land Use Management (SEMLUM 2024)

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Paola Amoruso	LUM, Italy

Ports of the Future - Smartness and Sustainability (SmartPorts 2024)

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Marco Petrelli	Roma Tre University, Italy

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Massimiliano Bencardino	University of Salerno, Italy

Smart Transport and Logistics - Smart Supply Chains (SmarTransLog 2024)

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Smart Tourism (SmartTourism 2024)

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Sustainable Evolution of Long-Distance Freight Passenger Transport (SOLIDEST 2024)

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Sustainability Performance Assessment: Models, Approaches, and Applications Toward Interdisciplinary and Integrated Solutions (SPA 2024)

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Francesca Perrone	Sapienza University of Rome, Italy
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Specifics of Smart Cities Development in Europe (SPEED 2024)

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Venue

ICCSA 2024 took place on the main campus of Thuyloi University in Hanoi, Vietnam.

Plenary Lectures

Harnessing Artificial Intelligence for Enhanced Spatial Analysis of Natural Hazard Assessments

Prof. Dr. Biswajeet Pradhan

Director - Centre for Advanced Modelling and Geospatial Information Systems (CAMGIS), School of Civil and Environmental Engineering, Faculty of Engineering and IT, University of Technology Sydney, Australia

Abstract. In the realm of natural hazard assessments within spatial domains, the advent of Artificial Intelligence (AI) represents a paradigm shift, revolutionizing the way we conceptualize, model, and interpret environmental risks. This keynote address illuminates the profound impact of AI technologies, particularly machine learning algorithms and data-driven approaches, in reshaping our understanding and prediction capabilities concerning natural disasters.

By assimilating and scrutinizing vast spatial datasets, AI-driven models offer unparalleled accuracy and efficiency, facilitating timely and precise hazard assessments. Real-time processing of geospatial information not only enables rapid predictions but also forms the cornerstone of proactive disaster management strategies. Furthermore, AI's capacity lies in its adeptness at deciphering intricate spatial patterns inherent to natural hazards, unraveling subtle cues and previously unnoticed correlations within the data fabric.

This keynote delves into how AI's nuanced interpretation, coupled with advanced algorithms, elevates hazard modeling, providing deeper insights into the spatial dynamics of environmental risks. By augmenting traditional methodologies and revealing hidden patterns, AI fosters comprehensive risk assessments, fostering informed decision-making processes. The fusion of AI and natural hazard assessments in spatial domains heralds a more resilient approach to disaster preparedness and response.

Join us in embracing this transformative era, where AI's sophisticated modeling techniques and precise spatial interpretations converge, heralding proactive and effective mitigation strategies amidst the ever-evolving landscape of environmental challenges.

Short Bio. Distinguished Professor Dr. Biswajeet Pradhan is an internationally established scientist in the field of Geospatial Information Systems (GIS), remote sensing and image processing, complex modelling/geo-computing, machine learning and soft-computing applications, natural hazards and environmental modelling. He is the Director of the Centre for Advanced Modelling and Geospatial Information Systems (CAMGIS) at the Faculty of Engineering and IT at the University of Technology, Sydney (Australia). He was listed as the World's Most Highly Cited Researcher by the Clarivate Analytics Report for five consecutive years, 2016–2020, as one of the world's most influential minds.

He ranked number one (1) in the field of "Geological & Geomatics Engineering" during the calendar year 2021–2023, according to the list published by Stanford University Researchers, USA. This list ranks the world's top 2% most highly cited researchers based on Scopus data. In 2018–2020, he was awarded as World Class Professor by the Ministry of Research, Technology and Higher Education, Indonesia. He is a recipient of the Alexander von Humboldt Research Fellowship from Germany. Between 2015–2021, he served as "Ambassador Scientist" for the Alexander Humboldt Foundation, Germany.

Professor Pradhan has received 58 awards since 2006 in recognition of his excellence in teaching, service and research. Out of his more than 850 articles (Google Scholar citation: 70,000, H-index: 129), more than 750 have been published in science citation index (SCI/SCIE) technical journals. He has authored/co-authored ten books and thirteen book chapters.

Software Engineering Research in a New Situation

Prof. Carl K. Chang

Professor Emeritus, Iowa State University, USA

Abstract. With the rise of Generative Artificial Intelligence (GAI), epitomized by Large Language Models (LLMs), a profound shift has unfolded in software engineering research. In this presentation, I will traverse my four-decade journey in software engineering research, focusing on situational awareness in the era of the Internet of Things (IoT). I have witnessed the turbulence brought forth by the AI community that demands changes in our approaches. Meanwhile, owing to the pervasiveness of services computing, services became the first-class citizen in modern-day software engineering methodologies.

I argue that situational awareness must permeate the entire lifecycle to consistently deliver software services that align with the dynamic needs of users and the ever-evolving environments. I will elucidate this argument by reviewing the Situ framework, offering a comprehensive illustration of my perspective. Furthermore, I will outline my vision regarding the formidable research challenges considering the rapidly shifting landscape dominated by an irresistible and profoundly disruptive generative AI tsunami.

Short Bio. Carl K. Chang is a former department chair and Professor Emeritus of Computer Science at Iowa State University. His research interests include requirements engineering, net-centric computing, situational software engineering and digital health. Chang was the 2004 President of the IEEE Computer Society. Previously he served as the Editor-in-Chief for IEEE Software (1991–1994), and as the Editor-in-Chief of IEEE Computer (2007–2010). He was the 2012 recipient of the Richard E. Merwin Medal from the IEEE Computer Society. Chang is a Life Fellow of IEEE, a Fellow of AAAS, and a Life Member of the European Academy of Sciences (EurASc).

Interpretability and Privacy Preservation in Large Language Models (LLMs)

Prof. My Thai

University of Florida (UF) Research Foundation Professor
Associate Director of UF Nelms Institute for the Connected World

Abstract. Large Language Models (LLMs) have transformed the AI landscape, captivating researchers and practitioners with their remarkable ability to generate human-like text and perform complex tasks. However, this transformative power comes with a set of critical challenges, particularly in the realms of interpretability and privacy preservation. In this keynote, we embark on an exploration of these pressing issues, shedding light on how LLMs operate, their limitations, and the strategies we can employ to mitigate risks. We begin by examining the interpretability in LLMs, which often function as enigmatic "black boxes." Their complex neural architectures make it challenging to understand how they arrive at specific outputs. This lack of transparency raises questions of trust and accountability. When deploying LLMs in real-world applications—whether for chatbots, content generation, or decision-making—it becomes crucial to demystify their decision paths.

We will use explainable AI (XAI) to offer faithful explanations, from the black-box to white-box models, and from feature-based [1, 2] to neuron circuits-based [3, 4] explanations. By visualizing attention mechanisms, feature importance, and saliency maps, we empower users to comprehend LLM predictions. XAI not only fosters trust but also encourages responsible utilization of LLMs.

We next turn our attention to one of the utmost concerns and challenges: data privacy. LLMs process vast amounts of data, raising risks of data leakage, model inversion, the right to be forgotten, and inadvertent exposure of sensitive information. Furthermore, the integration of LLMs into diverse applications also significantly brings these challenges to the next level [5]. This talk explores strategies to protect privacy, including differential privacy, federated learning, and data encryption.

Short Bio. My T. Thai is a University of Florida (UF) Research Foundation Professor, Associate Director of UF Nelms Institute for the Connected World, and a Fellow of IEEE and AAIA. Dr. Thai is a leading authority who has done transformative research in Trustworthy AI and Optimization, especially for complex systems with applications to healthcare, social media, critical networking infrastructure, and cybersecurity. The results of her work have led to 7 books and 350+ publications in highly ranked international journals and conferences, including several best paper awards from the IEEE, ACM, and AAAI.

In responding to a world-wide call for responsible and safe AI, Dr. Thai is a pioneer in designing deep explanations for black-box ML models, while defending against explanation-guided attacks, evident by her Distinguished Papers Award at the Association for the Advancement of Artificial Intelligence (AAAI) conference in 2023. At the same year, she was also awarded an ACM Web Science Trust Test-of-Time award, for her landmark work on combating misinformation in social media. In 2022, she received an IEEE Big Data Security Women of Achievement Award. In 2009, she was awarded the Young Investigator (YIP) from the Defense Threat Reduction Agency (DTRA), and in 2010 she won the NSF CAREER Award. She is presently the Editor-in-Chief of the Springer Journal of Combinatorial Optimization and the IET Blockchain Journal, and editor of the Springer book series Optimization and Its Applications.

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Contents – Part VIII

A Systematic Analysis of the Scientific Literature on the Relationships Between Urban Redevelopment Initiatives and Property Market Dynamics

Francesco Tajani[1], Pierluigi Morano[2], Felicia Di Liddo[2], and Federico Stara[1](✉)

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[2] Department of Civil, Environmental, Land, Building Engineering and Chemistry (DICATECh), Polytechnic University of Bari, 70126 Bari, Italy

Abstract. The present research concerns the relevant and current issue of the urban regeneration. In particular, a systematic literature review on fifty contributions focused on the investigation of the relationships between the definition of urban redevelopment initiatives and the property market dynamics is carried out. The mentioned relationship is analyzed by taking into account both (i) the effects that the interventions on the territory determine on the real estate mechanisms, in terms of variation in the real estate values and dynamism of the supply and demand and (ii) the modalities in which the market trends (volume of transactions, prices, rents, average sales times, supply and demand) influence the urban transformation processes. The study is part of a wider research line and intends to provide an intermediate step of the analysis of the consistent relevant literature focused on the double perspective in which the link between the projects on the territories and the property market dynamics can be dealt with.

Keywords: redevelopment projects · sustainable development goals · property prices · real estate market

1 Introduction

Within the cities governance processes, the urban regeneration policies constitute an important strategy aimed at the transformation and development of the territories. In general terms, starting from the needs of the community, the operations of the real estate enhancement and renovation of public spaces determine positive effects in attracting new activities and investments and generate benefits in terms of urban quality improvement.

The implications of the urban transformation on the real estate market are closely linked to the activation of an integrated economic layout capable of promoting the launch of actions related to sectors that are different than the construction one (mobility, infrastructures, public services, tertiary sector, production) [1] in a more holistic vision of the city system and its components.

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In this sense, if appropriately oriented and carried out, the urban redevelopment initiatives allow the definition of effective and participatory relationships among politics - the main place for decisions -, and urban, territorial and landscape planning, aimed at the successful relaunch of the territory in the perspective of the three sustainability (environmental, social and economic) pillars [2–4].

Therefore, any strategic action that involves the local communities cannot be correctly developed if the effects that the project could determine in the various fields are not *a priori* analysed. Among the affected economic sectors, the real estate sector assumes a fundamental role as it is a proxy variable of the appreciation of potential buyers and investors for the existing building stock near to the urban pole (building or public space) to be redeveloped. Similarly, with reference to the time before the redevelopment, the presence of degraded/derelict areas within a city has negative effects on the real estate market, decreasing (i) the demand for neighbouring properties both for leasing and purchase and, consequently, (ii) the market values.

In the mentioned framework, the presence of abandoned areas or disused properties makes it necessary for actions (even in a sufficiently short time) by the local authorities aimed at preventing that the negative effects due these existence can be reflected in the medium-long term for the community and that the real estate market could be significantly affected in terms of a collapse in the number of transactions and real estate prices. In theoretical terms, the urban regeneration interventions allow to renewal the image of the portion of the city undergoing transformation [5], by reducing the number of empty and underused real estate units which, in turn, potentially generate negative impacts on the property asset value related to the main risks associated to the progressive degradation of the considered the area.

The presence of abandoned properties and/or areas is, in fact, strictly associated with the phenomena of urban decay and criminality and the real estate/urban redevelopment projects favour the short-term growth of jobs connected to the urban recovery project which normally require a wide set of diversified skills and the inclusion of new workforces in the economic activities to be introduced [6]. In the real estate market, the trend of selling and rental prices is significantly influenced by the specificities of the urban area in which the property is located and the possible existence of close disamenities has negative impacts on the market demand for the area which, as mentioned, is reflected in the market values. The lower rents or prices that characterize the properties located in the proximity to the damaged territories (for which urge and relevant rehabilitation projects are needed) represent a direct economic cost borne by some communities which could be avoided through targeted intervention policies of governments or local entities.

It should be highlighted that, beyond the collective and potential investor's interest in intervening on urban territories with specific and effective recovery initiatives, a direct economic advantage for all properties owners in the neighbouring areas in supporting redevelopment initiatives is attested. This benefit firstly translates into an increase in their market values [7, 8]. Among the economic effects of the degraded and abandoned areas presence, those related to the (longer or shorter) time period required for the property lease or sale should be included: these could be different compared to other areas of the city and, consequently, could lead not only to losses linked to the lower unit rent and

price, but also to a higher risk due to the lack of attractiveness of the area which causes more extended negotiation times and, very often, subsequent asking prices decrease.

The existing relationship between the implementation of initiatives aimed at recovering underused assets and/or degraded sites and the realization of the opportunities connected to such operations, in terms of increasing urban prosperity and quality of life, is part of a more complex process in which the advantages for all interested parties (public entities, private investors, local communities, etc.) are numerous. The outcomes of effective territorial transformation strategies translate, first of all, into preventing the trigger or continuation of urban tissue deterioration, by improving the physical, economic and social infrastructures, generating new jobs, increasing the market value of near properties (especially residential and commercial).

2 Aim

In recent decades, the relevance assumed by the urban planning based on the programming of targeted interventions to be implemented in the territory is increasingly central.

Urban redevelopment inevitably determines a redefinition of the market values of the properties located in the area in which the transformation initiative is carried out. The benefits deriving from the realization of urban development projects, in fact, do not "only" concern the increase of the life quality of the citizens, but also the properties enhancement in the redeveloped territory. In this sense, the regeneration determines a significant economic impact on the surrounding building tissue and on the new area potentialities and, in light of the possible territorial changes that can be triggered through the planned redevelopment projects, the projection of the future market unitary prices aims of analyzing the effects on the existing assets values.

The urban policies that guide the existing city transformation and the evaluation tools are essential for a valid *ex ante* analysis of the likely impacts that the redevelopment could have on the dynamics of the reference real estate market.

Therefore, among the different strategies for renovating the public and private property stocks, the examination of the local market trends (existing demand and current and forecast supply) constitutes a fundamental phase to support the choice processes.

In the outlined context, the present research intends to provide a systematic literature review on fifty academic contributions focused on the investigation of the relationships between the definition of urban redevelopment initiatives and the property market dynamics. The literature on the topic is particularly widespread and these fifty contributions represent a first selection of all the existing studies: for this reason, they do not intend to constitute an exhaustive framework on the topic, but a first analysis of what has already been carried out. In particular, in the work this relationship is studied taking into account both (i) the effects that the initiatives on the territory determine on the real estate mechanisms, in terms of variation in the real estate values and dynamism of the supply and the demand and (ii) the modalities in which the market trends (volume of transactions, prices, rents, average sales times, supply and demand) influence the urban transformation processes.

In Fig. 1 the two main perspectives explained in the relationship between the market and the urban redevelopment are shown and the double linkage that is established

between them in terms of cause and effect is highlighted by the double direction of the introduced arrow.

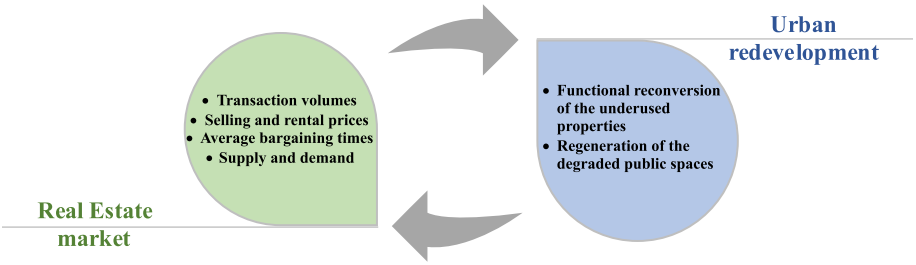

Fig. 1. The double relationship between the urban regeneration initiatives and the property market dynamics

The existing reference literature is mainly focalized on the first aspect described (analysis of the impacts deriving from the implementation of urban interventions on the real estate market) and aims to provide a valid support for decision-making processes, since the increase in the property asset values is included among the benefits associated with the development of such initiatives. In this sense, different Authors have carried out e*x ante* and *ex post* evaluations on the possible (in the situation of a preliminary assessment with the intervention that is not yet implemented) or already obtained (in the situation of an *ex post* evaluation with the intervention that is concluded) implications that the urban renewal project generates on the local real estate market [9–13]. With reference to different geographical contexts and time periods, the main purpose of the scientific contributions belonging to this research line concerns the definition of evaluation models capable of examining the market effects connected to the execution of real estate and/or urban enhancement initiatives in order to address the local government policies. In general terms, it is known that an urban transformation strategy (appropriately developed starting from the analysis of the framework of the community needs and following the verification of the financial and economic feasibility of the project) produces an increase in the urban quality of the area in which the project is implemented and, thus, a positive variation in the property values. The direct relationship that associates the raising of the quality conditions of the place, consequent to any redevelopment project on an urban scale, and the increase in the values of the property stock represents a crucial and widely studied in the literature issue.

The same relationship between the urban redevelopment and the dynamics of the real estate market in the opposite direction (aimed, therefore, at verifying how the specificities of the market affect the transformation operations to be carried out in the territory) is explored in targeted studies of the reference literature [14–16].

In particular, starting from the examination of the market trends (analysis of the supply and demand and the average market values), the decision-making processes related to the urban redevelopment can be guided by the local market mechanisms. In this sense, in the present review a set of papers that intend to evaluate whether and to what extent the market dynamics orient the urban planning choices are explained and

studied. From this perspective, the analyzes focused on the examination of the linkage between the market trends and the local renovation initiatives to be carried out, are part of the broader context of the scientific researches aimed at providing effective tools to support the public administrations and the potential investors towards aware and profitable choices. In fact, the identification of the aforementioned relationship should be included among the operations for the *ex ante* evaluation of the sustainability of the interventions in order to validate or refute the investment choices. It should also be pointed out that from the first phases of defining the project solution, the analysis of the current and forecast market supply and demand constitutes a fundamental step for the continuation of the subsequent levels of planning and of the following intervention realization. This demonstrates the importance assumed by the examination of the existing market conditions in the urban area in which the project is located and, from a broader perspective, of the city in order to (i) select the intended uses that are most suitable to the current needs and requests of the local community, (ii) possibly, move the area in which to operate to other ones in which the market dynamics are more adequate to the set purposes.

Therefore, the goal of present research regards the (not exhaustive) recognition of the literature focused on the illustrated topic, by distinguishing the studies that analyze the explicit relationship in one perspective (effects of redevelopment on the dynamics of the real estate market) and those that delve into the same issue but in the opposite sense (impacts of the real estate mechanisms on the redevelopment choices), with different purposes and practical implications. From the first screening of the researches on the topic, its relevance has clearly emerged and it will be further explored through the increase of the set of papers.

To successfully achieve the fixed literature review's targets (that in the current form constitutes an intermediate step of an in progress research aimed at providing a comprehensive and wider framework of the scientific contributions on the topic), this work is articulated as follows. In the third section the method carried out for identifying the papers to be included in the collection is briefly illustrated. In the fourth section the analysis of the records included in the review is developed in order to summarize the most relevant outputs and to highlight the main focuses. In the fifth section, the conclusions of the work are discussed.

3 The Methodology Adopted for the Literature Review Development

To effectively carry out the systematic analysis of scientific literature papers on the already introduced topic, the first phase of the implemented methodology concerns the definition of targeted keywords and combinations of them, to be included in the main databases for the selection of records consistent with the focus. In particular, the identification and selection of contributions has been carried out on the Scopus, Web of Science and Google Scholar databases by entering the following keywords: (i) urban requalification, (ii) urban transformation projects, (iii) interventions on territory, (iv) real estate market, (v) properties prices, (vi) rental prices, (vii) residential market dynamics, (viii) real estate trends, (ix) relationships between market and redevelopment.

Starting from the obtained multiple records, the detection of the most adequate ones has been performed, by taking into account the consistence with the objectives of the present analysis, the availability of the open access text and the language of the selected contributions, thus excluding those whose topic is not consistent with the aspects strictly connected to the explored focus, and those not available and written in a language other than English. From the selection carried out according to the chosen exclusion criteria, fifty papers have been definitively collected and subsequently analysed, in order to investigate the issues analyzed by each work, to identify the goal, to highlight any points of contact and differences in terms of obtained outputs.

The methodology used for the collection of scientific contributions has allowed to provide a (non-exhaustive) framework of fifty papers focused on the analysis of the existing relationships between urban redevelopment and the dynamics of the property market, in terms of (i) effects generated by the implementation of intervention on market mechanisms or, vice versa, (ii) influence determined by the local market trends on the urban planning choices.

It should be highlighted once again that the present work is part of a wider research (currently *in itinere*) that intends to examine the topic in a more detailed way: in this sense, this study represents an intermediate step of a broader analysis.

With reference to the set goals, in Table 1 an overview of the fifty papers collected in the present review is provided: according to the chronological order of the references, the year of publication and the geographical context of analysis (if expressly declared) of each record are included in the second and third columns, and the studied relationship (among the two previously explained) based on the goal of each research is reported in the fourth column.

Table 1. Analysis of the selected records

No.	Year of publication	Context of analysis	Analyzed perspective
[17]	1992	USA	Real Estate market -> Urban redevelopment
[18]	1994	Newcastle upon Tyne, England	Urban redevelopment -> Real Estate market
[19]	1999	Pacific Rim Cities	Real Estate market -> Urban redevelopment
[20]	2001	Undefined	Real Estate market -> Urban redevelopment
[21]	2002	China	Urban redevelopment -> Real Estate market
[22]	2002	China	Real Estate market -> Urban redevelopment
[23]	2003	Singapore	Urban redevelopment -> Real Estate market

(*continued*)

Table 1. (*continued*)

No.	Year of publication	Context of analysis	Analyzed perspective
[24]	2003	Beijing, China	Real Estate market -> Urban redevelopment
[25]	2005	Hong Kong, China	Real Estate market -> Urban redevelopment
[26]	2005	Athens, Greece - Bratislava, Slovakia - Brussels, Belgium - Helsinki, Finland - Lyon, France - Madrid, Spain - Manchester, England - Newcastle upon Tyne, England - Stuttgart, Germany - Valencia, Spain - Vienna, Austria and Zurich, Switzerland	Urban redevelopment -> Real Estate market
[27]	2009	Milwaukee, Wisconsin - USA e Minneapolis, Minnesota - USA	Urban redevelopment -> Real Estate market
[28]	2011	Norway	Real Estate market -> Urban redevelopment
[29]	2011	Undefined	Urban redevelopment -> Real Estate market
[30]	2011	Hong Kong, China	Urban redevelopment -> Real Estate market
[31]	2013	China	Real Estate market -> Urban redevelopment
[32]	2013	Undefined	Real Estate market -> Urban redevelopment
[33]	2014	Reggio Calabria, Italy	Real Estate market -> Urban redevelopment
[34]	2015	Italy	Real Estate market -> Urban redevelopment
[35]	2015	Italy	Real Estate market -> Urban redevelopment
[36]	2016	Milan, Italy	Real Estate market -> Urban redevelopment
[37]	2016	Kalisz, Poland	Urban redevelopment -> Real Estate market
[38]	2016	Undefined	Real Estate market -> Urban redevelopment
[39]	2017	Taipei, Taiwan	Urban redevelopment -> Real Estate market

(*continued*)

Table 1. (*continued*)

No.	Year of publication	Context of analysis	Analyzed perspective
[40]	2017	Oslo, Norway	Urban redevelopment -> Real Estate market
[41]	2017	Krakow, Poland	Real Estate market -> Urban redevelopment
[42]	2017	Shenzhen, China	Urban redevelopment -> Real Estate market
[43]	2017	Konya, Turkey	Real Estate market -> Urban redevelopment
[44]	2018	Sydney, Australia	Real Estate market -> Urban redevelopment
[45]	2018	Hong Kong, China	Urban redevelopment -> Real Estate market
[46]	2018	Milan, Italy	Real Estate market -> Urban redevelopment
[47]	2018	North of Italy	Real Estate market -> Urban redevelopment
[48]	2019	Naples, Italy	Real Estate market -> Urban redevelopment
[49]	2019	Tehran, Iran	Real Estate market -> Urban redevelopment
[50]	2020	Osun, Nigeria	Urban redevelopment -> Real Estate market
[51]	2020	Milan, Turin, Padua, Novara, Udine (Italy)	Real Estate market -> Urban redevelopment
[52]	2020	Naples, Italy	Real Estate market -> Urban redevelopment
[53]	2020	China	Real Estate market -> Urban redevelopment
[54]	2020	Reggio Calabria, Italy	Real Estate market -> Urban redevelopment
[55]	2020	Bari, Italy	Urban redevelopment -> Real Estate market
[56]	2020	Copenhagen, Denmark and Hamburg, Germany	Urban redevelopment -> Real Estate market
[57]	2020	Porto, Portugal and Brescia, Italy	Urban redevelopment -> Real Estate market

(*continued*)

Table 1. (*continued*)

No.	Year of publication	Context of analysis	Analyzed perspective
[58]	2020	Trento, Italy	Real Estate market -> Urban redevelopment
[59]	2021	Poznań, Poland	Urban redevelopment -> Real Estate market
[60]	2021	Singapore	Urban redevelopment -> Real Estate market
[61]	2022	England	Real Estate market -> Urban redevelopment
[62]	2022	Buenos Aires, Argentina	Real Estate market -> Urban redevelopment
[63]	2022	China	Real Estate market -> Urban redevelopment
[64]	2023	Connecticut, USA	Real Estate market -> Urban redevelopment
[65]	2024	Hong Kong, China	Urban redevelopment -> Real Estate market
[66]	2024	Delhi, India	Urban redevelopment -> Real Estate market

4 Results of the Records Analysis

The effects that the urban regeneration can generate on the property market are multiple and can translate into positive or negative results. The redevelopment of degraded or abandoned urban tissues or buildings through targeted interventions can – *inter alia* – determine significant changes in the selling or rental prices of the properties located in the surrounding areas, with the consequent variations in the market demand and supply.

In this regard, the scientific literature is full of relevant contributions that aim to demonstrate and examine the existing relationship between the urban redevelopment and the real estate market dynamics. By analysing this relationship, the publications are focused on several aspects of the overall topic, also based on the different case studies for which the mentioned link is studied.

For example, Healey in 1994 [18] has investigated the impact of the public policy on the real estate development in an old industrial urban area of Tyne and Wear (in the North East of England) and the connected effects on the main trends of the specific sector. Furthermore, the Author has underlined the importance of understanding a priori the specificities of the local real estate development for the effective design and the evaluation of public governance strategies aimed at its strengthening and improving.

The implications of the urban redevelopment implemented with both public and private funds on the residential market segments in [27] have been dealt with by De Sousa et al. and by Ki and Jayantha [29], with the purpose to assess the variations on housing prices after the examined interventions.

Through the application of mathematical models and the use of technological tools such as Geographic Information Systems (GIS), Tiboni et al. [57] have defined a methodology for analyzing the effects of urban regeneration in historic centres, able to provide a useful tool for public subjects as promoters of redevelopment initiatives.

Similarly, Jayantha and Yung [45] have explored the consequences derived from the enhancement of historic buildings on the values of commercial properties located in the immediate proximity of the renovated sites.

The use of the Quantile Regression technique has allowed to assess the direction and strength of the impact of the urban renewal processes on the housing market mechanisms in terms of prices changes in the secondary residential market in downtown of Poznań (Poland), in order to analyse the redistribution of the implications on the specific market [59].

According to Gospodini [26], however, the discussion also concerns the potential of the urban transport infrastructures (such as subways, regional railways and tram) realization, that can indirectly act as a catalyst for the regeneration of degraded areas. The focus is, then, more recently reiterated in the research carried out by Agnihotri and Paul [66], in which the relationship between metropolitan rail connectivity and housing prices in Dehli has been studied. A direct spatiotemporal influence on the residential values in the surrounding areas has been found, by assessing the average annual price shift for apartments around metro stations from 2010 to 2019.

By analyzing the specific case of Singapore, Dell'Anna et al. [60] have identified the close correlation between the urban infrastructural development and the real estate market.

The economic policies of the local public administrations have often affected the planning of the redevelopment interventions. Bruns-Berentelg et al. [56] have dealt with the regeneration processes implemented since the 1990s in the cities of Copenhagen (Denmark) and Hamburg (Germany). While the objective of the Danish administration pursued in the redevelopment of its Ørestad and port districts was to finance a mass transport system at city level and, therefore, to improve competitiveness through the development of infrastructure, that of the German town is was to use the redevelopment of HafenCity's waterfront to increase competitiveness through port modernization.

In addition, Yau [30] has explained how the urban redevelopment may be responsible for the gentrification of neighbourhoods due to the resulting increase in property prices and rents near redeveloped sites. The same topic has been then explored in depth by Liu et al. [42] through the exam of the causes and consequences of redevelopment-induced indirect displacement. The Authors have investigated the chain effects of price-shadowing in Shenzhen (China), by concluding that the urban regeneration exhibits strong impacts on adjacent housing prices by creating property hotspots and bringing about changes in the market mechanisms.

By reversing the perspective and analyzing the role of the real estate market in the definition of urban regeneration policies, the literature traces a clear common thread. The exam of the current real estate dynamics is certainly useful for supporting decision makers in developing effective urban regeneration plans and projects, and thus orienting their choices. This topic is widely developed in [52] with the aim of analyzing the real estate mechanisms of the city of Naples (Italy) through the integration of a Multi-Criteria Decision Analysis method (MCDA) and the GIS.

The evaluation of real estate assets value currently represents one of the crucial aspect for the territorial marketing strategies definition, with a view to developing high-performance and competitive cities. In this framework, an integrated assessment model capable of mapping out and encapsulating the multidimensional set of factors that shape the attractiveness of alternative real estate transactions has been proposed by Del Giudice et al. [48].

The study of the real estate market data, to understand the differentiation of housing prices and orient the urban space transformation initiatives, is a key issue of the discussion of Wu [22] carried out for the Chinese city of Shanghai.

The implementation of the multi-criteria analysis methodologies has proven to be particularly useful in the processes of urban regeneration and local development. In fact, Calabró and Della Spina [38] have concluded that these assessment tools are highly strategic, especially if adopted before the planning or feasibility verification phases, by playing a monitoring and management role of the projects to be carried on the territories.

With reference to the UK commercial property markets, the benefit in the use of system dynamics modelling to understand the market mechanisms and their long-term behaviour has been pointed out in [61]: the approach concerns non-linear model of the complex relationships and behavioural factors that are difficult to include in existing econometric models, among which the potential impact of the redevelopment on the supply of new properties and rental growth and the response times of various parts of the market development process to the market signals. Within the illustrated question, the study carried out by Omidipoor et al. [49] has explained how the active involvement of owners, investors and administrations is able to increase the success of the urban redevelopment. In order to promote the participatory processes, a spatial decision support system based on GIS tool for the owner-investor partnership in the renovation of the urban blighted areas has been developed. Similarly, Lombardi and Ferretti [34] have claimed that the current decision-making processes are based on evaluation systems that are not able to address the problem as they do not take into account the complete involvement of the interested actors. Therefore, the Authors have presented an innovative generation of evaluation systems to orient the decision-making mechanisms in the urban planning and regeneration, in order to empower planners and decision makers to better understand the interaction between city design, social preferences, economic issues and policy incentives.

Then, Bottero et al. [47] have developed an evaluation model to support the choice process related to the interventions of urban regeneration. In particular, in the study an original multi-criteria approach that combines SWOT Analysis, Stakeholder Analysis and PROMETHEE method for the assessment of alternative regeneration strategies of an urban area in Northern Italy has been proposed.

5 Conclusions

In the present paper the relationship (in both perspectives) between i) the effects that territorial regeneration interventions could determine on the real estate dynamics, in terms of changes in property values and dynamism of supply and demand and ii) the modalities in which the market trends (volume of transactions, selling prices, rents, average sales times, supply and demand) can influence the urban transformation processes, has been examined.

The analysis of the scientific literature on the topic (fifty relevant paper) has allowed to highlight the general significant positive effects of a redevelopment project on the surrounding real estate market mechanisms. Furthermore, the study has pointed out how the various factors (sales and rents time, market trends, size of the area to be redeveloped, etc.) can affect the implementation of an urban project and the previous decision making processes. In this sense, the territorial renewal initiatives – if effectively carried out in consistence with the current needs of the community and the reference regulatory provisions - increase the attractiveness of the local real estate market. Therefore, an intimate connection between the transformation of urban space and the increase of the property market values is established: the renovation project, in fact, will promote the market desirability, by generating the rental and selling prices growth related to the properties located in the same urban context. This output is ordinarily found in the academic contributions aimed at assessing the impact of these urban strategies on the value of the existing (residential, commercial, offices, etc.) property assets carried out in different international geographical contexts.

However, despite being potentially positive due to their ability to meet the communities demand and to provide new and necessary infrastructures and collective services to replace the lacking or inefficient ones, the urban redevelopment investments have a high implicit risk. In fact, the cogency to support the public administrations in the choice processes (in the situations in which different proposals are developed or limited financial resources can be used) has emerged. In this sense, the evaluation discipline should orient the decision mechanisms related to the implementation of valid urban initiatives toward those able to generate a series of positive consequences for the economy and local well-being. Furthermore, the assessment of the effects of the regeneration operations on the property market dynamics represents a useful tool capable of addressing the projects to be carried out on the territory. The evaluation models – defined for the verification of the feasibility of the projects and their selection among different alternatives – should be combined in multi-criteria analyses for the effective process control.

In addition, the systematic exam of the scientific literature concerning the relationships between the property market trends and the urban interventions planning has highlighted how the (current and forecast) market supply and demand can influence the identification of the initiatives to be performed on the territories. The integration of the investigation of the real estate market specificities with the use of the GIS tool can provide a valid indication for obtaining an initial ‘snapshot’ of the areas to be renovated and for planning future urban regeneration scenarios. In the outlined framework, the real estate dynamics that characterize a specific urban context and the communities’ needs overview represent helpful references for guiding urban planning strategies.

In this sense, this review does not aim to identify and systematize the contents of all the relevant papers, but it limits itself to providing an approach to the analysis of the studied relationship. This goal has been pursued through the study of the consistent relevant literature on the analysis of the double perspective in which the relationship between the investments on the territories and the property market dynamics can be identified and interpreted.

The practical implications of the study carried out in this paper and in progress for further developments, firstly, regard the development of a framework of significant studies on the issue that, with reference to different geographical contexts and purposes, intend to focalize on multiple aspects related to the broad question. Currently, the urge to define suitable polices for the sustainable development of the cities is strictly connected to (i) the scarce public financial availability, (ii) the consequent involvement of private investors (who take part to the initiatives in the only profitable situations), (iii) the need to improve the quality of the degraded and/or abandoned urban areas, (iv) the fixed goals for the creation of more living and safe cities. The likely effects that an urban regeneration initiative could determine on the property market mechanisms (in terms of future forecast demand and supply, real estate prices, selling time, etc.) constitute an important question to be assessed in the wider framework of the benefits deriving from these interventions implementation, as they are mainly indicative of the market appreciation of the specific urban area and, thus, of the value of the property (residential, commercial, offices) assets. On the other hand, the analysis of the current and forecast market trends is fundamental to address the urban planning and design decisions, as the market dynamics (in terms of appreciation and preference by the community, prices, number of transactions, etc.) constitute a proxy variable of the urban quality level of the specific area. The choices of the potential users and investors of living or investing in a specific territory allow the decision makers to understand its potentialities and to identify the areas on which a higher interest by them could be attested. However, this should not determine an unbalanced development of the cities, but should help the planning of the interventions to be carried out according to the given priorities, that are associated to the current property market mechanisms (interest shown by potential investors, demand and supply dynamism, etc.).

Note: The current study has been developed within the current research "Resilience and sustainability of urban regeneration initiatives. Methods for assessing the effectiveness of investments on the built environment", Call for Research Projects 2022, Sapienza University of Rome.

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