jOiNEd For sUsTainability - bUilding climate REsilient communities in WB and EU

STADY VISIT AT UNIVERSITY OF NOVI SAD Novi Sad, Serbia

December 4th to 6th , 2023

Venue: Rectorate Building, University of Novi Sad,
Dr Zorana Djindjica 1, Novi Sad, Serbia
(Multimedia Room II-13, 2nd floor)

VELCOME NOTE - Mirjana Laban

Date: 04 December 2023
Place: Novi Sad, Serbia

Co-funded by the European Union

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NOVI SAD, VOJVODINA, SERBIA

City of Novi Sad

EUROPEAN CAPITAL OF CULTURE 2022

Novi Sad is the administrative, economic, cultural, scientific and touristic centre of the Autonomous Province of Vojvodina and the second largest city in Serbia. The city population exceeded 370,000.

Co-funded by the European Union

UNIVERSITY OF NOVI SAD

University of Novi Sad, with more than 50,000 students and 5,000 employees, is one of the largest educational and research centers in Central Europe. It belongs to the group of comprehensive universities, which are characterized by providing nearly all fields of science and higher education.

The University of Novi Sad offers around 400 accredited study programs at the level of Bachelor, Master, Specialist and Doctoral studies, carried out at its Faculties and within its Centers for Interdisciplinary and Multidisciplinary Studies.

Co-funded by the European Union

FACULTY OF TECHNICAL SCIENCES

The Faculty of Technical Sciences-University of Novi Sad was established in Novi Sad, in May, 1960. It consists of 13 departments, 10 administrative services and 31 research centers.
With over 15.000 students and 1.200 employees, covering the area of over 33.000 m2 divided into 8 buildings, the Faculty ranks among the largest and most developed faculties in the region.

SCIENCE PARK

Co-funded by the European Union

1FUTURE

dr Ljiljana Popovic
Executive director

DISASTER RISK REDUCTION CENTER – FACULTY OF TECHNICAL SCIENCES

Climate change, natural and man-made disasters are on the rise in the last decades in the Western Balkans. Human casualties, extensive damage to urban areas, negative impact on the environment and further weakening of the regional economy are amongst indicators of increasing vulnerability.
The on-going Covid 19 pandemic reveals these days how powerless humanity is to defend itself against the simplest organism. Also, cataclysmic wild fires are burning out entire communities and ecosystems.
The sustainability of the human kind and our planet depends on our capability to live and cope with climate change and disasters, to build back better and to manage risks.
Preliminary surveys showed shortage of knowledge and skills of the staff in the field of Climate change adaptation. The survey also showed that both young people and professionals at WB are ready to learn.
Different levels of knowledge and skills were noticed, based on the education acquired from other disciplines, with many people learning on the job in an unstructured way. These competences, knowledge and skills are insufficient to solve the growing problems.
Moreover, the lack of safety culture in society in general is notable.

DISASTER RISK MANAGEMENT AND FIRE SAFETY STUDY PROGRAMME
BACHELOR, MASTER (2011) AND PHD LEVEL SINCE 2019
ERASMUS+ K-FORCE http://kforce.uns.ac.rs/

Co-funded by the European Union

NOVI SAD
TOURIST MAP

1. THE CITY HALL
2. THE ROMAN CATHOLIC PARISH CHURCH OF ST. MARY'S NAME
3. THE BUILDING OF THE EXECUTIVE COUNCIL OF THE AUTONOMOUS PROVINCE OF VOJVODINA (FORMER IBANY. RESIDENCE)
4. THE BUILDING OF MATICA SRPSKA
5. THE HOUSE AT THE 'WHITE LION'S
6. THE SERBIAN ORTHODOX BISHOP'S PALACE
7. ST. GEORGE'S SERBIAN ORTHODOX CHURCH
8. THE SERBIAN ORTHODOX CHURCH OF ST. NICHOLAS
9. THE SERBIAN ORTHODOX CHURCH OF THREE HOLY HIERARCHS
10. THE SERBIAN ORTHODOX CHURCH OF HOLY MOTHER'S ASCENSION
11. THE ROMAN CATHOLIC CHURCH OF ST. ICRU
12. THE SYNAGOGUE
13. THE GREEK CATHOLIC CHURCH OF ST. APOSTLES PETER AND PAUL
14. THE SLOVAK LUTHERAN CHURCH
15. THE REFORMED CHRISTIAN CHURCH
16. NOVI SAD MUSEUM
17. VOJVODINA MUSEUM
18. THE COLLECTION AND EXHIBITION OF THE INSTITUTE FOR NATURE PROTECTION
19. THE COLLECTION OF FOREIGN ART
20. THE GALLERY OF MATICA SRPSKA
21. MEMORIAL COLLECTION OF PAULE BELJANSKI
22. THE COLLECTION DONATED BY BAJKO MAMUZIC
23. SERBIAN NATIONAL THEATRE
24. NOVI SAD THEATRE
25. THEATRE OF THE YOUNG
26. THE CULTURAL CENTRE OF NOVI SAD
27. THE DANUBE PARK
28. THE MONUMENT TO THE VICTIMS OF FASCISM
29. ARMENIAN MONUMENT
30. NOVI SAD FAIR
31. SPORTS-BUSINESS CENTRE "VOJVODINA"
32. "STRAND" BEACH
33. BUNGALOW COMPLEX "THE DANUBE SILVER"

LEGEND

- TOURIST INFORMATION CENTRE
- RAILWAY STATION
- MAIN BUS STATION
- LOCAL/SUBURBAN BUS STATION
- HOTEL
- PENSION
- BUNGALOW COMPLEX
- HARBOUR CAPTAIN'S OFFICE
- THE PIER
- THE BOAT PIER
- ROWING CLUB
- SAILING CLUB
- CAR PARK
- HOSPITAL
- POST-OFFICE
- SWIMMING POOL
- FORTRESS
- PUBLIC TOILET
- SPORTS TERRAINS
- UNIVERSITY
- MUSEUM
- GALLERY
- THE CEMETERY
- THE CHURCH
- THE SYNAGOGUE

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1FUTURE

VENUE

Rectorate Building, University of Novi Sad, Dr Zorana Djindjica 1, Novi Sad, Serbia (Multimedia Room II-13, 2nd floor)

WELLCOME TO NOVI SAD!!!

Campus map (30 - Rectorate Building)

Co-funded by the European Union

WELLCOME TO NOVI SAD!!!

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jOiNEd For sUsTainability - bUilding climate REsilient communities in WB and EU

Sustainable and Resilient Cities – UNS courses

UNS Study visit

University of Novi Sad (UNS)

Date: 04 December 2023
Place: Novi Sad

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or EACEA. Neither the European Union nor the granting authority can be held responsible for them."

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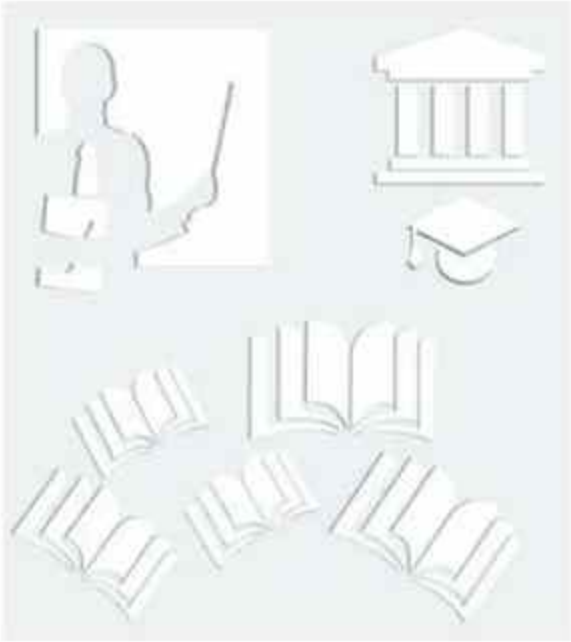
Undergraduate Academic Studies



Disaster Risk Management and Fire Safety

Disaster Risk Management and Fire Safety

General information

Type of studies
Undergraduate Academic Studies

Academic degree
Bachelor with Honours in Disaster Risk Management and Fire Safety (B.Dis.Ris.Managem.Fir.Saf.)

Educational field
Technical-Technological Science

Scientific, professional or art field
Environmental and Occupational Safety Engineering

Duration (year/sem)
4 / 8

Total ECTS
240

Co-funded by the European Union

Undergraduate Academic Studies / Disaster Risk Management and Fire Safety

Disaster Risk Management and Fire Safety

Year: 2, Semester: Summer	
Hazards	
Devices and Systems in Fire Protection	
Risk Management and Sustainable Settlements' Development	
Risks in Manipulating Hazardous Substances	
Applied Information Technologies	
Interdisciplinary	yes
ECTS	7

Year: 3, Semester: Winter	
Fundamentals of Thermodynamics and Heat Transfer	
Elements of a Building and Installation	
Modeling and Simulation in Risk Management	
Institutional Frameworks in Risk Management	
Safety Aspects in the Built Environment	
Interdisciplinary	yes
ECTS	7

Year: 4, Semester: Winter	
Disaster risk management cycle	
Flood Defence Measures	
Izborni predmet 7	
Izborni predmet 8	
Elective Course 6	
Professional Practice	
Interdisciplinary	yes
ECTS	5

Co-funded by the European Union

Undergraduate Academic Studies / Disaster Risk Management and Fire Safety

Course: Risk Management and Sustainable Settlements' Development

Year: 2, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Course is active from 01.10.2011..

Co-funded by the European Union

Undergraduate Academic Studies / Disaster Risk Management and Fire Safety

Course: Risk Management and Sustainable Settlements' Development

Year: 2, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Acquisition of knowledge which will enable engineers for risk and fire protection management and active participation and cooperation with other participants in spatial planning processes, so that the risk analysis and vulnerability in the settlements are the integral part of the starting phases of the plan document development and strategic planning of the sustainable settlement development.

Co-funded by the European Union

Undergraduate Academic Studies / Disaster Risk Management and Fire Safety

Course: Risk Management and Sustainable Settlements' Development

Year: 2, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Acquired theoretical and applied knowledge enables identification of risk components from the occurrence of catastrophic events and fire and vulnerability of the settlement in the field analysis which is the subject of planning, carrying out procedures of risk analysis and vulnerability in the urban fields, as well as defining solutions which should be considered in the planning process. Acquired knowledge enables understanding of the spatial and urban planning processes and consideration of existing qualities and values of the environment.

Co-funded by the European Union

Undergraduate Academic Studies / Disaster Risk Management and Fire Safety

Course: Risk Management and Sustainable Settlements' Development

Year: 2, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Types of plan documents in urban and spatial planning. Current regulations in the field of spatial planning and urban design. Sustainable elements of the settlement development. Importance and development of towns through history. Urbanization as a process. Modern cities, their characteristics and problems. Functioning of the city systems. Sustainable development of the town. Modern approach to planning sustainable towns. Analysis of the incorporation possibilities, risk analysis within the existing law solutions. Risk identification and analysis in catastrophic events and fire in preparation of the plan documentation. Vulnerability concept. Analysis of the existing plans and consideration of the applied conceptual solutions from the aspect of prevention against catastrophic events and fire. Case studies – analysis of existing plan documents (of all levels) and analysis from the previous period.

Undergraduate Academic Studies / Disaster Risk Management and Fire Safety

Course: Risk Management and Sustainable Settlements' Development

Year: 2, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Lectures, Term Paper, Presentation of the visiting professor, consultations.

Co-funded by the European Union

Course: Risk Management and Sustainable Settlements' Development

Year: 2, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Authors	Name	Year	Publisher	Language
Mijić Vučković, J.	Grad – juče, danas, sutra	2005	Narodna knjiga, Beograd	Serbian language
Grupa autora	Strateški okvir za održivi razvoj Srbije	2004	Institut za arhitekturu i urbanizam Srbije	Serbian language
United Nations Human Settlements Programme (UN-HABITAT), 2010	Land and Natural Disasters	2010	United Nations Human Settlements Programme	English

Co-funded by the European Union

Course: Risk Management and Sustainable Settlements' Development

Year: 2, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Authors	Name	Year	Publisher	Language
Stanarević, S., Mandić, G., Katić, Lj.	The proceedings of human security and new technologies	2018	University of Belgrade – Faculty of security studies, Human security research center, Beograd	Serbian language
Rogers, R., Power, A.	Cities for a small country	2000	Faber and Faber Limited, London	English
Grupa autora	Komunalna higijena	2002	Prometej, Novi Sad	Serbian language

Co-funded by the European Union

Course: Risk Management and Sustainable Settlements' Development

Year: 2, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Authors	Name	Year	Publisher	Language
Obrknežev, R. i dr.	Ekološki atlas Novog Sada	1994	JP „URBANIZAM" Zavod za urbanizam, Novi Sad	Serbian language
Milosavljević, M. i dr.	Generalni plan grada Novog Sada do 2021. godine	1999	JP „URBANIZAM" Zavod za urbanizam, Novi Sad	Serbian language

Co-funded by the European Union

Course: Risk Management and Sustainable Settlements' Development

Year: 2, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Course activity	Pre-examination	Obligations	Number of points
Test	Yes	Yes	30.00
Exercise attendance	Yes	Yes	5.00
Presentation	Yes	Yes	10.00
Lecture attendance	Yes	Yes	5.00
Term paper	Yes	Yes	20.00
Practical part of the exam - tasks	No	Yes	30.00

Co-funded by the European Union

Undergraduate Academic Studies / Disaster Risk Management and Fire Safety

Course: Safety Aspects in the Built Environment

Year: 3, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Course is active from 01.10.2011..

Co-funded by the European Union

Undergraduate Academic Studies / Disaster Risk Management and Fire Safety

Course: Safety Aspects in the Built Environment

Year: 3, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

The knowledge of basic characteristics of the built environment (structure, materialization) and urban infrastructure.

Co-funded by the European Union

Course: Safety Aspects in the Built Environment

Year: 3, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Acquired theoretical and applied knowledge enables identification of different factors in the built environment from the aspect of applied design solutions and materialization of the objects, as well as consideration of the risk factors concerning urban infrastructure in the case of catastrophic events and fire. Acquired knowledge also enables formulation of suggestion for preventive measures, as well as consideration and characterization of existing solutions of preventive protection of the objects and infrastructure in the case of catastrophic events and fire.

Co-funded by the European Union

Undergraduate Academic Studies / Disaster Risk Management and Fire Safety

Course: Safety Aspects in the Built Environment

Year: 3, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Typology and classification of the construction materials and construction, planning and design of object, with an emphasis on architectural-civil engineering preventive measures of object safety in the conditions of catastrophic events and fire and behavior of construction materials and constructions in fire. Introduction to the basic elements of municipal system and their protection: hydrotechnical systems, water supply systems, drainage and treatment system, flood control system, infrastructure complexes, corridors and facilities, energy system, power supply, power distribution networks, heat supply system, heating systems, gas systems, telephone and cable distribution systems, undeveloped land, underground objects, subways, tunnels, pedestrian passes, underground garages. Case studies – event analysis from the previous period. Analysis of the planed objects – project documentation, analysis of the built objects and consideration of applied conceptual solutions from the aspect of protection against catastrophic events and fire.

Course: Safety Aspects in the Built Environment

Year: 3, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Lectures, Term papers, presentations, consultations.

Co-funded by the European Union

Course: Safety Aspects in the Built Environment

Year: 3, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Lectures, Term papers, presentations, consultations.

Co-funded by the European Union

Course: Safety Aspects in the Built Environment

Course specification

Year: 3, Semester: Winter

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Authors	Name	Year	Publisher	Language
Buchanan, A.H.	Structural Design for Fire Safety	2006	John Wiley & sons, LTD, England	English
M. David Egan	Građevinske konstrukcije i požar	1990	Građevinska knjiga, Beograd	Serbian language
Krnjetin, S.	Graditeljstvo i zaštita životne sredine	2001	Prometej, Novi Sad	Serbian language
Kreimer, A., Arnold, M., Carlin, A. (ed.)	Building Safer Cities: The Future of Disaster Risk Management	2003	The International Bank for Reconstruction and Development / The World Bank, Washington	English

Co-funded by the European Union

Course: Safety Aspects in the Built Environment

Course specification

Year: 3, Semester: Winter

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Authors	Name	Year	Publisher	Language
Steve Curwell, Bob Fox, Morris Greenberg, Chris March	Hazardous building materials – a guide to the selection of environmetally responsible alternatives	2002	Spon press, USA and Canada	English
Vlahović, M.	Geologija u građevinarstvu	2008	Akademska misao, Beograd	Serbian language
Mladenović, S., Pavlović, M., Stanojević, D.	Korozija i zaštita betona i armiranog betona	2008	Siszam, Beograd	Serbian language
Wines, J.	Green architecture	2000	Benedict Taschen Verlag GmbH, Koln	English

Co-funded by the European Union

Course: Safety Aspects in the Built Environment

Course specification

Year: 3, Semester: Winter

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Authors	Name	Year	Publisher	Language
Slessor, C.	Sustainable architecture and high technology	1997	Thames & Hudson, London	English
Brennecke, W. end al.	Atlas krovnih konstrukcija : kosi krovovi	1990	Građevinska knjiga, Beograd	English

Co-funded by the European Union

Course: Safety Aspects in the Built Environment

Course specification

Year: 3, Semester: Winter

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Course activity	Pre-examination	Obligations	Number of points
Test	Yes	Yes	30.00
Exercise attendance	Yes	Yes	5.00
Written part of the exam - tasks and theory	No	Yes	30.00
Presentation	Yes	Yes	10.00
Lecture attendance	Yes	Yes	5.00
Term paper	Yes	Yes	20.00

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Undergraduate Academic Studies / Disaster Risk Management and Fire Safety

Course: Disaster risk management cycle

Year: 4, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Course is active from 01.10.2011..

Co-funded by the European Union

Course: Disaster risk management cycle

Year: 4, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

The objective of the course is to master basic knowledge in the field of emergency management that enables the student to independently carry out an engineering analysis of various solutions in designing activities before, during and after a catastrophic event.

Co-funded by the European Union

Course: Disaster risk management cycle

Year: 4, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Students will be able to independently analyze the elements of the cycle of catastrophic events in order to define the activities that need to be carried out before, during and after a catastrophic event. Students acquire competences for designing a strategy of action in emergency situations.

Co-funded by the European Union

Course: Disaster risk management cycle

Year: 4, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

General about Disaster Risk Management Cycle. Prevention and Preparedness. Emergency interventions (Response). Recovery (Reconstruction). Application of information and communication technologies in individual phases of the catastrophic event management cycle.

Co-funded by the European Union

Course: Disaster risk management cycle

Year: 4, Semester: Winter

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Lectures, Auditory Practice, Consultations

Co-funded by the European Union

Course: Disaster risk management cycle

Course specification

Year: 4, Semester: Winter

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Authors	Name	Year	Publisher	Language
Coppola, D.	Introduction to International Disaster Management	2007	Butterworth Heinemann, Amsterdam	English
Mileti, D	Disasters by Design	1999	Joseph Henry Press	English
MUP-Sektor za vanredne situacije	Nacionalne strategije iz oblasti zaštite i spasavanja u vanrednim situacijama	2011	Službeni glasnik RS	Serbian language
Keković, Z. i dr.	Procena rizika u zaštiti lica, imovine i poslovanja	2011	Centar za analizu rizika i upravljanje krizama, Beograd	Serbian language

Co-funded by the European Union

Course: Disaster risk management cycle

Course specification

Year: 4, Semester: Winter

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Authors	Name	Year	Publisher	Language
Huder, R.C.	Disaster operations and decision making	2012	John Wiley & Sons, inc., New Jersey	English
Simonović, S.P.	Systems Approach in Management of Disasters : Methods and Applications	2011	Wiley, New Jersey	English
Hyndman, D., Hyndman, D.	Natural hazards and disasters, 5th edition	2016	Cengage Learning, USA	English
Philips, B. D.	Disaster recovery	2016	CRC Press	English

Co-funded by the European Union

Course: Disaster risk management cycle

Course specification

Year: 4, Semester: Winter

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Authors	Name	Year	Publisher	Language
Editors: Mirjana Laban, Meri Cvetkovska, Edisa Nukić, Enrico Ronchi, Sokol Dervishi	Book of proceedings – 1st international symposium Students for resilient society S-FORCE 2018	2018	Univerzitet u Novom Sadu, Fakultet tehničkih nauka, Departman za graševinarstvo i geodeziju i Visoka tehnička škola strukovnih studija u Novom Sadu	English
Laban , M. i dr	Book of proceedings – 1st international symposium – K-FORCE 2017	2017	Fakultet tehničkih nauka, Novi Sad	English

Co-funded by the European Union

Course: Disaster risk management cycle

Course specification

Year: 4, Semester: Winter

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature

Knowledge evaluation | Lecturers

Course activity	Pre-examination	Obligations	Number of points
Exercise attendance	Yes	Yes	5.00
Written part of the exam - tasks and theory	No	Yes	50.00
Lecture attendance	Yes	Yes	5.00
Term paper	Yes	Yes	20.00
Term paper	Yes	Yes	20.00

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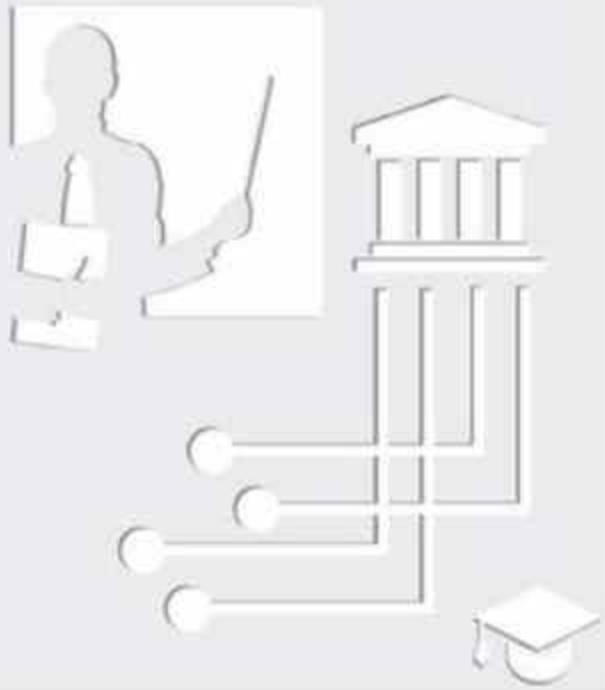
Disaster Risk Management and Fire Safety



Master Academic Studies

General information

Type of studies

Master Academic Studies

Academic degree

Master inženjer - upravljanje rizikom od katastrofalnih događaja i požara (Mast. inž. upr. riz.od katastr. dog. i pož.)

Educational field

Interdisciplinary

Scientific, professional or art field

IMT Studije (Upravljanje rizikom od katastrofalnih događaja i požara: Industrijsko inženjerstvo i inženjerski menadžment; Građevinsko inženjerstvo)

Duration (year/sem)

1 / 2

Total ECTS

60

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Master Academic Studies / Disaster Risk Management and Fire Safety

Disaster Risk Management and Fire Safety

Year: 1, Semester: Summer

Risk Analysis in Decision Making Process

Elective Course 4

Evacuation Calculation and Modelling

Study Research Work on theoretical basis of the master thesis

Master Thesis – Elaboration and Defence

Elective Course 4 *Choose 1*

Course

Design and Maintenance of Fire Suppression Systems

Financial Resistance to Risks

Interdisciplinary	yes
ECTS	4

Co-funded by the European Union

Master Academic Studies / Disaster Risk Management and Fire Safety

Course: Financial Resistance to Risks

Year: 1, Semester: Summer

Course specification

Course is active from 29.08.2017..

Co-funded by the European Union

Master Academic Studies / Disaster Risk Management and Fire Safety

Course: Financial Resistance to Risks

Year: 1, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

The objective of this course is to introduce students to basic economic instruments that contribute to reducing the socio-economic vulnerability of society to catastrophic events. Also, the objective of the course is that students acquire the competencies and knowledge necessary to improve the financial resilience of the society.

Co-funded by the European Union

Master Academic Studies / Disaster Risk Management and Fire Safety

Course: Financial Resistance to Risks

Year: 1, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Students gain competitions necessary to improve the financial resilience of societies. Students will be able to identify financial instruments for reducing the vulnerability of the society by analyzing potential capabilities of community and individuals.

Co-funded by the European Union

Master Academic Studies / Disaster Risk Management and Fire Safety

Course: Financial Resistance to Risks

Year: 1, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Financial models of risk management are being studied in the context of preparedness of community for catastrophic events. Different financial instruments for risk management are analyzed and compared, prior to a catastrophic event (relocation of funds with the aim of preventing and mitigating damage) and after a catastrophic event (risk transfer for reconstruction and recovery of society).

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Course: Financial Resistance to Risks

Year: 1, Semester: Summer

Course specification

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Lectures and auditory practices.

Co-funded by the European Union

Course: Financial Resistance to Risks

Course specification

Year: 1, Semester: Summer

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature | Knowledge evaluation | Lecturers

Authors	Name	Year	Publisher	Language
Vinod T.	Climate Change and Natural Disasters: Transforming Economies and Policies for a Sustainable Future	2017	Transaction Publishers	English
Gerard Caprio et al.	Handbook of Key Global Financial Markets, Institutions, and Infrastructure	2012	Elsevier	English
Branka Anđelković, Maja Kovač	Socijalni kapital: Nevidljivo lice otpornosti	2016	UNDP Srbija	Serbian language

Co-funded by the European Union

Course: Financial Resistance to Risks

Course specification Year: 1, Semester: Summer

Basic informations | Educational goal | Educational outcomes | Course content | Teaching methods | Literature

Knowledge evaluation | Lecturers

Course activity	Pre-examination	Obligations	Number of points
Project	Yes	Yes	40.00
Exercise attendance	Yes	Yes	5.00
Written part of the exam - tasks and theory	No	Yes	50.00
Lecture attendance	Yes	Yes	5.00

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Thank you for your attention

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jOiNEd For sUsTainability - bUilding climate REsilient communities in WB and EU

Cities resilient to climate change and disasters and fires

UNS Study visit

University of Novi Sad (UNS)

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Date: 04 December 2023
Place: Novi Sad

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INTRODUCTION

The EU has made a commitment to achieve **CARBON NEUTRALITY BY 2050**, in alignment with the **Paris Agreement's aim** to limit global warming to **1.5°C** above pre-industrial levels.

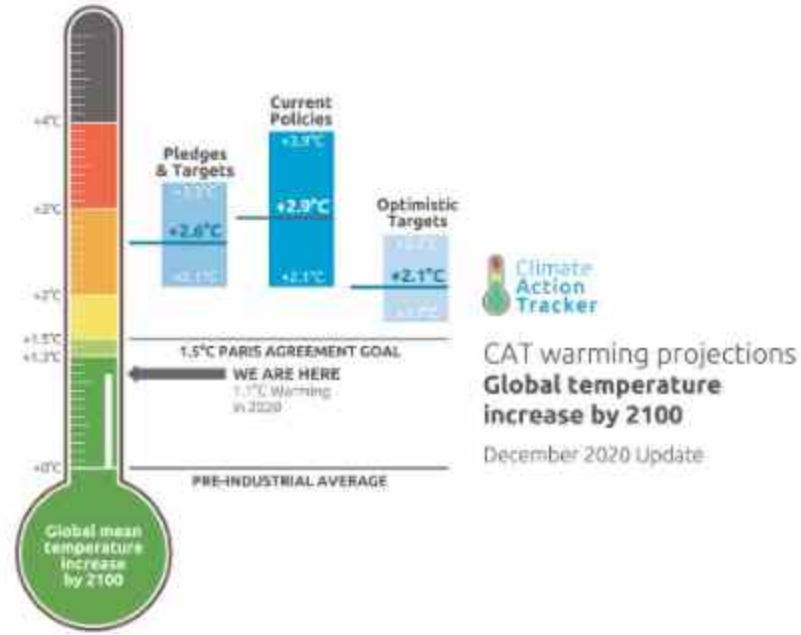

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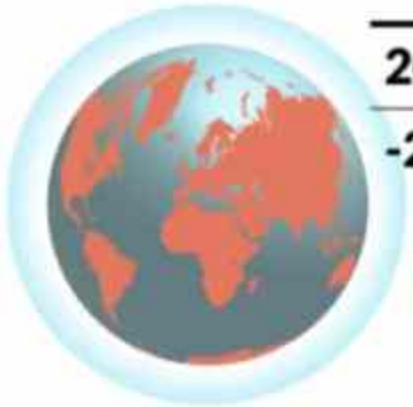
Image source: (1) https://www.gisreportsonline.com/r/european-green-deal/; (2) https://legal-planet.org/2020/12/02/is-the-paris-agreements-ambitious-1-5c-within-striking-distance/;

INTRODUCTION

EU intermediate **targets** for **2030**

Greenhouse gas emissions



2020	2030
-20%	≥-55%

Renewable energy

2020	2030
20%	≥32%

Energy efficiency

2020	2030
20%	≥32.5%

Image source: https://www.gisreportsonline.com/r/european-green-deal/

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INTRODUCTION

Cities

occupy just

3%

of the earth's land

but account for

two-thirds

of global energy demand

and

70%

of carbon emissions

Source: World Economic Forum

INTRODUCTION

Image source: https://unhabitat.lk/about-us/sustainable-development-goals/

Almost 70% of the world's population is expected to live in cities by 2050

Source: United Nations

Make cities and human settlements inclusive, safe, resilient and sustainable

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INTRODUCTION

Resilient cities

"cities that have the ability to **absorb, recover** and **prepare** for future shocks (economic, environmental, social & institutional)."

OECD

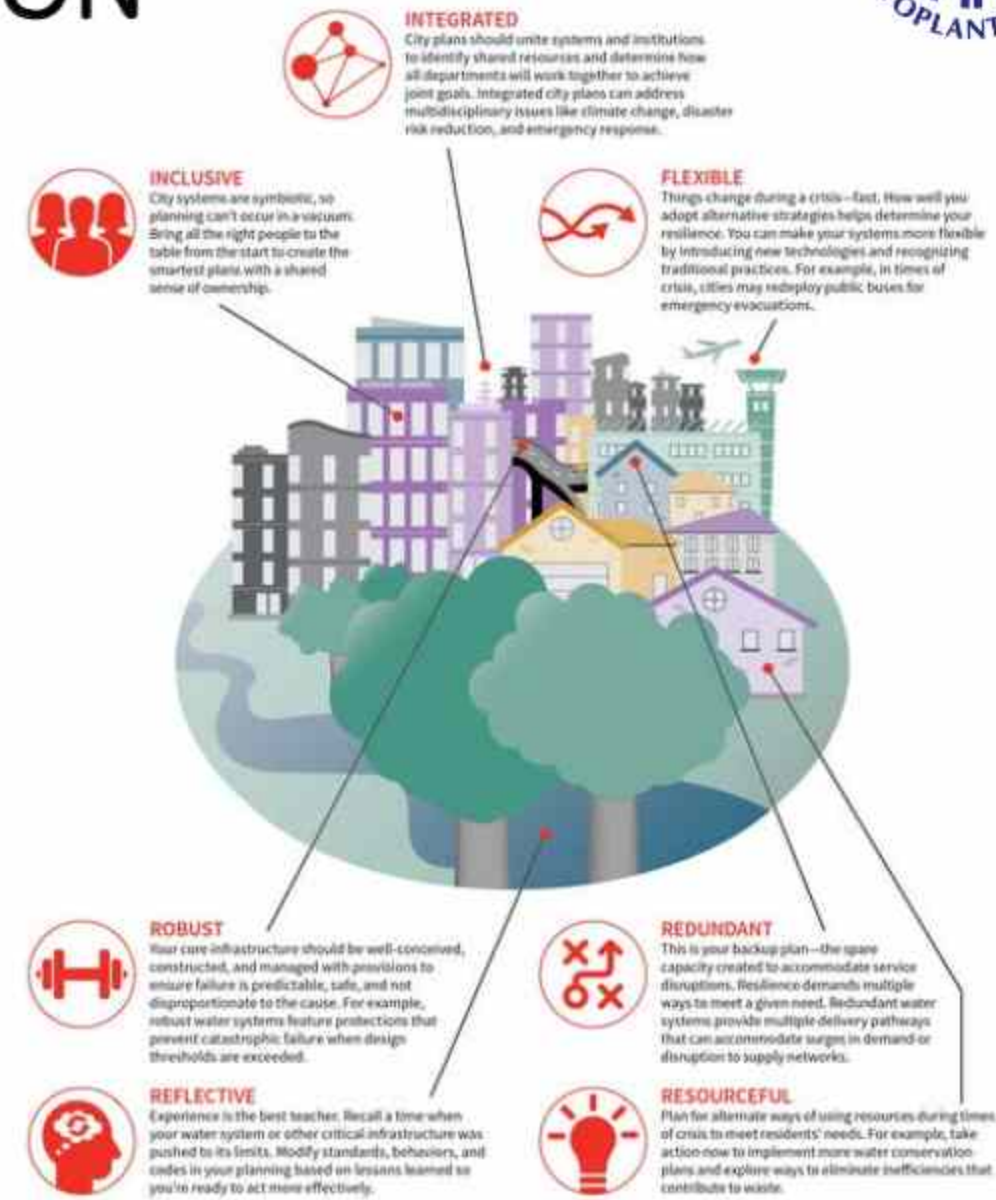


Image source: https://www.weareharris.com/media/2914/what-is-resilience-infographic.jpg

THE BUILDING SECTOR
PART OF THE PROBLEM AND KEY PART OF SOLUTION

EU building sector, being the largest single energy consumer and one of the largest CO_2 emitters, has vast potential for reducing energy demand and reduction of GHG emissions.

Buildings are responsible for approximately

40%
of energy consumption

36%
of CO2 emissions in the EU

35%
of the EU's buildings are over 50 years old

75%
of the building stock is energy inefficient

Image source: https://energy.ec.europa.eu/system/files/2019-01/buildings_performance_factsheet_0.pdf

THE BUILDING SECTOR
PART OF THE PROBLEM AND KEY PART OF SOLUTION



Every day in Europe

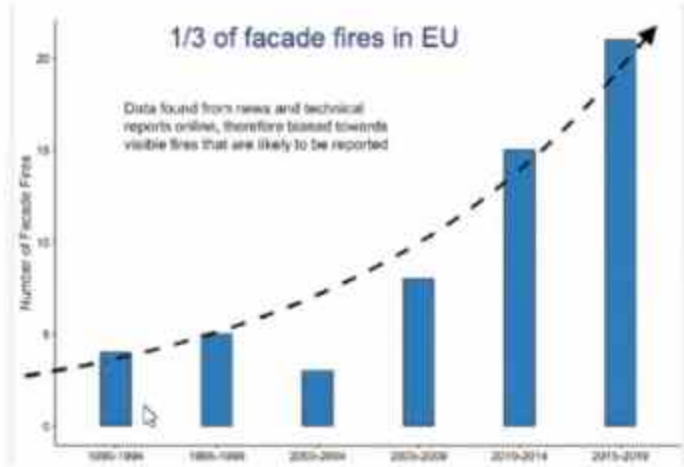
> 5000
fires are reported each day

90%
of all fire victims are killed by fires in buildings

4000
people are killed by fire each year

70000
people are hospitalised each year due to severe injuries caused by fire

1%
of GDP – is eaten up by fire damage each year



SUSTAINABLE AND FIRE RESILIENT BUILDINGS

Fire Resilience

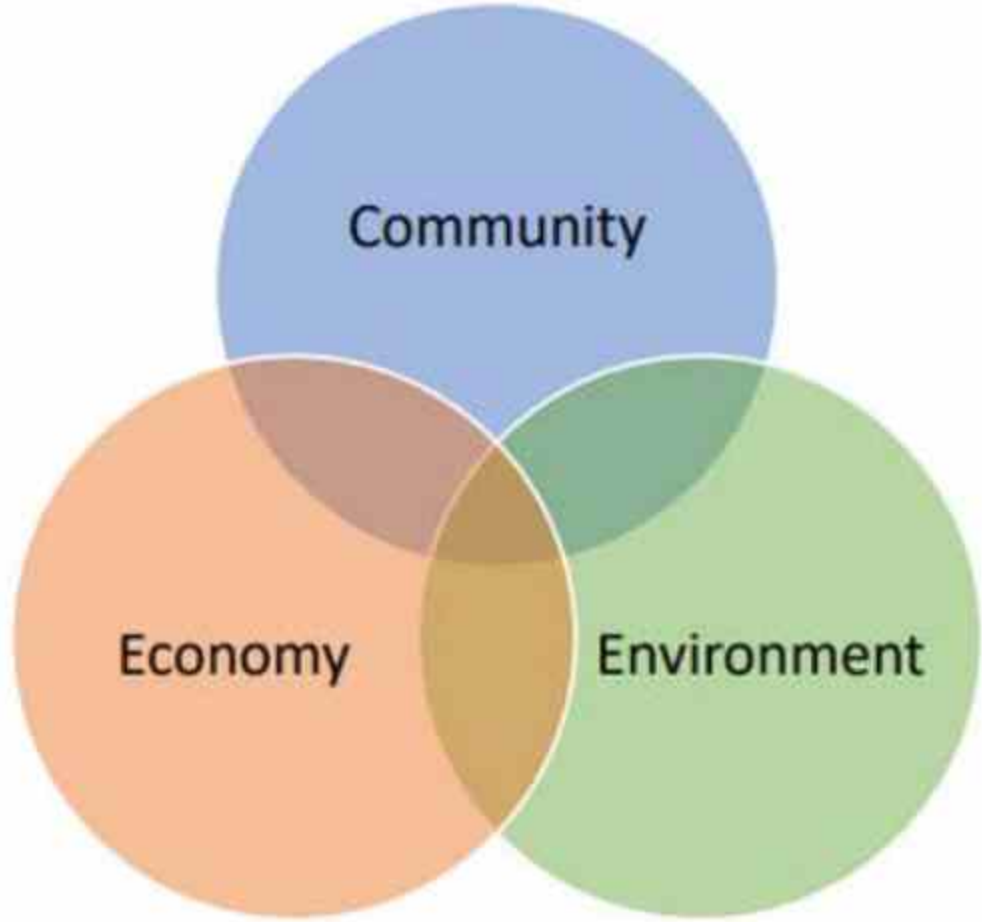
The ability of a building to withstand the effect of a fire?

Fire resilience ≠fire resistance

Holistic approach:

"The ability of a system, community or society to adapt, transform and recover from a fire timely and efficiently."

How will these elements adapt and recover from the effect of a fire?



Source: Fire Safe Europe

SUSTAINABLE AND FIRE RESILIENT BUILDINGS

Sustainable buildings

"The practice of creating sustainable/high-performance structures that is a holistic approach to design, construction, and demolition so as to minimize the buildings' **impact on the environment, the occupants and the community**."

▼

Sustainable buildings MUST BE fire safe and fire resilient.

Source: Fire Safe Europe

SUSTAINABLE AND FIRE RESILIENT BUILDINGS

Source: SAFR Buildings Concept. Meacham and McNamee, 2023

SUSTAINABLE AND FIRE RESILIENT BUILDINGS

A disconnect in sustainable building rating schemes

Rating schemes:

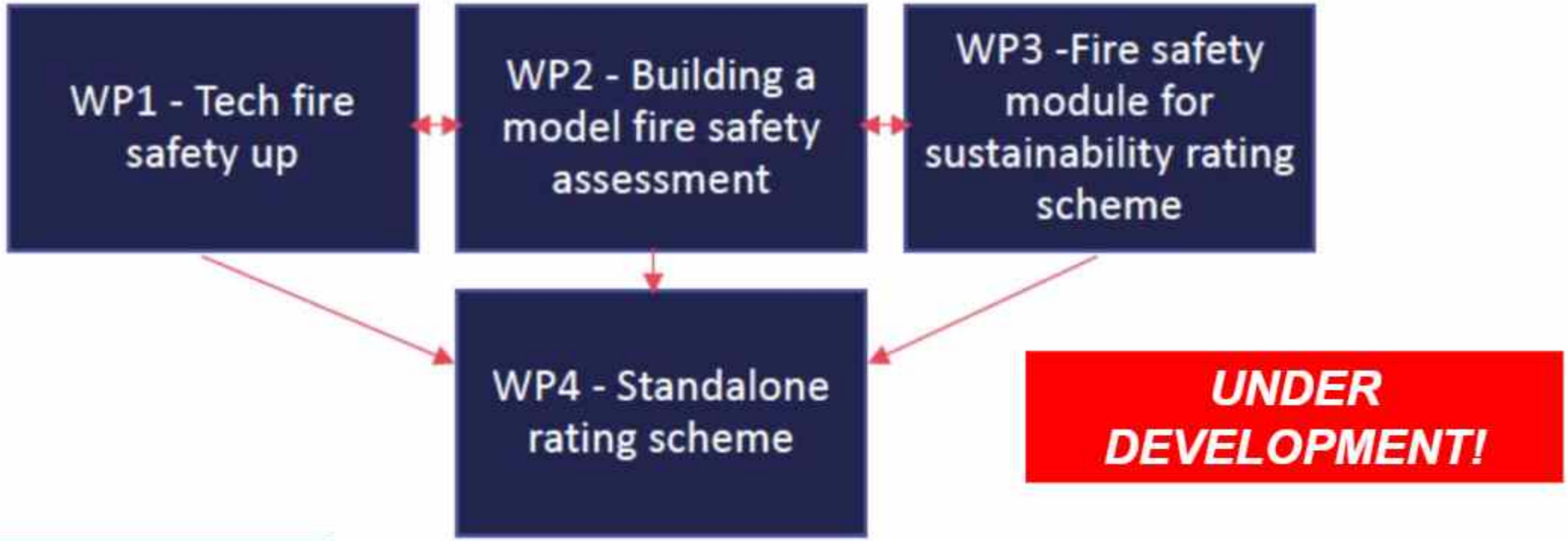
- assume fire is handled in Building Codes/Regulations
- deal with natural disasters

Building Codes/Regulations only deal with Fire Safety for safe escape of people, not fire resilience

SUSTAINABLE AND FIRE RESILIENT BUILDINGS

A Fire Safety Rating Scheme for Buildings

A relative scoring system to inform consumers on the level of fire safety of a building based on a holistic evaluation of buildings through a series of key requirements.



Source: The European Fire Safety Community Project, 2020

SUSTAINABLE AND FIRE RESILIENT BUILDINGS

A link in European Legislation

EU acknowledges the importance of fire safety in renovation:

- MS should be able to use their **long-term renovation strategies** to **address fire safety issues** which affect energy efficiency renovations and the lifetime of buildings *(EPBD, 2018).*
- Fire safety aspects should be considered during the **design, selection of materials, construction, renovation and operation of buildings** in order to improve prevention, detection, early suppression, evacuation, compartmentation, structural resistance and fire-fighting, as well as the relevant competencies of involved professionals *(Report Maximising the energy efficiency potential of the EU building stock, 2020).*

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THE RENOVATION WAVE

Renovation rate must double by 2030

- Current renovation rate ~ 1% (deep renovation only 0.2%)
- Result: 35 million building units renovated by 2030

Make buildings more **energy-efficient**, **sustainable**, and **resilient**

Image source: https://www.natureplus.org/artikel-news/bpie-action-plan-for-the-renovation-wave

THE RENOVATION WAVE

Renovation Wave Priorities

Tackling **energy poverty** and **worst-performing buildings**

Renovation of **public buildings**

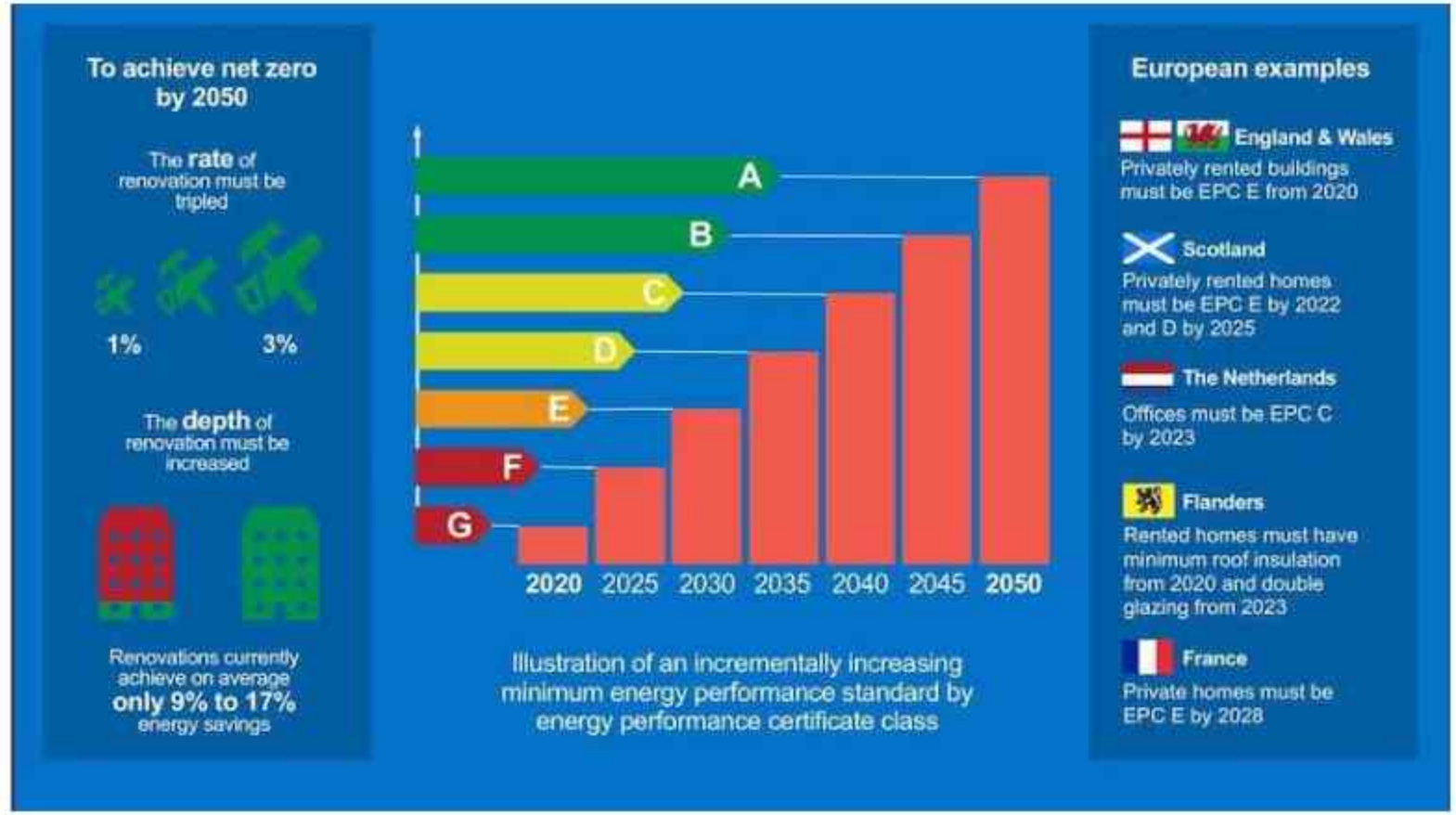
Decarbonisation of **heating** and **cooling**

Renovation measures **must ensure equivalent or superior fire safety** for citizens than the existing buildings.

THE RENOVATION WAVE

Ongoing revision of EPBD:

- Introduction of **Minimum Energy Performance Standards (MEPS)** for the worst-performing buildings that **factors in fire-safety.**



Source: The European Fire Safety Community Project, 2020

DIGITALISATION OF BUILDINGS

The digitalisation of buildings and construction technologies are essential drivers for improving EE: acceleration of the planning, implementation, control and monitoring of the renovation plans' outcomes, and more efficient planning and management of energy.

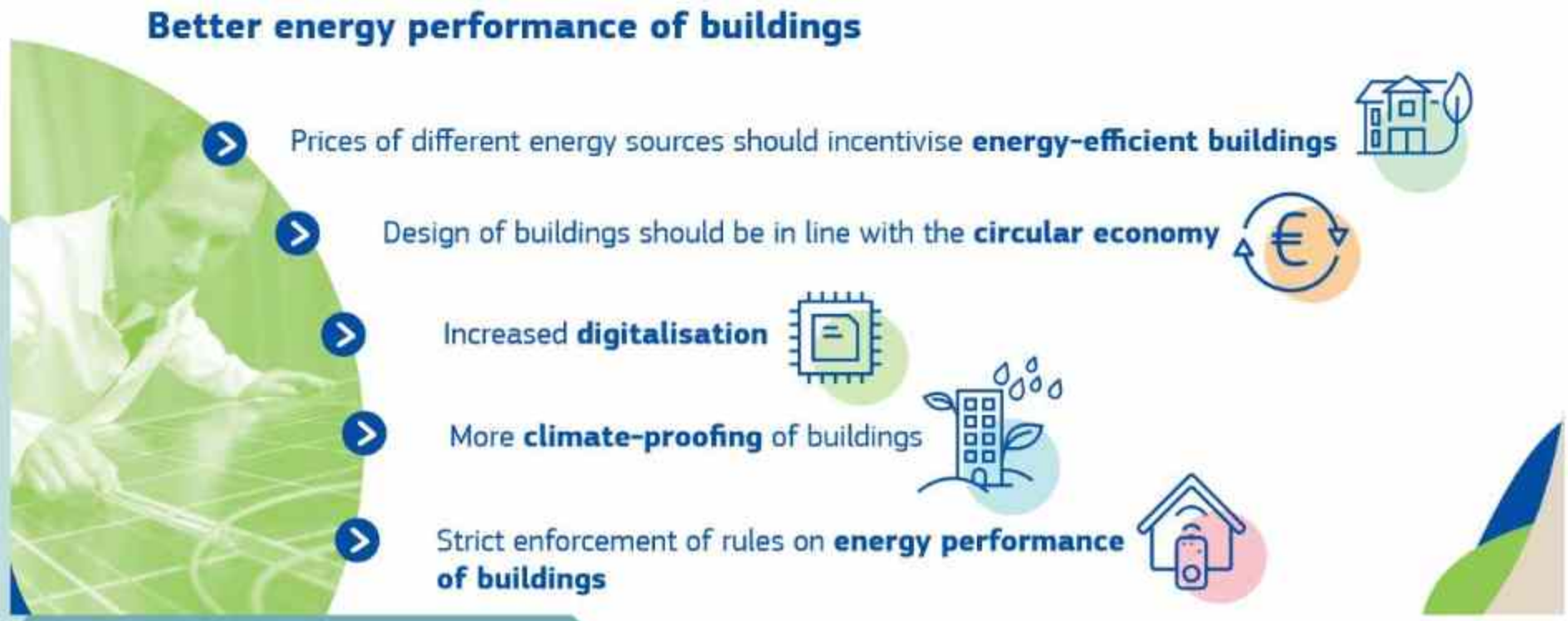


Image source: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en

DIGITALISATION OF BUILDINGS

The construction sector is UNDERDEVELOPED in terms of overall digitalisation and data applications in comparison with other industry sectors.

During building's life cycle a great amount of information is generated.

Despite the existence of large amount of building-related data, the data is often scarce, of unreliable quality and limited accessibility and there is a lack of strategies to efficiently manage and correlate them.

Image source: https://medium.com/@saeid_90285/5-challenges-why-aec-industry-is-slow-in-digitalization-c47c8d9c1416

European Digital Building Logbook Models

To encourage deep energy renovations and overcome barriers in building renovations, the EC has mandated the use of **DIGITAL BUILDING LOGBOOKS** (DBL).

DBL was first introduced as an autonomous tool by the **Renovation Wave initiative** in 2020.

Renovation Wave

Deep renovation is not always achievable in one go. It is therefore important to create better conditions for staged renovation. The Commission will introduce **Digital Building Logbooks**[27] that will **integrate all building related data** provided by the upcoming **Building Renovation Passports**[28], **Smart Readiness Indicators**, **Level(s)**[29] and **EPCs** to ensure compatibility and integration of data throughout the renovation journey.

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European Digital Building Logbook Models

DBL DEFINITION (EPBD recast 2023)

'digital building logbook' means a common repository for all relevant building data, including data related to energy performance such as energy performance certificates, renovation passports and smart readiness indicators, ***as well as on the life-cycle GWP and indoor environmental quality,*** which facilitates informed decision making and information sharing within the construction sector, among building owners and occupants, financial institutions and public authorities;

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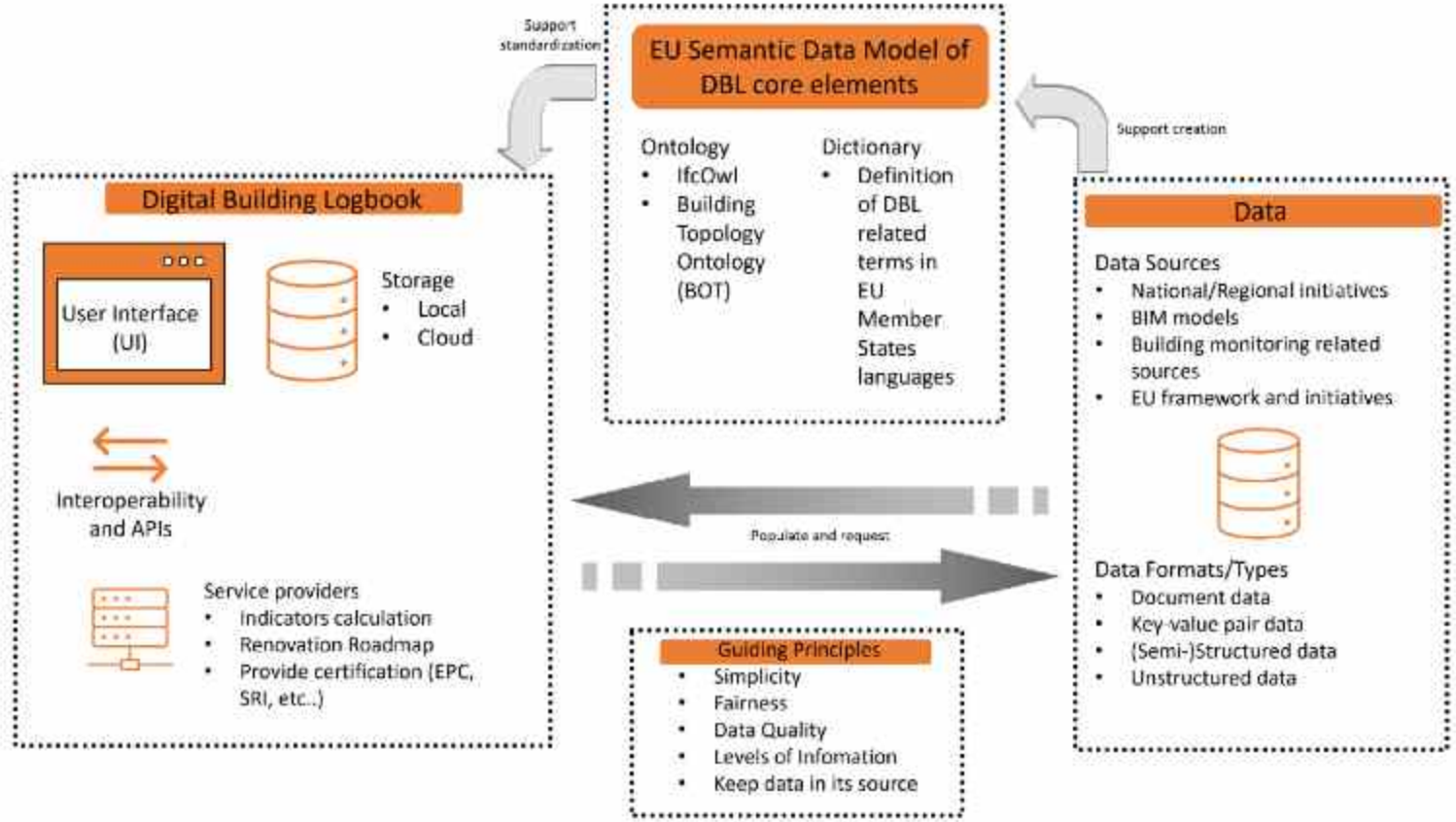
European Digital Building Logbook Models

DBL is considered as **a key solution to bridge the gap** between the vast amount of data and information generated throughout the building's lifecycle and the lack of methodologies and tools **to safely manage, organise, structure, and share this data**.



DBL definition according to the surveyed papers and reports from the EC

Image source: https://doi.org/10.1016/j.heliyon.2023.e19285

European Digital Building Logbook Models

There are several initiatives on DBLs at the regional and national level in Europe.

Belgium (Flanders) – Woningpas
https://woningpas.vlaanderen.be/

France - Mon carnet logement
https://moncarnetlogement.fr/

Spain – PAS-E
http://pas-e.es/#/

Sweden – BASTA Loggbok
https://www.bastaonline.se/

Germany – Eigenheim Manager
https://eigenheim-manager.de/

Netherlands – Madaster
https://madaster.com/

Sweden – MinVilla
https://minvilla.villaagarna.se/

Sweden – Produktkolen
https://www.produktkollen.se/

Co-funded by the European Union

Image source: https://eubsuperhub.eu/assets/content/Deliverables/D2.4.pdf

European Digital Building Logbook Models

Much of the recent DBL research is related to projects funded by the EU Horizon programme (ten H2020 projects and four Horizon Europe project, which implements DBL concepts, were identified).

iBRoad
Individual Building Renovation Roadmaps

ALDREN

BAMB
BUILDINGS AS MATERIAL BANKS

DigiPLACE

PROBONO

BIM4Ren

X-tendo

EUB SuperHub

BIM4EEB

D2EPC
DYNAMIC DIGITAL ENERGY PERFORMANCE CERTIFICATES

European Digital Building Logbook Models

Although some important progress has been made, a common European DBL model has not yet been implemented as some crucial aspects are still under development.

European Commission

Study on the Development of a European Union Framework for Digital Building Logbooks

FINAL REPORT

Figure 1 Overview of the different work packages of the study

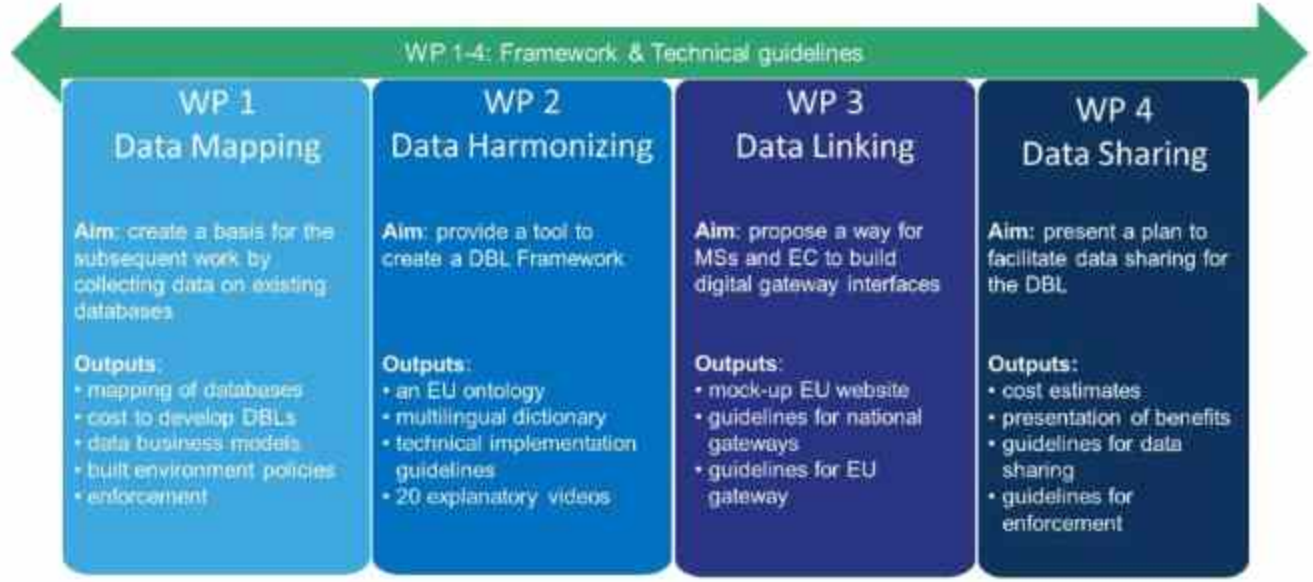


Image source: https://www.ecorys.com/app/uploads/files/2022-07/DBL%20-%20Meeting%20Report%20-%20Announcement%20Webinar_0.pdf

ORIGINAL VERSION OF DBL

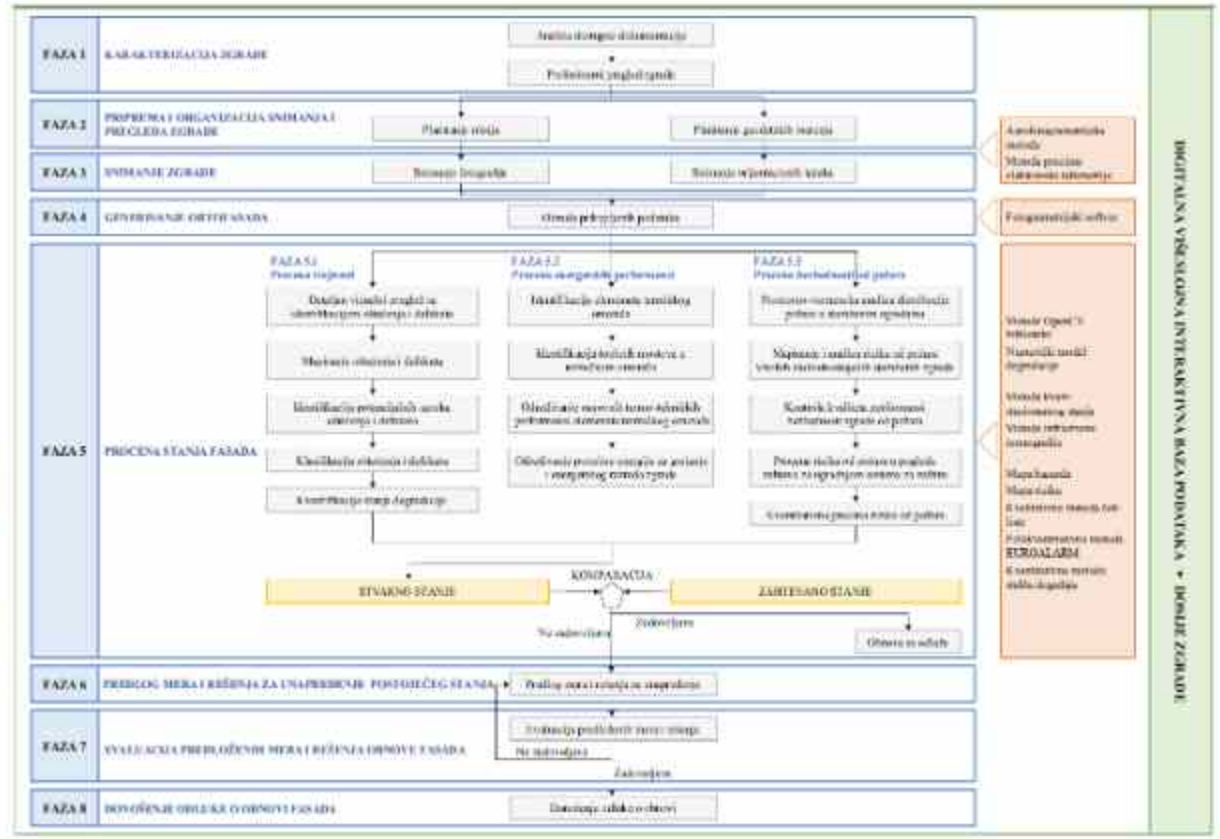
The Proposed Digital Building Repository

A novel decision support tool for building renovation management DBR - ONE OF THE OUTCOMES of the STRATEGIC MODEL FOR THE RENOVATION of concrete facades of high-rise residential buildings, developed within PhD theses.

PHD THESES RESEARCH SUBJECT

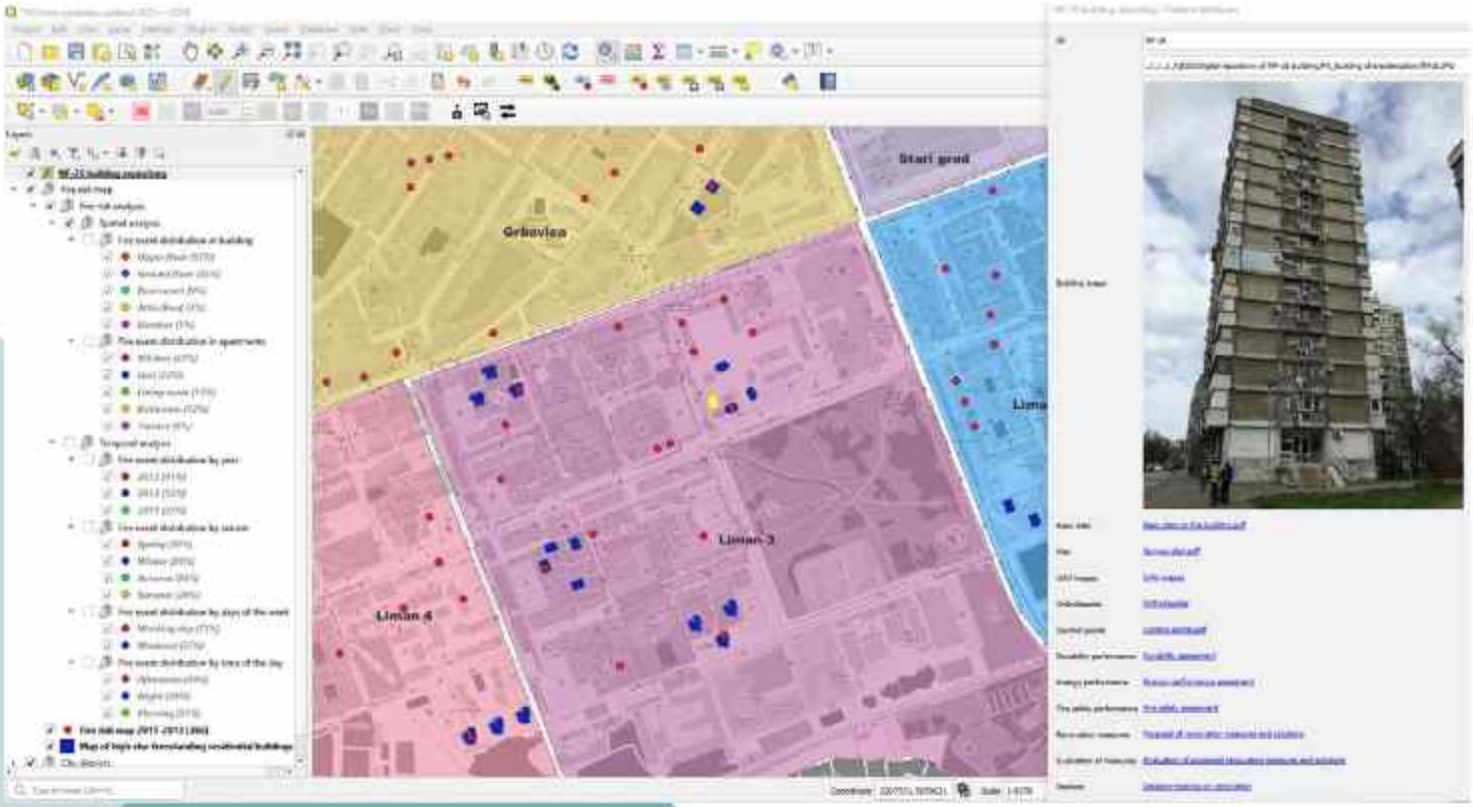
High-rise residential buildings built in Novi Sad between 1961 and 1990

70 BUILDINGS



The Proposed Digital Building Repository

MULTI-LAYERED GEOREFERENCED INTERACTIVE DATABASE



DBR DATA STRUCTURE

MODULE 1	Basic data on the building
MODULE 2	Building survey plan
MODULE 3	Building facades photographs and coordinates of RPs
MODULE 4	Orthomosaic and orthofacades
MODULE 5	Building facades performance
MODULE 6	Proposed renovation measures and solutions
MODULE 7	Evaluation of proposed renovation measures and solutions
MODULE 8	Renovation decision

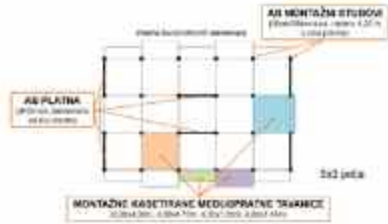
The Proposed Digital Building Repository

MODULE 1: Basic data on the building

P1: Building characterization

DATA CATEGORIES:

- General building information
- Data on building morphology
- Data on building structure
- Data on technical building system



GENERAL INFORMATION	
UNIQUE IDENTIFIER	
AVAILABLE DOCUMENTATION	
LOCATION	
YEAR OF CONSTRUCTION	
ARCHITECT	
INVESTOR	
CONTRACTOR	
APPLIED REGULATIONS	
BUILDING MORPHOLOGY	
GROUND FLOOR LAYOUT AND TYPICAL FLOORS	
BUILDING FACADES	
NUMBER OF STOREYS / BUILDING HEIGHT (m)	
BUILDING CONTENT	APARTMENTS / NUMBER AND STRUCTURE
UNIFUL FLOOR AREA (m²)	
BUILDING STRUCTURE	
FOUNDATION	
TYPE OF STRUCTURE	

The Proposed Digital Building Repository

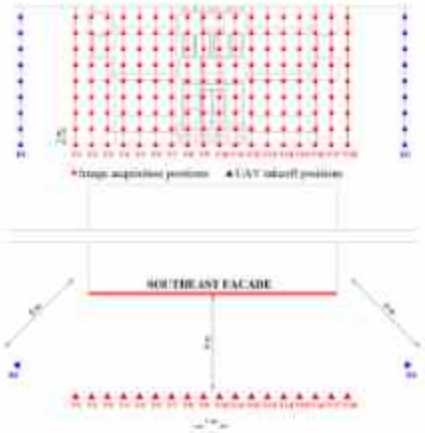
MODULE 2: Building survey plan

P2: Preparation and organization of building survey

DATA CATEGORIES:

- **UAV mission plan** - flight parameters (flight mode, pattern, flying distance, take off positions, camera orientation, GSD, image overlap percentage and capture intervals).
- **Geodetic measurement plan** - the positions of the surveying instrument, number and positions of reference points.

Flight Parameter		Performance	Flight Pattern
Flight mode		Manual	
Flying distance from the façade		6 m	
Camera orientation		Perpendicular	
GSD		2.1 mm	
Area covered by a single image		9 m × 7 m	
Image capture intervals		1 m × 1 m	
Image overlap	Vertical	86%	
	Horizontal	89%	



The Proposed Digital Building Repository

MODULE 3: Building facades photographs and coordinates of RPs

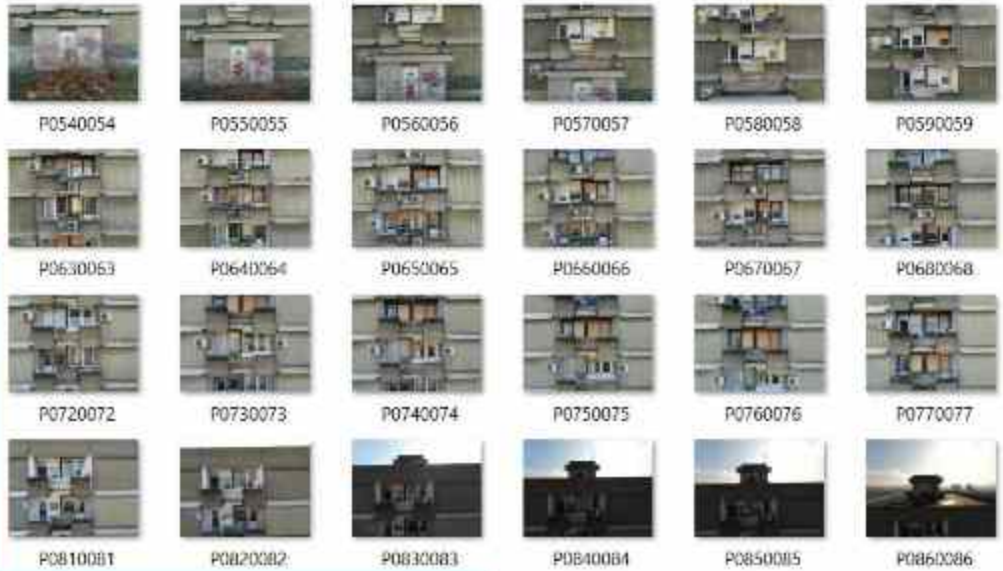
P3: Building survey

DATA CATEGORIES:

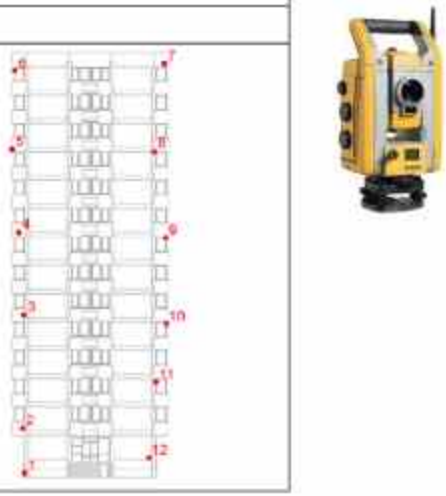
- Building facades photographs
- 3D coordinates of selected points

R. br.	Oznaka kontrolne tačke	Koordinate kontrolnih tačaka X (m)	Y (m)	Z (m)
1	L1	7409074,75	5011569,83	80,62
2	L2	7409204,54	5011599,89	80,25
3	L3	7409323,84	5011639,54	79,96
4	L4	7409373,99	5011527,15	79,41
5	L5	7409431,01	5011375,98	78,90
6	L6	7409328,83	5011337,24	78,70
7	L8	7409177,04	5011289,00	78,50
8	L9	7409128,61	5011415,56	79,54
9	L13	7409267,44	5011504,50	78,50

Poricije kontrolnih tačaka



No.	RP	Coordinates X (m)	Y (m)	Z (m)	Positions of reference points
SOUTH FASADE					
1	1	7409198,870	5011352,137	85,865	
2	2	7409198,738	5011351,882	90,270	
3	3	7409198,871	5011351,899	101,487	
4	4	7409198,362	5011351,741	109,621	
5	5	7409197,749	5011351,531	117,845	
6	6	7409197,890	5011351,759	125,575	
7	7	7409212,133	5011356,011	126,310	
8	8	7409211,200	5011355,709	117,610	
9	9	7409212,259	5011356,085	109,103	
10	10	7409212,292	5011356,179	100,582	
11	11	7409211,319	5011355,893	94,844	
12	12	7409210,593	5011355,853	87,372	



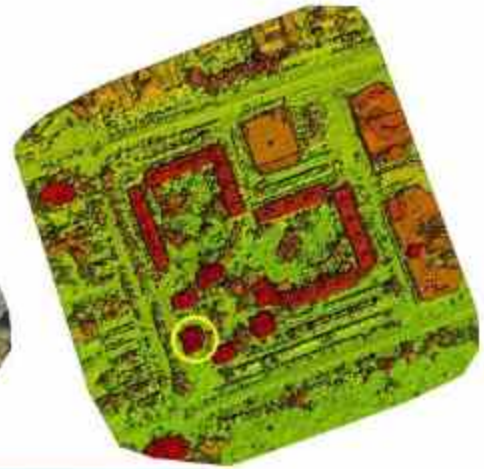
The Proposed Digital Building Repository

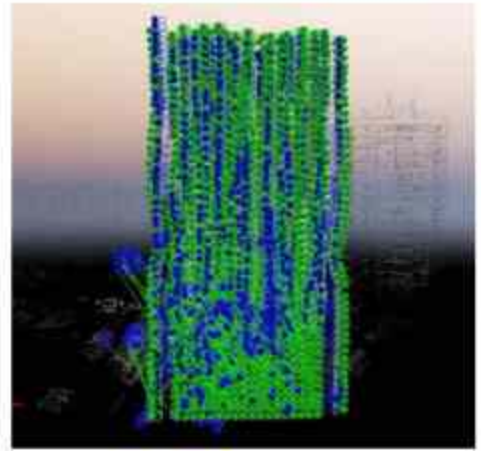
MODULE 4: Orthomosaic and orthofacades

P4: Orthomosaic and ortofacades generation

DATA CATEGORIES:

- Orthofacades
- Orthomosaic
- Digital surface model





The Proposed Digital Building Repository

MODULE 5: Building facades performance

Sub-module 5.1: Durability performance of building facades

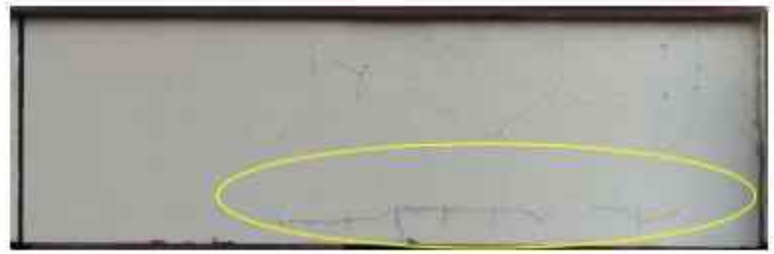
P5.1: Durability assessment of building facades

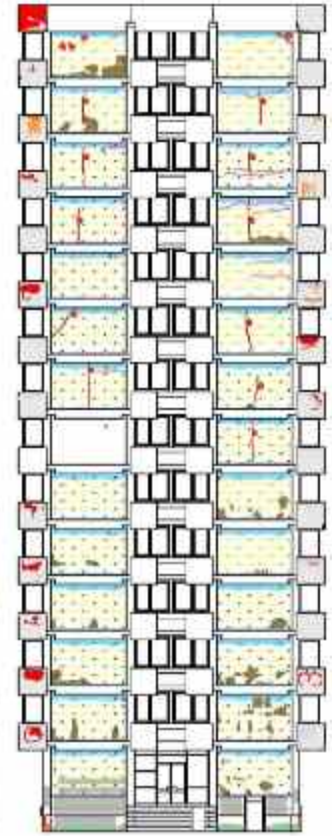
DATA CATEGORIES:

- Identified damages and defects
- Potential causes of damages and defects
- Classification of damages and defects
- Quantification of the degradation

Degradation condition of RC shear wall Z_{RC1}

Group of defects and damages	Defect/damage	Level of degradation of wall segment (floor)												
		0/GF	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
PHYSICAL NATURE DAMAGES	Oriented cracks	A	A	A	A	A	A	NP	C	C	A	C	C	C	C
	Surface moisture	B	B	B	B	B	B	NP	B	B	B	B	B	B	B
CHEMICAL NATURE DAMAGES	Efflorescence	B	B	B	B	B	B	NP	B	B	B	B	B	B	B
	Biological growth	-	A	A	A	A	A	NP	A	A	A	A	A	A	A
MECHANICAL NATURE DAMAGES	Material gap/porosity	A	C	A	A	C	A	NP	C	A	C	C	C	A	A
	Local mechanical damages	B	B	A	A	B	A	NP	B	A	B	B	B	A	A
DEFECTS	Perforated surface	D	D	D	D	D	D	NP	D	D	D	D	D	D	D
	Locally unsufficiently compacted concrete	A	C	C	C	C	C	NP	C	C	C	C	C	C	C
	Traces of formwork attachment	C	C	C	C	C	C	NP	C	C	C	C	C	C	C
	Geometric imperfections	B	B	B	B	B	B	NP	B	B	B	B	B	B	B
	Nonuniformly porous object texture	A	A	A	A	A	A	NP	C	A	A	A	C	A	A
DEGRADATION SEVERITY (%)		5,31	6,81	6,83	6,92	6,17	5,59	NP	5,82	5,60	5,78	5,79	5,81	6,63	6,44
		6,00 — global degradation state: GOOD													





The Proposed Digital Building Repository

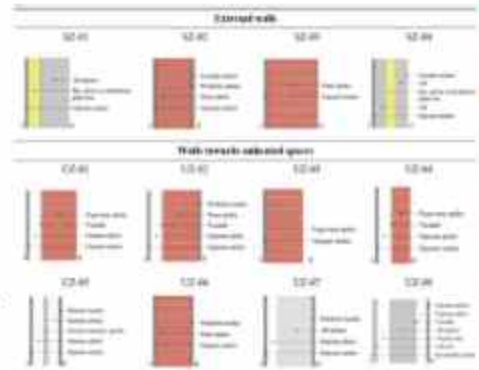
MODULE 5: Building facades performance

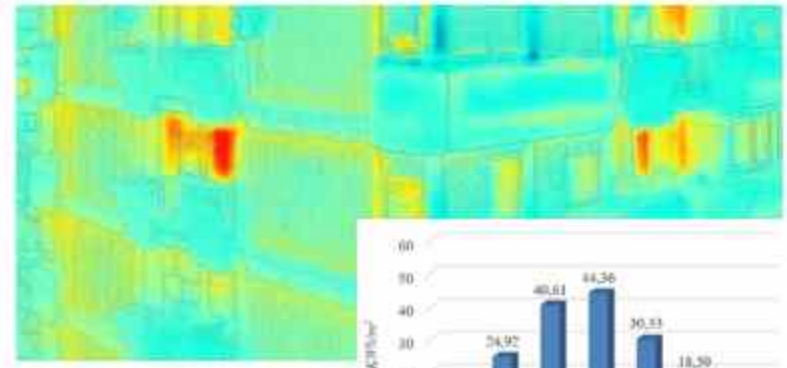
Sub-module 5.2: Energy performance of building

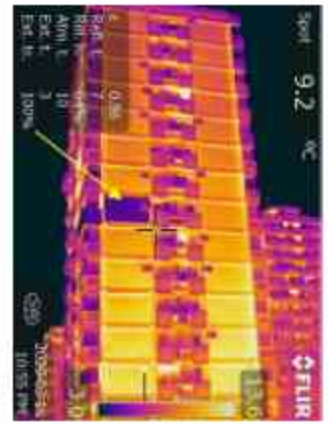
P5.2: Energy performance assessment

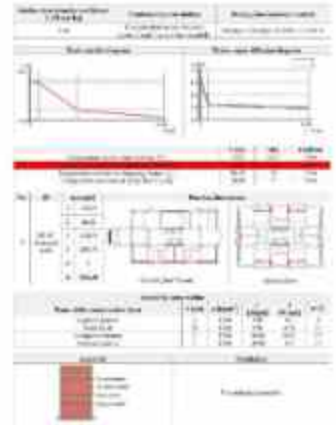
DATA CATEGORIES:

- Elements of building envelope
- Basic thermal-technical performance of building envelope
- Thermal bridges in the building envelope
- Required energy for heating of the building
- Building energy class









Energy class	$Q_{H,nd,ref}$ [%]	$Q_{H,ref}$ [kWh/(m²a)]
A+	≤ 15	≤ 10
A	≤ 25	≤ 18
B	≤ 50	≤ 35
C	≤ 100	≤ 70
D	≤ 150	≤ 105
E	≤ 200	≤ 140
F	≤ 250	≤ 175
G	> 250	> 175

The Proposed Digital Building Repository

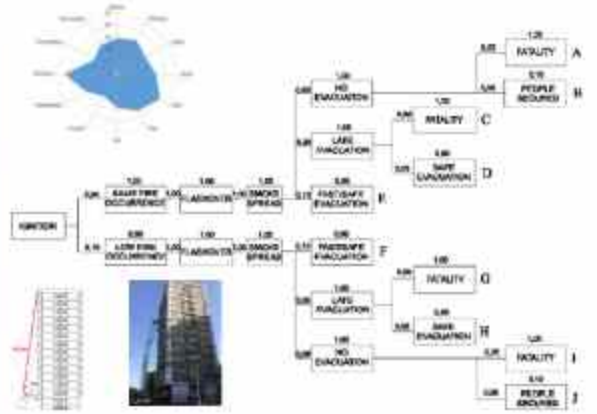
MODULE 5: Building facades performance

Sub-module 5.3: Fire safety performance of building

P5.3: Fire safety assessment

DATA CATEGORIES:

- Spatio-temporal analysis of fire distribution in residential (new Fire hazard map)
- Fire risk in high-rise residential buildings (new Fire risk map)
- The quality of building's fire safety performance (new Check-list)
- The building's fire risk in terms of fire protection system requirements
- The building's fire risk (quantified)

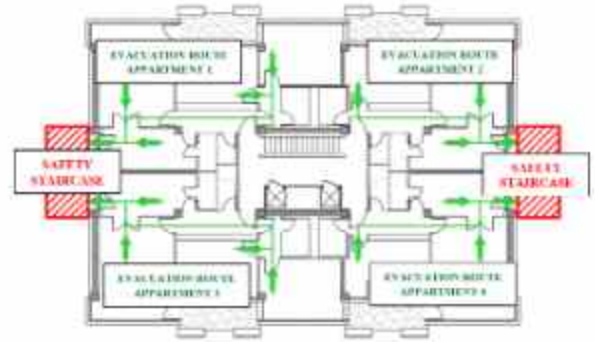


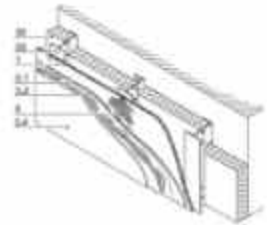
The Proposed Digital Building Repository

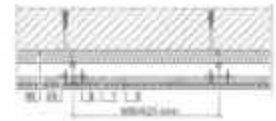
MODULE 6: Proposed renovation measures and solutions

P6: Proposal of measures and solutions for facade renovation

Proposed technical fire protection measures	
Construction measures	➢ replacement of the combustible partition in the niche in the ground floor hallway ➢ reconstruction of the external ramp for pedestrians and wheelchairs ➢ construction of a safety staircase
Special systems	➢ rehabilitation of the internal hydrant installation ➢ equipping the building with additional firefighting appliances ➢ installation of an automatic fire detection, notification/extinguishing system
Electrical installations and devices	➢ installation of emergency lighting on evacuation routes
Mechanical installations	➢ installation of fire protection dampers in ventilation shafts ➢ modernization of the elevator control system
Proposed organizational fire protection measures	
➢ marking all building exits, evacuation routes, doors, passages, and staircases with visible and appropriate signs ➢ education and informing of residents through fire drills, organized at least once every five years ➢ organizing and involving residents in fire extinguishing equipment usage drills, at least once every five years	



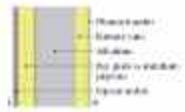
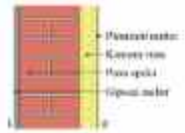
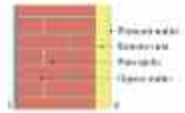
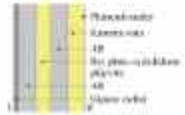


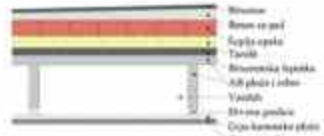


The Proposed Digital Building Repository

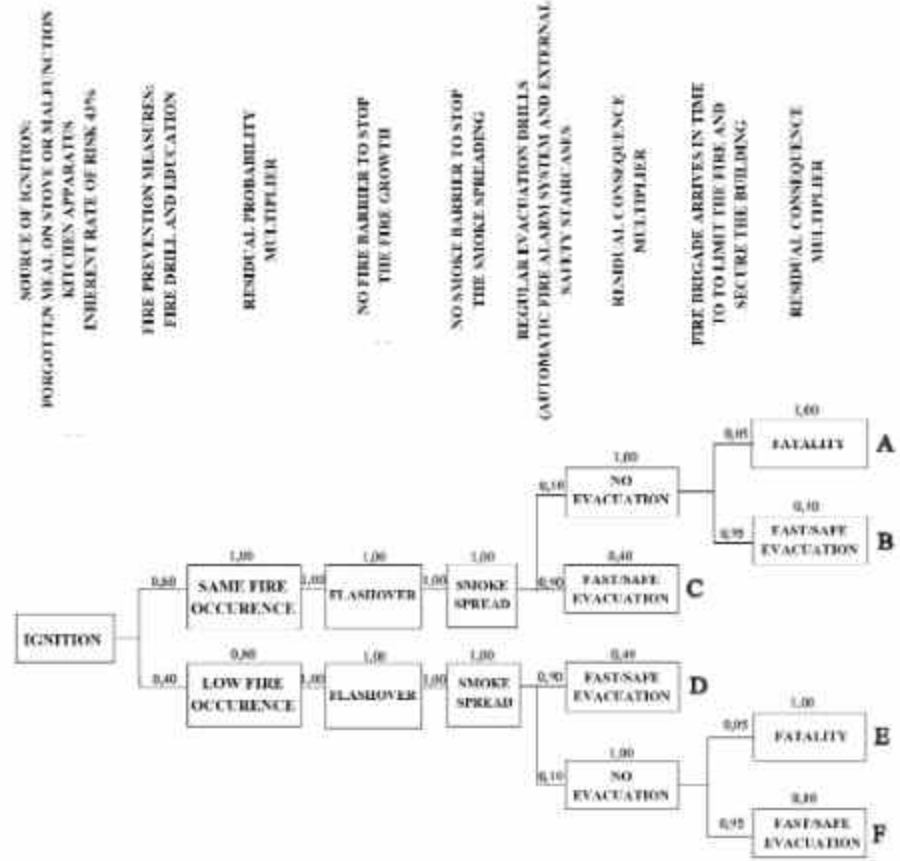
MODULE 7: Evaluation of proposed renovation measures and solutions

P7: Evaluation of proposed renovation measures and solutions

ID	Improved assembly	U_{before} [W/(m²K)]	U_{after} [W/(m²K)]	U_{max} [W/(m²K)]	Fulfilled YES / NO
SZ-01		1.49	0.38		YES
SZ-02		1.77	0.40	0.40	YES
SZ-03		1.45	0.38		YES
SZ-04		1.20	0.36		YES

RK-01	Slika sklopa	U [W/(m²K)]	U_{max} [W/(m²K)]	Ispunjeno DA / NE
Originalno rešenje		0,68	0,20	NE
Predloženo rešenje		0,19		DA

Improvement level	Transmission losses [kWh]	Ventilation losses [kWh]	Solar gains [kWh]	Gains from people [kWh]	Gains from appliance [kWh]	Energy required for heating [kWh]	Spec. annual energy required for heating [kWh/m²a]	Energy class
Designed state	576038,58	224607,36	184369,81	13712,56	52178,68	568802,62	162,17	F
I level	387356,61	93577,47	129861,01	13712,56	52178,68	289096,87	82,42	D
II level	282795,24	93577,47	120800,59	13712,56	52178,68	193414,71	55,14	C

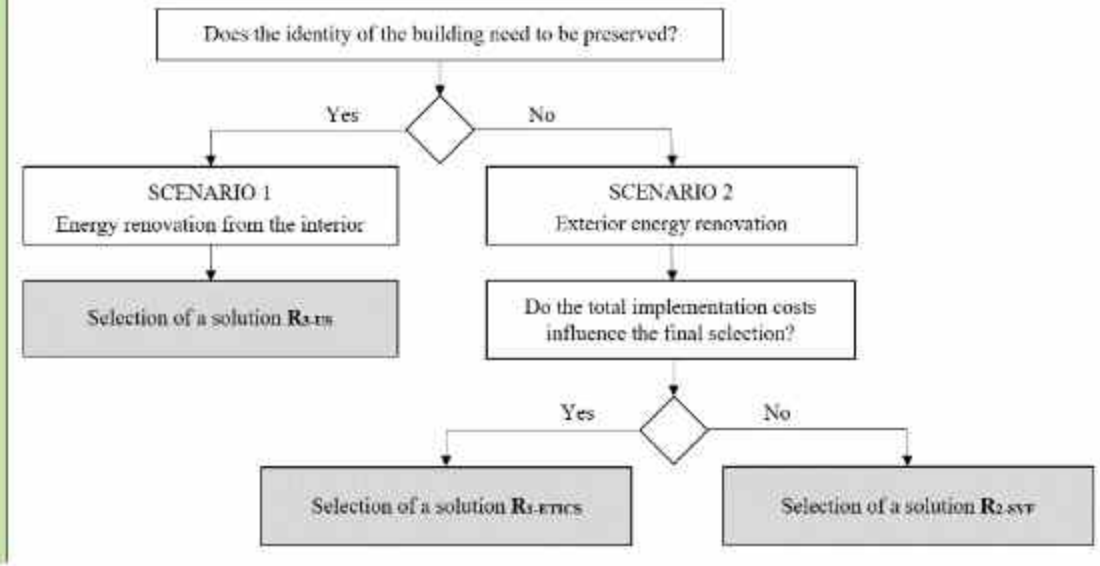


The Proposed Digital Building Repository

MODULE 8: Renovation decision

P8: Decision-making on renovation

IMMEDIATE INTERVENTIONS	SHORT-TERM INTERVENTIONS	LONG-TERM INTERVENTIONS
• Replacement of prefabricated reinforced concrete fences. • Repair of prefabricated parapets where concrete detachment has been detected. • Installation of an automatic fire detection and alarm system. • Installation of pressurized ventilation in the stairwell area. • Equipping the building with additional fire extinguishing equipment and providing training for residents on its use. • Installation of emergency lighting on evacuation routes. • Marking all exits from the building, evacuation routes, doors, passages, and staircases with visible signs of their appropriate purpose. • Removal of all objects from the entrance hall and vestibule that could obstruct evacuation.	• Replacement of gypsum walls within the thermal envelope. • Removal of the finishing layer on parapets and assessment of the condition of the external concrete and joints; necessary repair interventions. • Replacement of windows and doors. • Replacement of the flat roof system. • Thermal insulation of interfloor structures above unheated spaces. • Installation of fire protection dampers in ventilation shafts. • Modernization of the elevator control system. • Repair of the internal hydrant installation. • Replacement of the fire barrier in the ground floor corridor niche. • Education and information of residents through organized fire drills, at least once every five years. • Organizing and participating in fire extinguisher use drills within the building, at least once every five years.	• Repair of defects and damages on external walls, cantilever slabs, and edge beams. • Reconstruction of the pedestrian ramp for the entrance to the building, ensuring accessibility for wheelchair users. • Planning and construction of a safety staircase accessible from every apartment. • Installation of an automatic fire suppression system in the building, including the installation of sprinkler units in high-risk areas.



The Proposed Digital Building Repository

The integration of the presented tool with relevant publicly available digital platforms, such as geoportal GeoSrbija, would enable easy access, retrieval and exchange of information among various stakeholders involved in the building renovation process.

The repository can also serve as a basis for development of a **computer model** (application/expert system) that enables the operator (engineer) to quickly and simultaneously assess the durability, energy performance, and fire safety of high-rise residential buildings, and also suggests measures and solutions to improve these performances.

CONCLUSION

In 10 years, the buildings of Europe will be the microcosms of a more resilient, greener and digitalised society, operating in a circular system by reducing energy needs, waste generation and emissions at every point and reusing what is needed (Renovation Wave).

The importance of DBLs, which contain all relevant building-related data (including fire performance data!) throughout the entire life cycle of a building, is evident in the era of digitalisation, and interest in this topic is growing at the EU level.

Image source: https://www.epc.eu/content/programs/SPfE/BMU1.jpg

Thank you for your attention

Contact info about the presenter:
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Novi Sad, Serbia

e-mail: suzanav@uns.ac.rs
web page: www.gradjevinans.net

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jOiNEd For sUsTainability - bUilding climate REsilient communities in WB and EU

CIRCULAR ECONOMY IN THE BUILT ENVIRONMENT

Prof. dr Mirjana Laban

STUDY VISIT AT THE UNIVERSITY OF NOVI SAD, Novi Sad, Serbia

Date: 04 December 2023
Place: Novi Sad, Serbia

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1FUTURE

THE EUROPEAN GREEN DEAL

https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

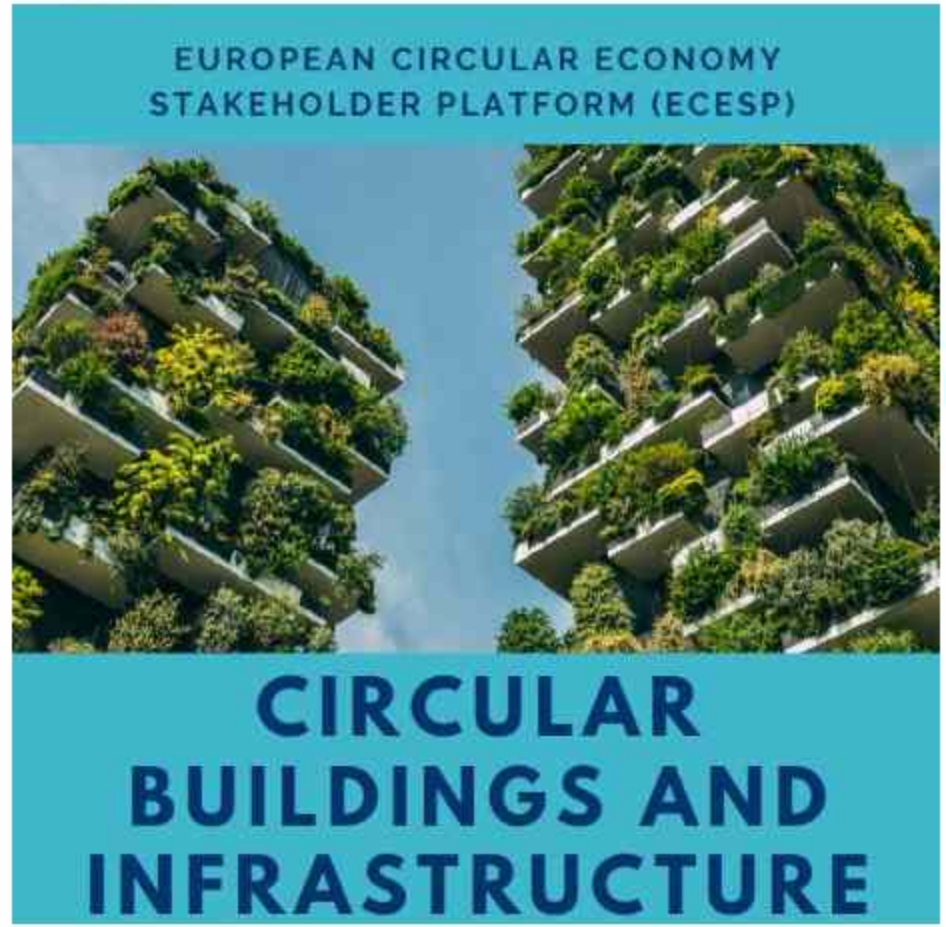
Key figures:

- The first climate-neutral continent by 2050
- At least 55% less net greenhouse gas emissions by 2030, compared to 1990 levels
- 3 billion additional trees to be planted in the EU by 2030

European Climate Pact

https://climate-pact.europa.eu/index_en

European Circular Economy Stakeholder Platform



https://circulareconomy.europa.eu/platform/en

Europe's state of the environment 2020:
change of direction urgently needed to face climate change challenges, reverse degradation and ensure future prosperity

https://www.eea.europa.eu/highlights/soer2020-europes-environment-state-and-outlook-report

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1FUTURE

UNIVERSITAS STUDIORUM NEAPOLITANENSIS MCMLX

Social Climate Fund

Emissions trading for road transport and buildings

Carbon Border Adjustment Mechanism

EU Emissions Trading System - for power, industry, maritime & aviation

Land Use, Forestry and Agriculture Regulation

Energy Taxation Directive

EU Forest Strategy

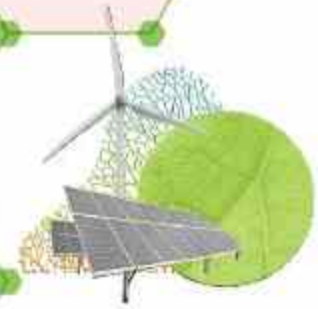
2030 CLIMATE TARGETS

Energy Efficiency Directive

Effort Sharing Regulation

Renewable Energy Directive

Alternative Fuels Infrastructure Regulation



CO_2 emissions standards for cars and vans

FuelEU Maritime Initiative

ReFuelEU Aviation Initiative

EUROPEAN GREEN DEAL

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FIT FOR 55 – COMMISSION PROPOSALS

EU Emissions Trading System (ETS) reform

New EU Emissions Trading System for building and road transport fuels

Social Climate Fund

Effort Sharing Regulation

Regulation on Land Use, Forestry and Agriculture (LULUCF)

CO2 emissions standards for cars and vans

Carbon Border Adjustment Mechanism (CBAM)

Renewable Energy Directive

Energy Efficiency Directive

Alternative Fuels Infrastructure Regulation (AFIR)

ReFuel EU Aviation Regulation

FuelEU Maritime Regulation

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1FUTURE

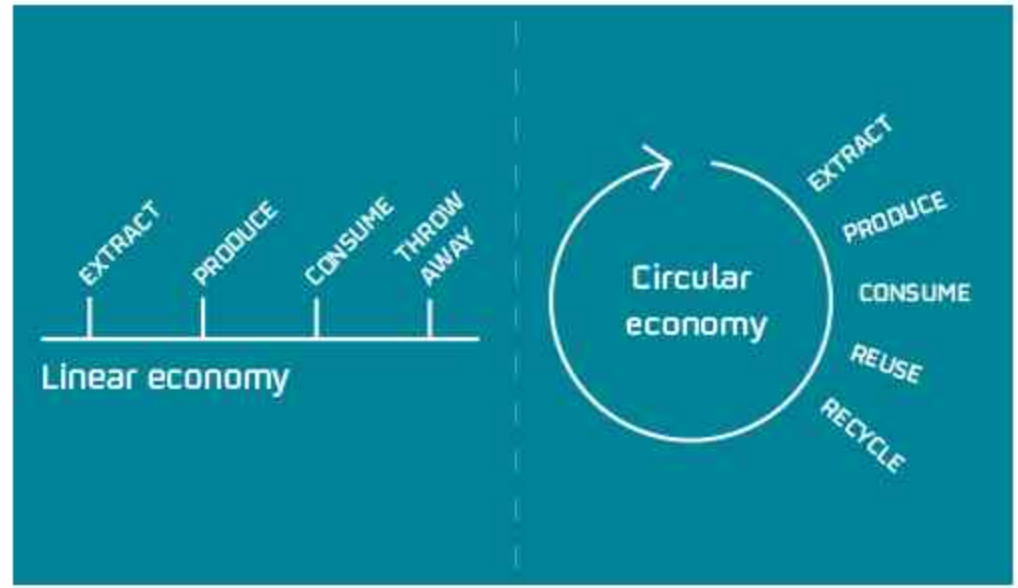
Based on a building's full lifecycle, the building sector is responsible for:

1/2 of all extracted materials

1/2 of the total energy consumption

1/3 of water consumption

1/3 of waste generation



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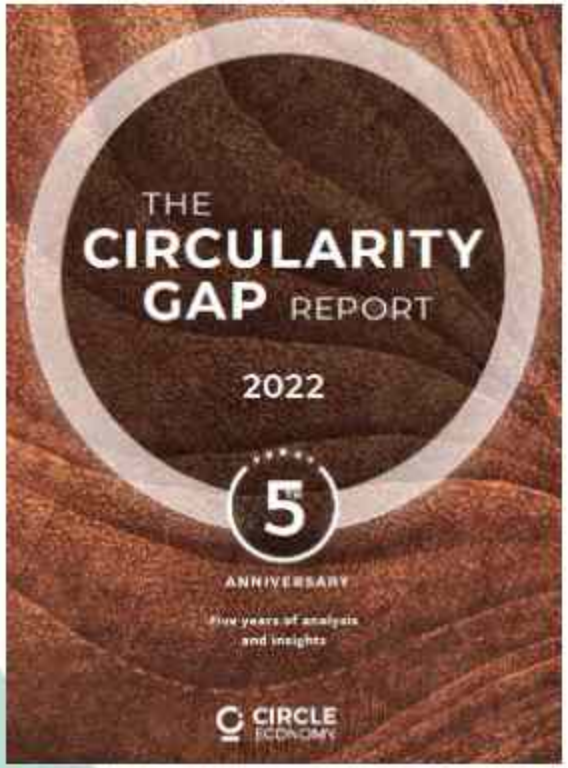
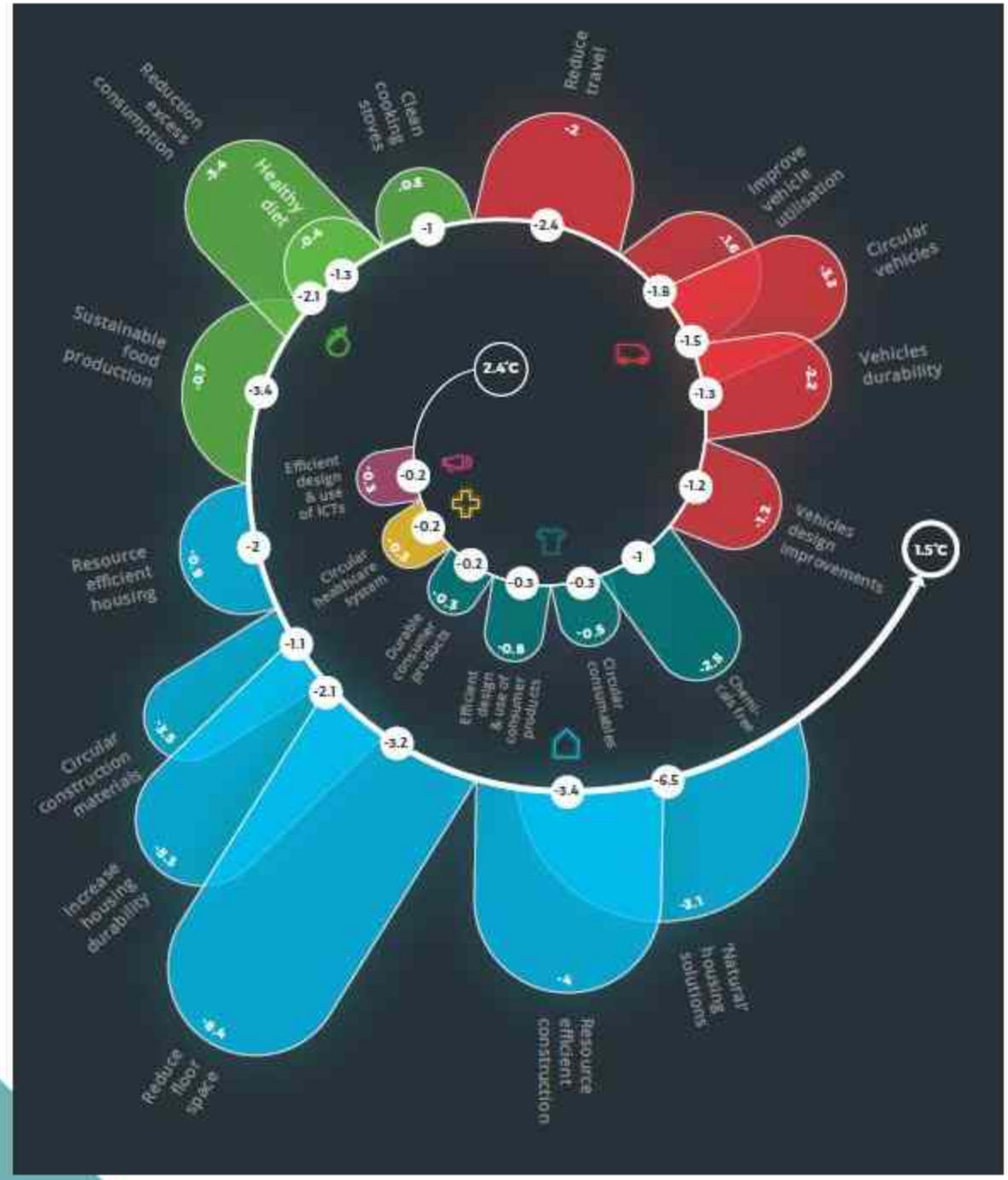


https://www.circularity-gap.world/2022



Together, the combined interventions can almost double the current global Circularity Metric of 8.6%, bringing it to 17%. This results in:

- Shrinking global material use and extraction by 28%.
- Cutting global GHG emissions by 39%—fully closing the Emissions Gap as defined in our report and taking into account the updated NDCs.
- Allowing the world to achieve the Paris Agreement's goal of keep at 1.5-degrees of warming by 2032.*

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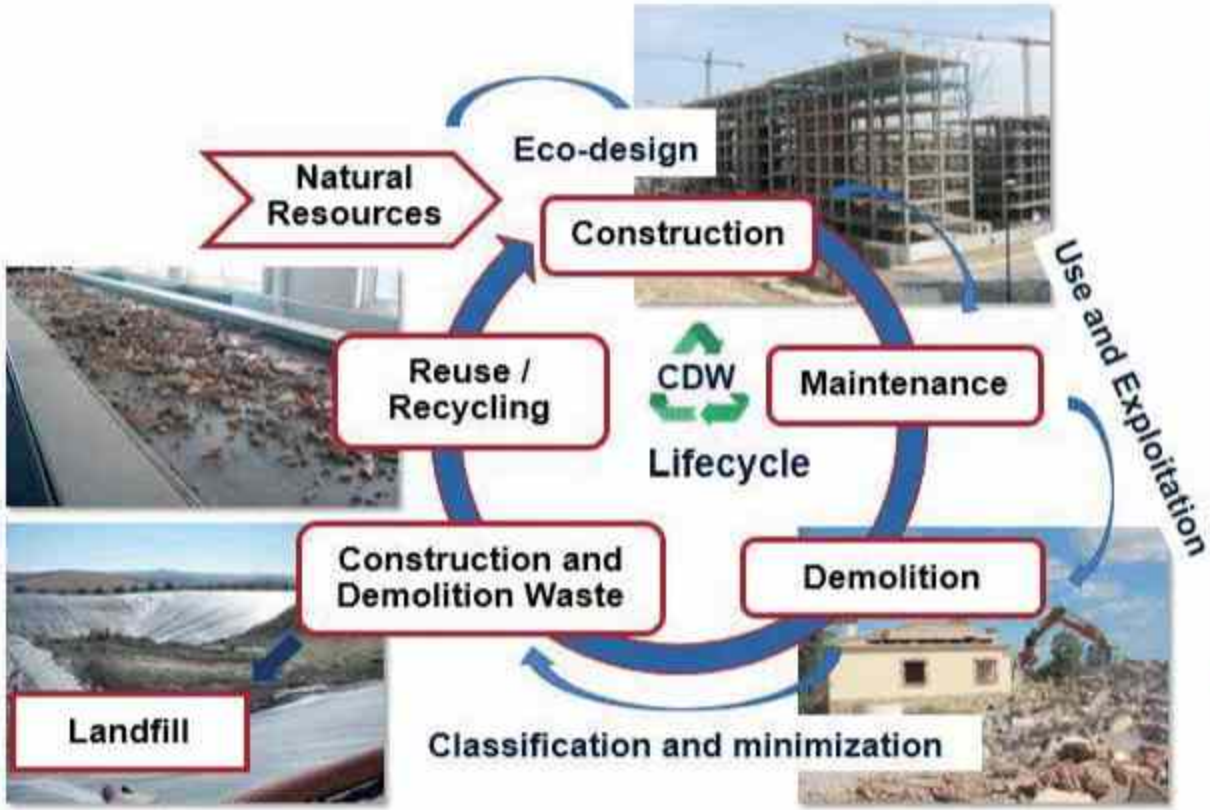
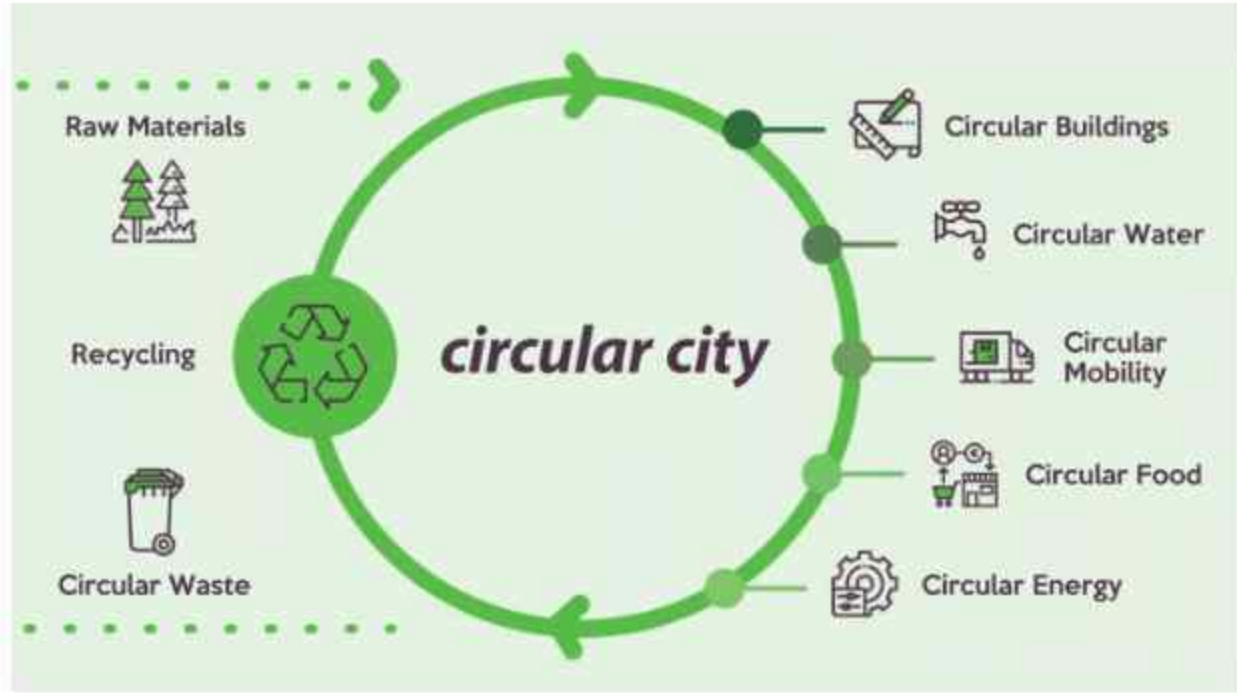
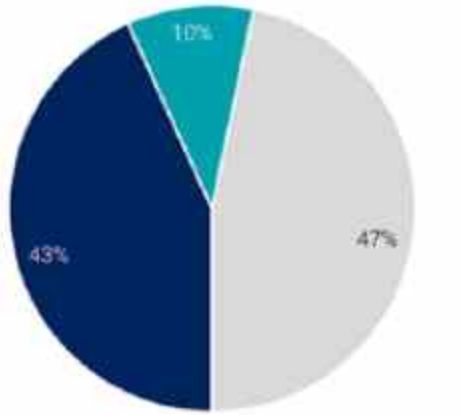
Circular Economy in Construction Industry



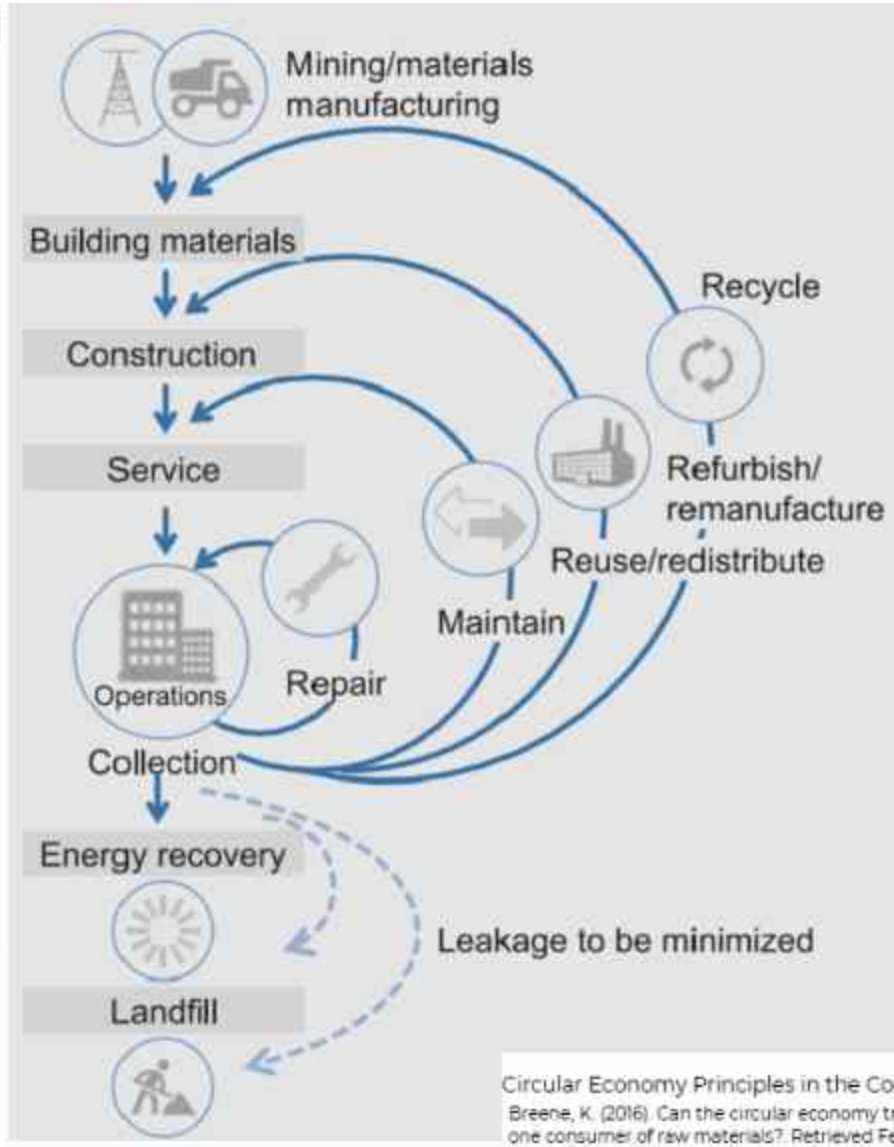


Co-funded by the European Union

Life cycle stage	Circular economy aspect
Design	DfD Design for adaptability and flexibility Design for standardisation Design out waste Design in modularity Specify reclaimed materials Specify recycled materials
Manufacture and supply	Eco-design principles Use less materials/optimise material use Use less hazardous materials Increase the lifespan Design for product disassembly Design for product standardisation Use secondary materials Take-back schemes Reverse logistics
Construction	Minimise waste Procure reused materials Procure recycled materials Off-site construction
In use and refurbishment	Minimise waste Minimal maintenance Easy repair and upgrade Adaptability Flexibility
End of life	Deconstruction Selective demolition Reuse of products and components Closed-loop recycling Open-loop recycling
All stages: management of information including metrics and datasets	



Global Infrastructure Hub. (2021). Advancing the circular economy through infrastructure. Retrieved February 8, 2022, from source



Circular Economy Principles in the Construction Value Chain
Breene, K. (2016). Can the circular economy transform the world's number one consumer of raw materials?. Retrieved February 8, 2022, from source

In total, the construction (infrastructure and buildings) sector consumes around 60% of the world's materials and is responsible for around 53% of the world's greenhouse gas emissions[ii].

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COST ACTION CA21103:
Implementation of Circular Economy in the Built Environment

https://circularb.eu/

CircularB Action aims to develop a common international framework of a circularity rating tool with Key Performance Indicators (KPIs) based on current best practices of CE construction, state-of-the-art and ECEAP.

Circular Economy
Building's circularity
Circular Value Chain
Built Environment
Sustainable Development Goals

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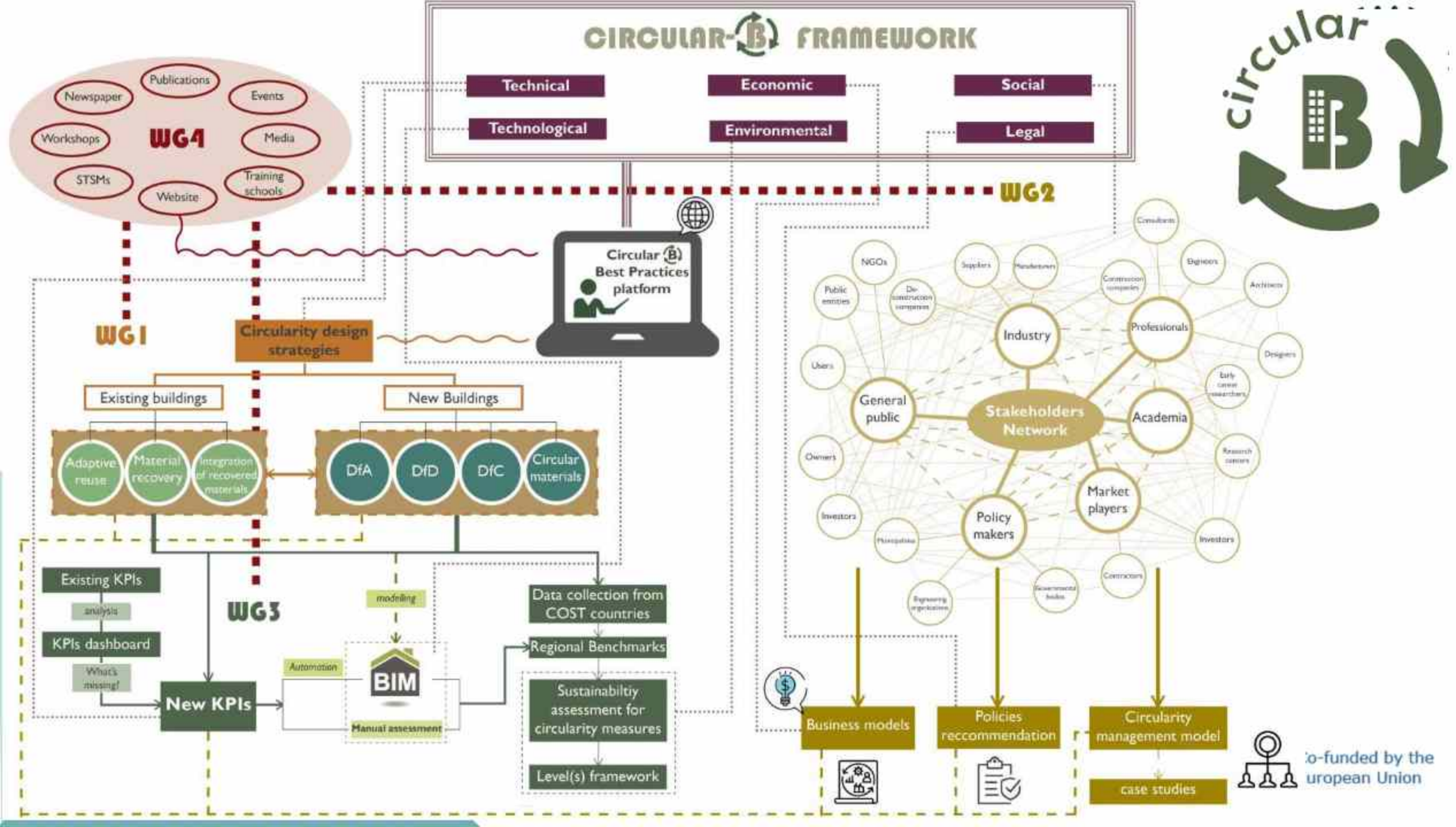
CIRCULAR-B FRAMEWORK
Technical
Economic
Social
Technological
Environmental
Legal
circular
WG4
Publications
Newspaper
Events
Workshops
Media
STSMs
Training schools
Website
WG2
Circular B Best Practices platform
WG1
Circularity design strategies
Existing buildings
New Buildings
Adaptive reuse
Material recovery
Integration of recovered materials
DfA
DfD
DfC
Circular materials
Stakeholders Network
Industry
Professionals
Academia
General public
Market players
Policy makers
NGOs
Suppliers
Manufacturers
Consultants
Engineers
Architects
Designers
Public entities
Construction companies
Users
Owners
Investors
Contractors
Existing KPIs
analysis
KPIs dashboard
What's missing?
New KPIs
WG3
modelling
Automation
BIM
Manual assessment
Data collection from COST countries
Regional Benchmarks
Sustainabiltiy assessment for circularity measures
Level(s) framework
Business models
Policies reccommendation
Circularity management model
case studies
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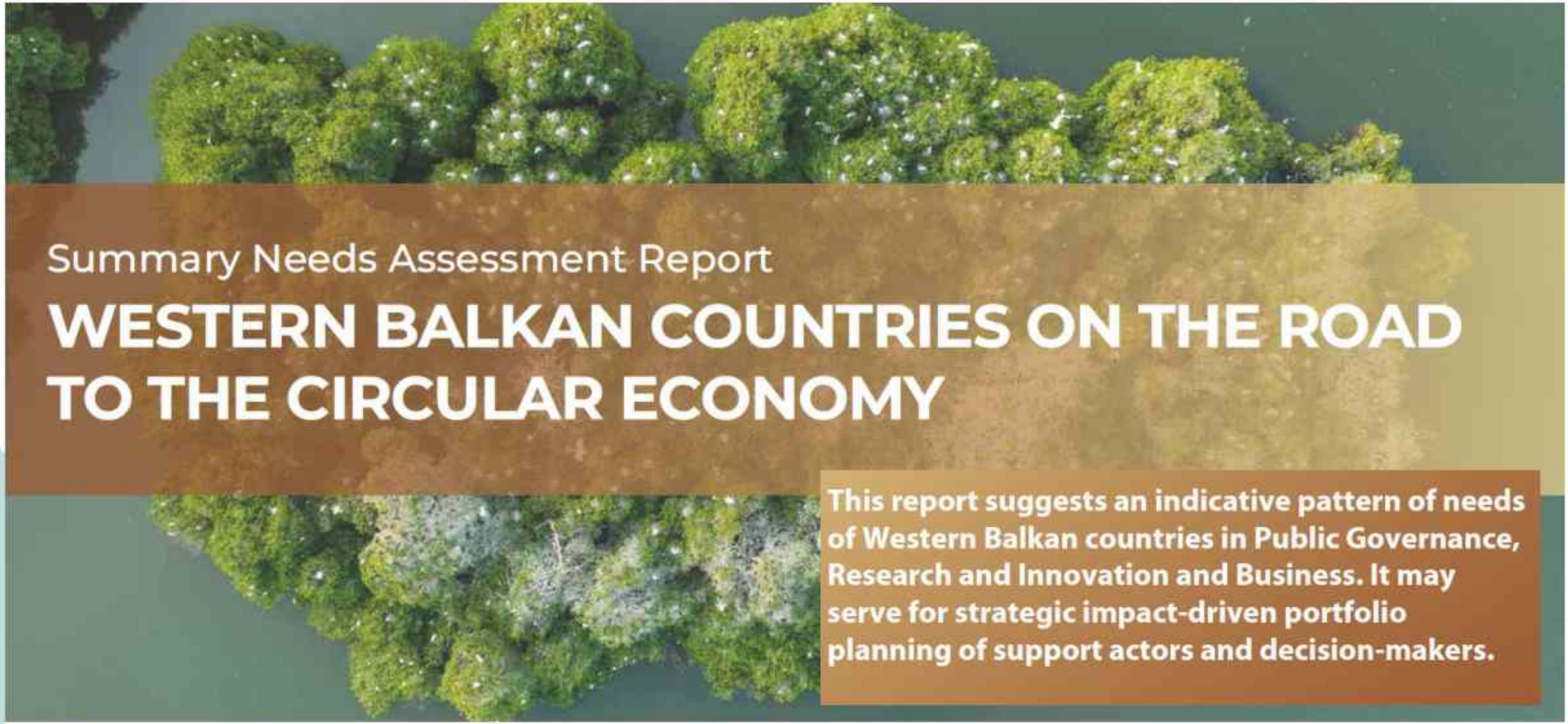


Summary Needs Assessment Report

WESTERN BALKAN COUNTRIES ON THE ROAD TO THE CIRCULAR ECONOMY

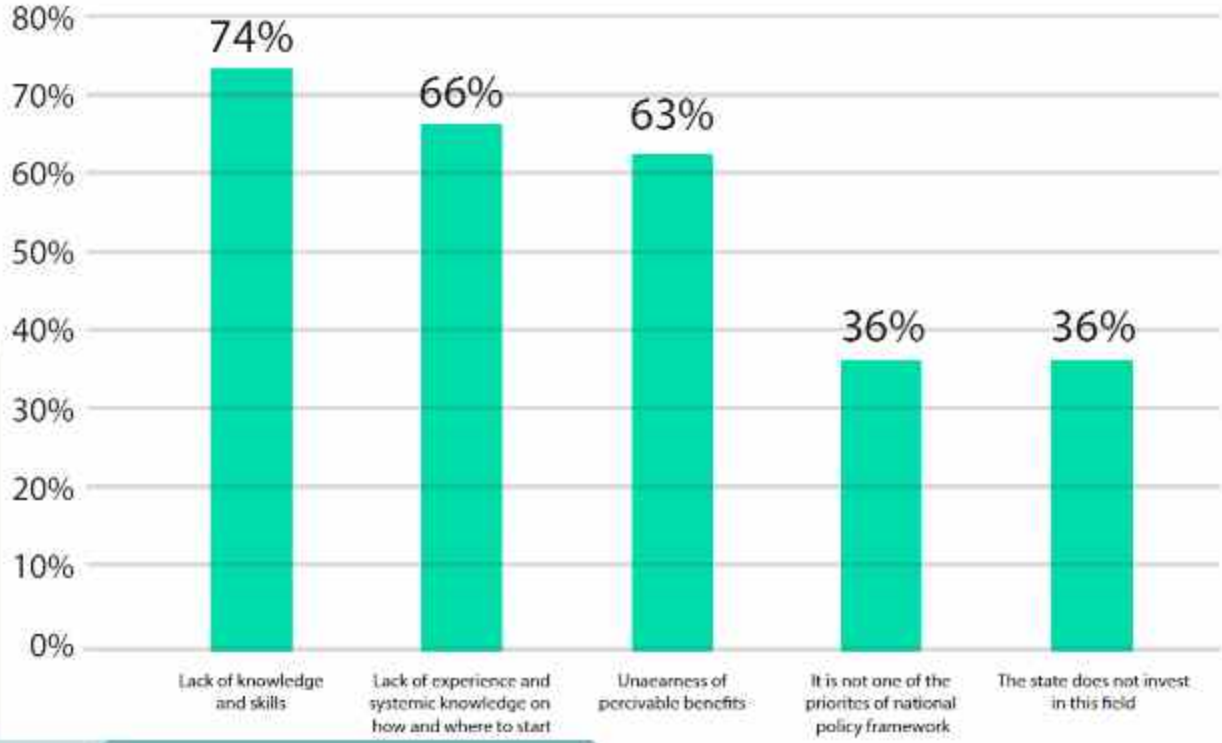
This report suggests an indicative pattern of needs of Western Balkan countries in Public Governance, Research and Innovation and Business. It may serve for strategic impact-driven portfolio planning of support actors and decision-makers.

1FUTURE

Main barriers to implementing circular economy in Western Balkan countries

Despite the different policy situations in all the countries, main barriers to implementing the circular economy are:

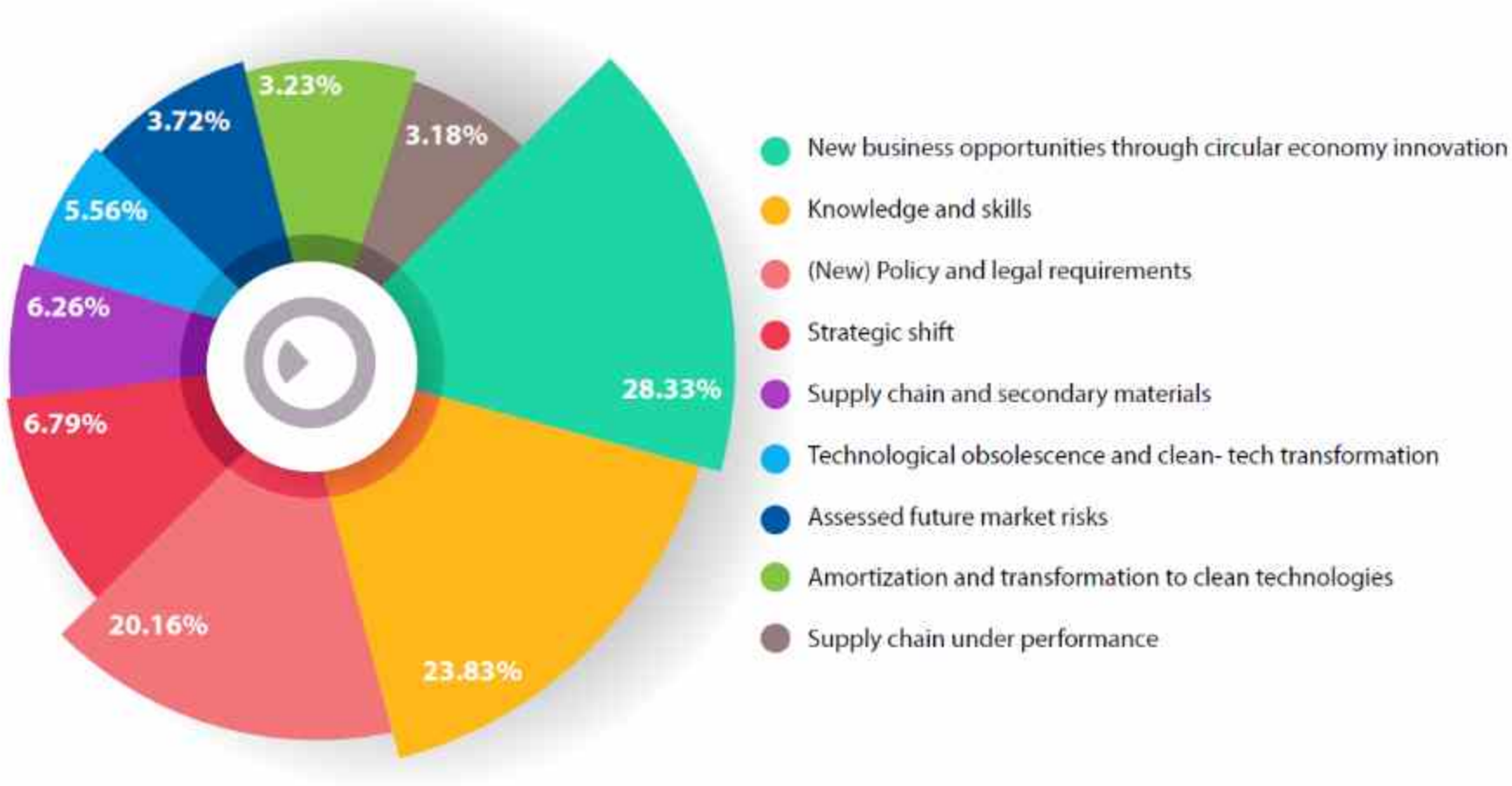
- lack of knowledge and skills
- unawareness of perceivable benefits
- lack of experience of where and how to start
- lack of multidisciplinary professions and skills



Barriers to bringing new policies that anticipate circular economy in Western Balkan Countries

Co-funded by the European Union

Biggest challenges in future development of companies in Western Balkans



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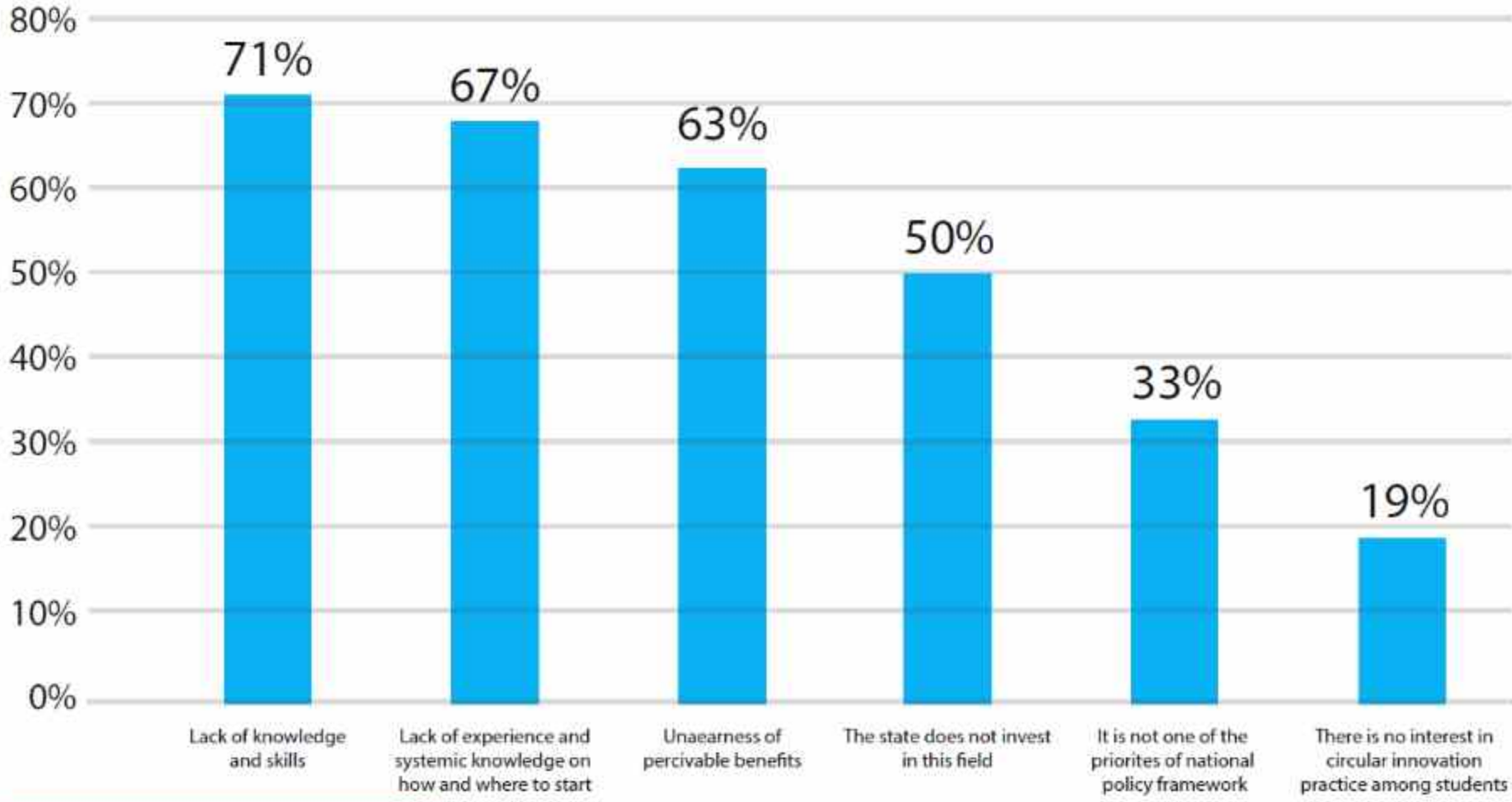
Barriers to introducing CE in innovation sector and academia in Western Balkan countries



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II. Circular economy

We commit to the process of transition from linear to a circular economy being fully aware of the necessity for research and innovation system to support this transition. With the aim to further contribute in this way to the environmental protection and minimization of the amount of waste generated in the region we envision the following actions:

- **Integrate the Western Balkans into the EU industrial supply chains by:**
  - Taking decisive action to improve the **sustainability of primary production of raw materials;**
  - Applying an **industrial ecosystem approach** to attain an environmentally sustainable, balanced economic recovery across the region, in particular for key future-proof industrial ecosystems such as renewable energy, digital, mobility; and resource-intensive industrial sectors such as tourism, textile, transport-automotive and energy-intensive industries;
- Develop **circular economy strategies** looking at the entire lifecycle of products, waste prevention, modern waste management and recycling, re-use, repair and re-manufacturing;
- Make further progress in constructing and maintenance of **waste management infrastructure** for cities and regions;
- Design and implement **consumer-targeted initiatives** raising awareness of citizens on waste, separate collection and sustainable consumption;
- Conclude and implement a **regional agreement on prevention of plastic pollution**, including specifically addressing the priority issue of marine litter;
- Further implement **Smart Specialisation Strategies**, place-based, innovation-led transformation agendas for sustainability.

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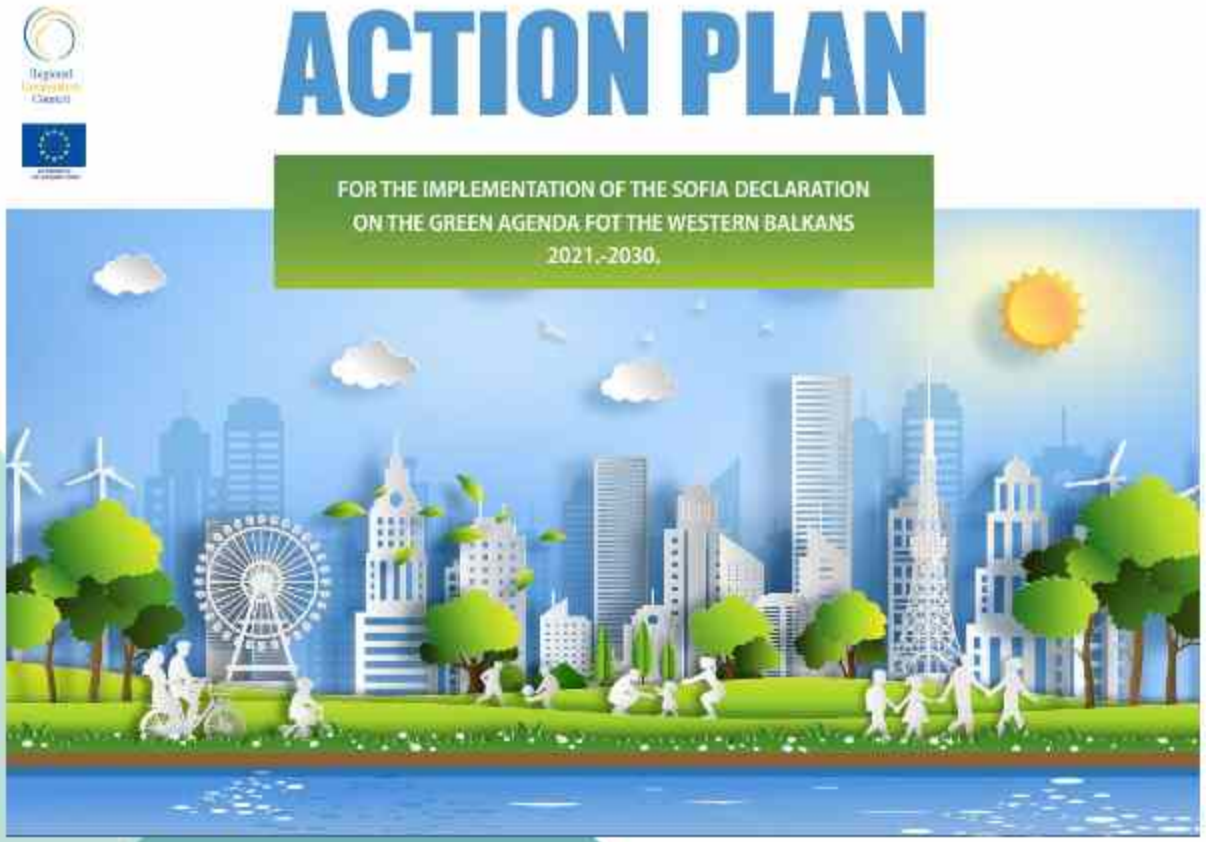
https://www.rcc.int/docs/596/action-plan-for-the-implementation-of-the-sofia-declaration-on-the-green-agenda-for-the-western-balkans-2021-2030



ALB

MNG

BH

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WELLCOME TO NOVI SAD!!!

Prof. dr Mirjana Laban, mirjana.laban.ftn@gmail.com

UNS 1FUTURE TEAM

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1FUTURE

jOiNEd For sUsTainability - bUilding climate REsilient communities in WB and EU

Sustainable Agriculture

Assist. Prof. dr Ljiljana Popović

ljiljana.popovic@uns.ac.rs

Date: 04 December 2023

Place: Novi Sad, Serbia

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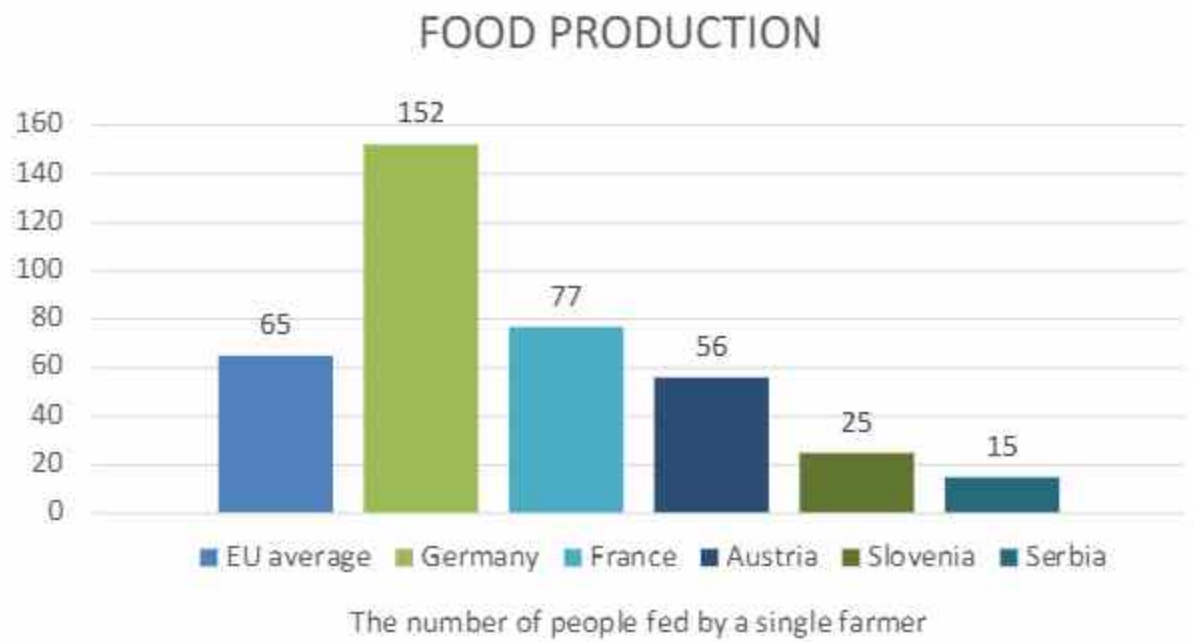
Facts about Serbian village

- Serbian villages are disappearing.
- Out of 4,700 villages in Serbia, 1,200 will vanish in the next fifteen years.
- In over 1,000 villages, fewer than 100 inhabitants reside.
- In over 200, villages there is not a single resident under 20 years old.
- In 400 villages, there are no stores.
- In 230 villages, there are no schools.

Co-funded by the European Union

Facts about Serbian agriculture

- Serbia has 5,097,000 hectares of agricultural land: 0.59 hectares per capita
- 4,224,000 hectares are arable: 0.47 hectares per capita
- 3,355,859 hectares are cultivated, leaving a significant 860,000 hectares uncultivated.



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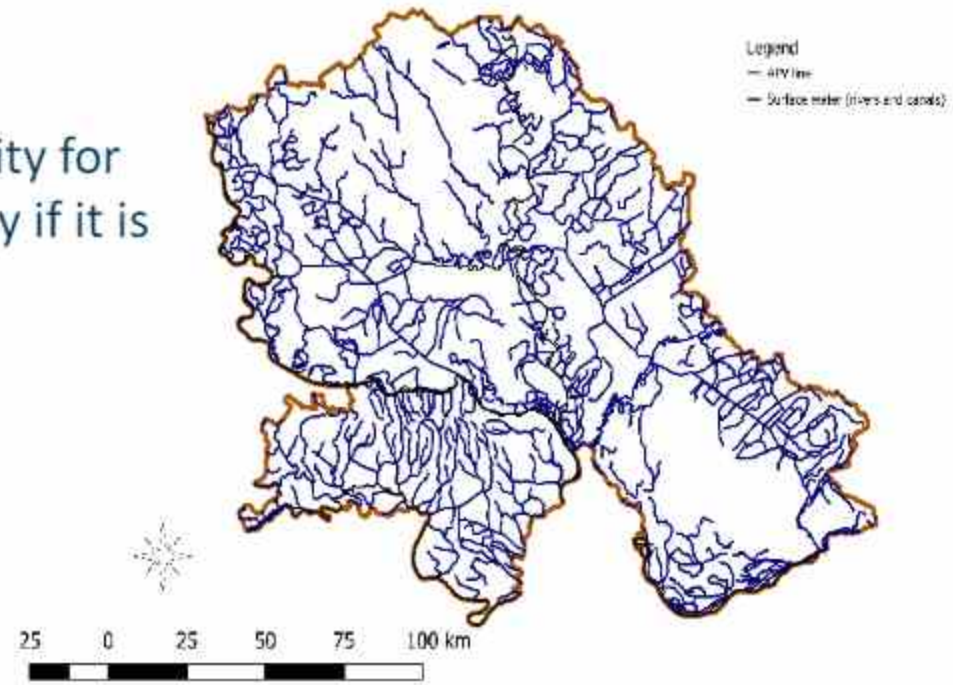
Facts about Serbian agriculture

- Vojvodina has 22,000 kilometres of canals.
- The Danube – Tisa – Danube canal, with a 929-kilometer canal network, is the largest hydrosystem in the world! It is a unique hydro-engineering system for flood control irrigation, amelioration, forestry, water supply, waste water evacuation, tourism, fishing, hunting.
- Only about 3%, or around 100,000 hectares, of arable land is irriga
  - Contribution of agriculture to GDP is 6-7%
  - Agriculture represents a significant opportunity for the Serbian economy and rural areas, but only if it is modern and based on the latest technology.



Definition of drought

- The World Meteorological Organization defines drought as a prolonged absence or marked deficiency of precipitation, a deficit of precipitation that causes a lack of water for a specific activity, and as a period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance.

Types of drought:

Meteorological drought

Agricultural drought

Hydrological drought

Socio-economic drought

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Drought mitigation

Short-term adaptation measures:

- Adjusting the calendar of works in the field to the changed climatic conditions
- Crop insurance

Medium-term adaptation measures:

- Agriculture digitalization
- Improvement of soil fertility

Long-term adaptation measures:

- Irrigation systems
- Large scale Early warning systems
- Development of new varieties and hybrids tolerant to drought

Co-funded by the European Union

Antares

Project aim: ANTARES aims to evolve BioSense Institute into a European Centre of Excellence (CoE) for advanced technologies in sustainable agriculture

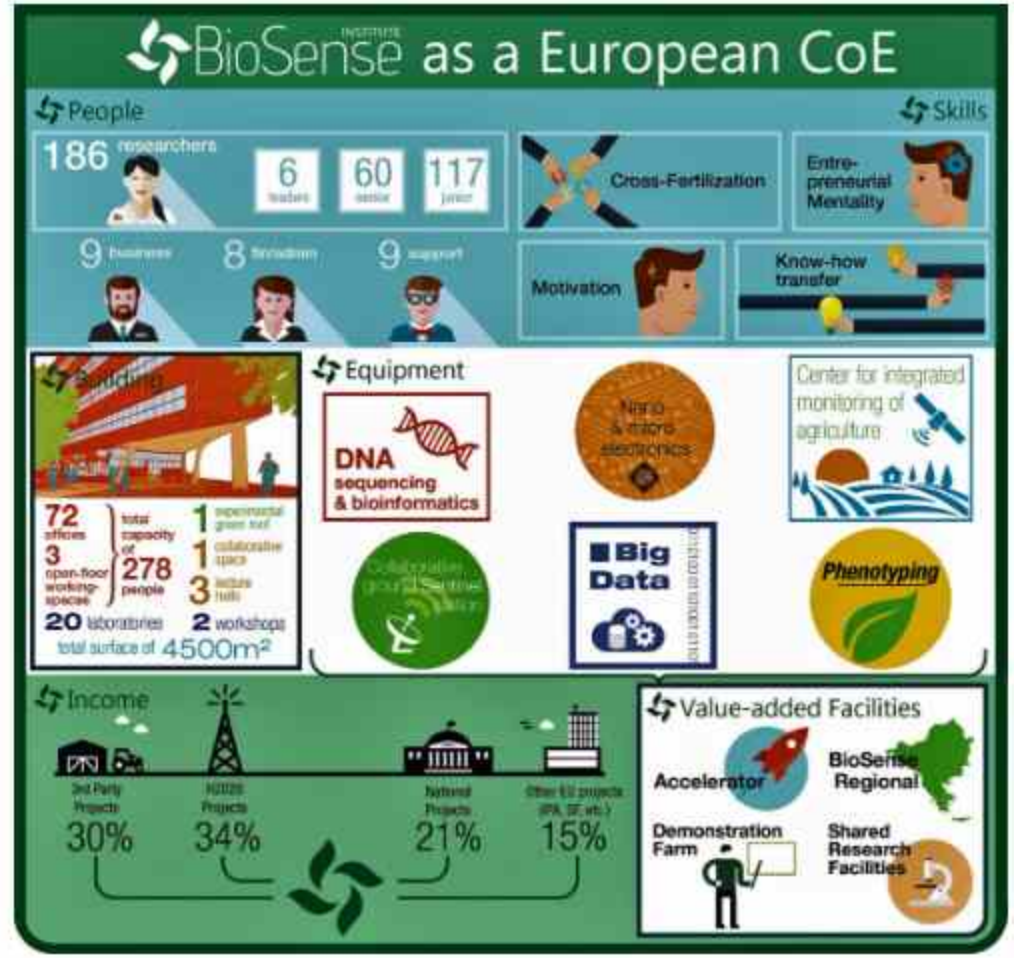
Deliverables:

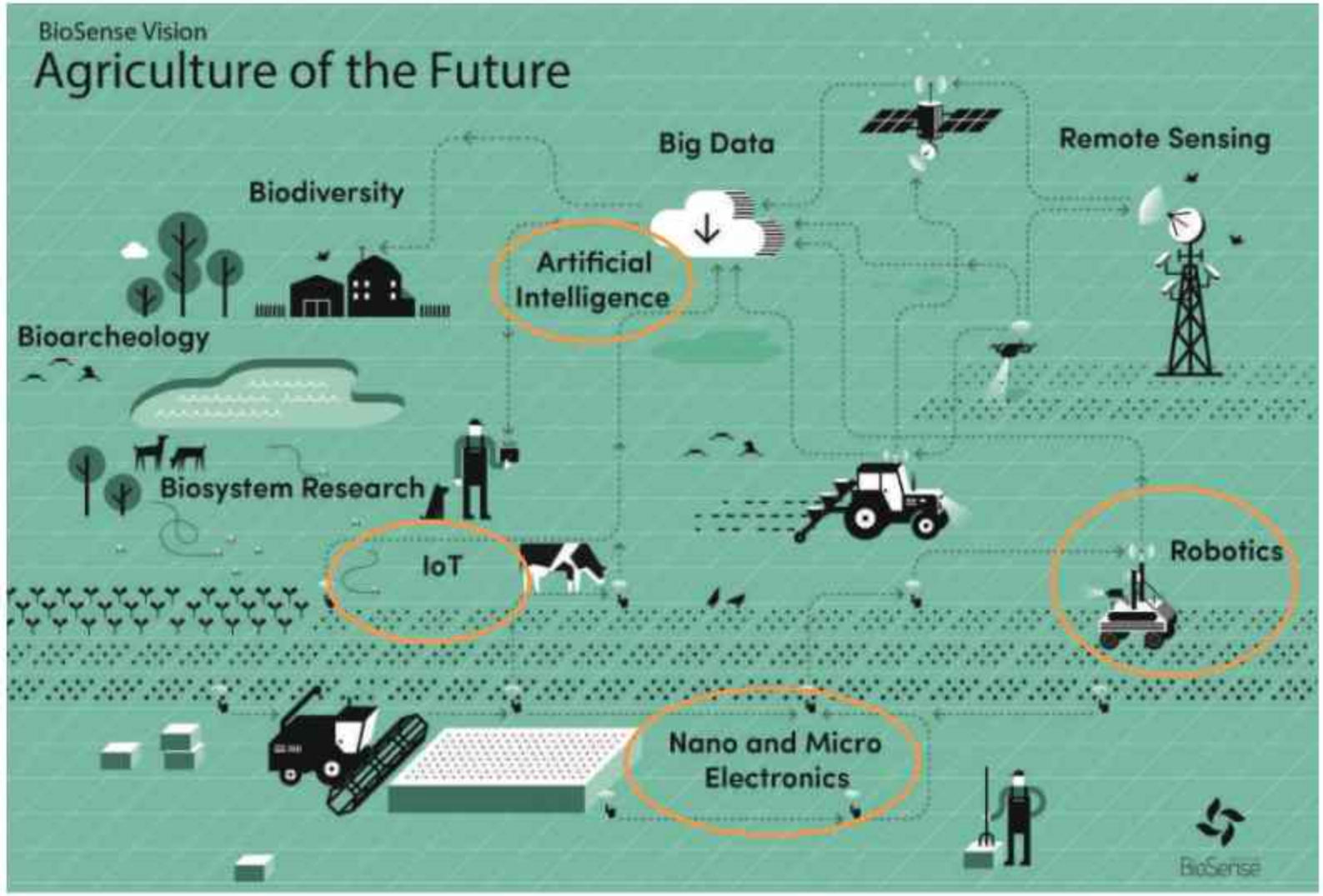
- disruptive digital solutions to the European farming sector,
- boosting research excellence,
- stimulation of entrepreneurship and employment at regional level,
- To secure enough safe food for growing global population.

Antares

Three pillars of sustainability:

1. strong research infrastructure that includes the new building and state-of-the-art equipment,
2. dedicated human resources plan and
3. scientific excellence across various disciplines:
   - material science,
   - micro and nano electronics,
   - sensor design,
   - remote sensing,
   - Internet of Things,
   - artificial intelligence and
   - biosystem research.





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Digital farm

Physical part of the Digital Farm

Different AgTech solutions:

- sensors,
- satellite images,
- drones,
- agrorobots,
- variable rate technology machinery and other

Virtual part of the Digital Farm

Digital platform ***AgroSense*** for monitoring crop conditions and planning of agricultural activities using a mobile phone or a computer.

Data collected from:

- satellites,
- drones,
- robots,
- various sensors and
- meteorological stations,

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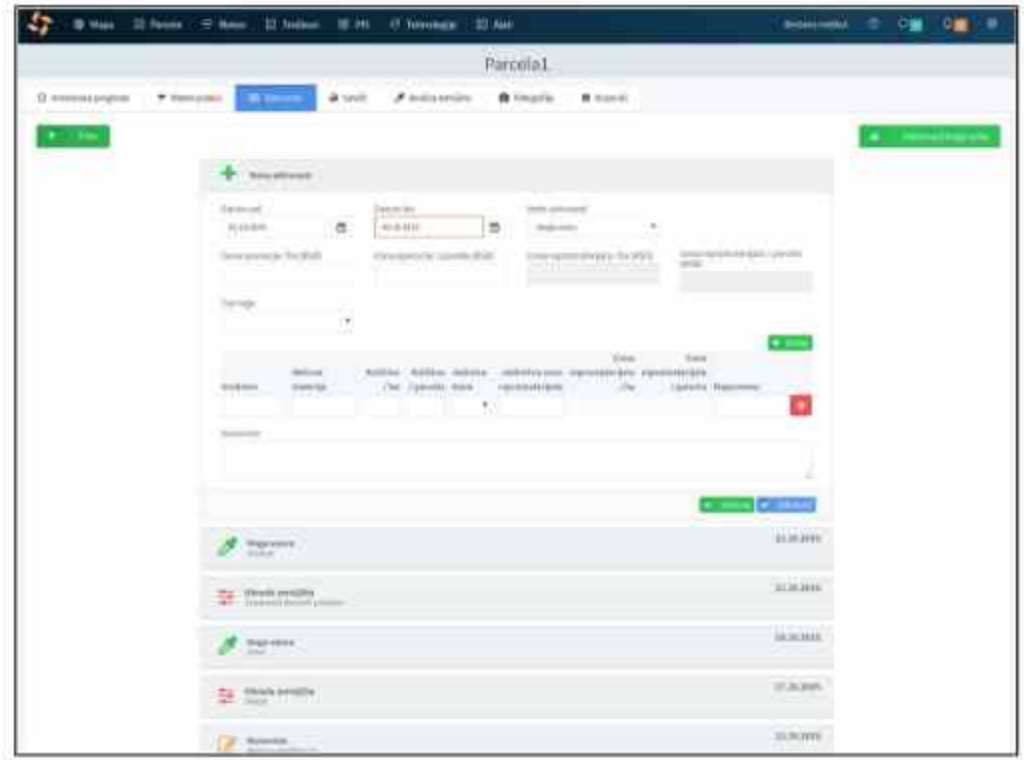
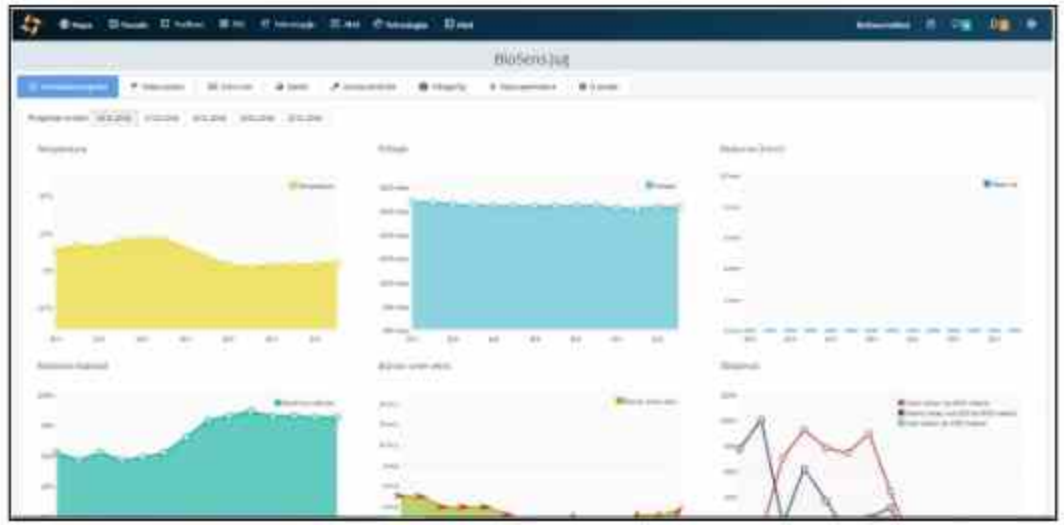
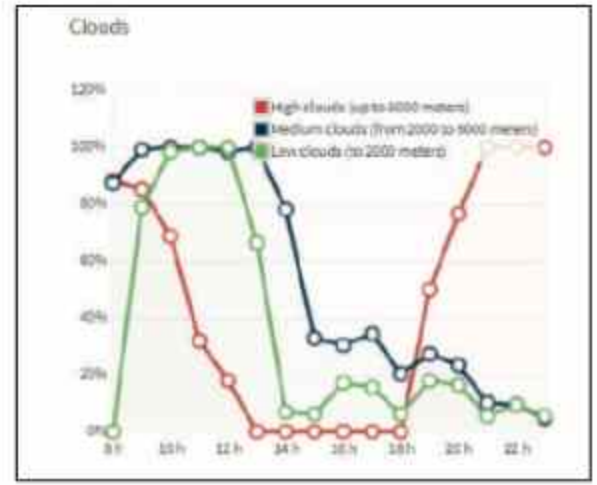
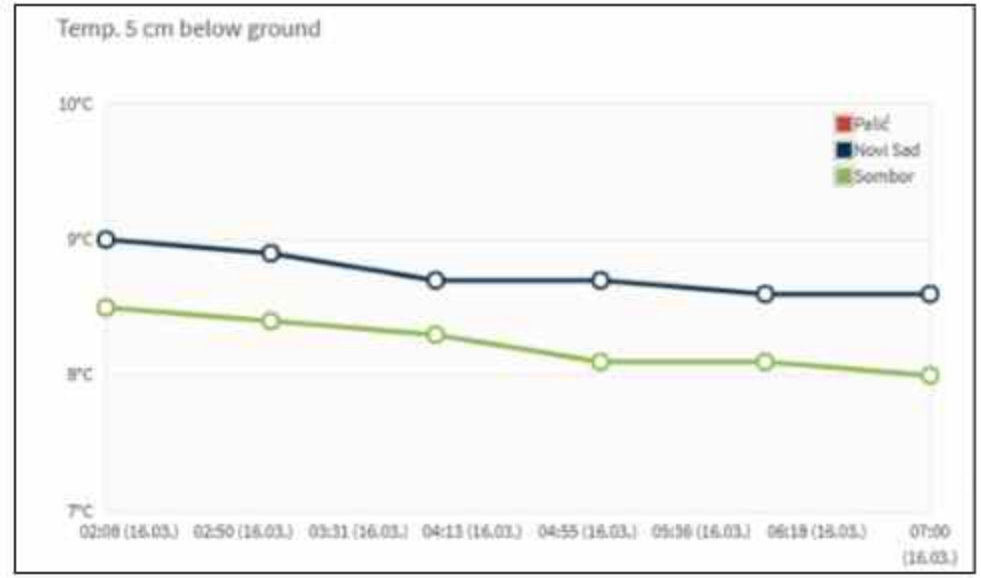


Diary of agricultural activities

Co-funded by the European Union



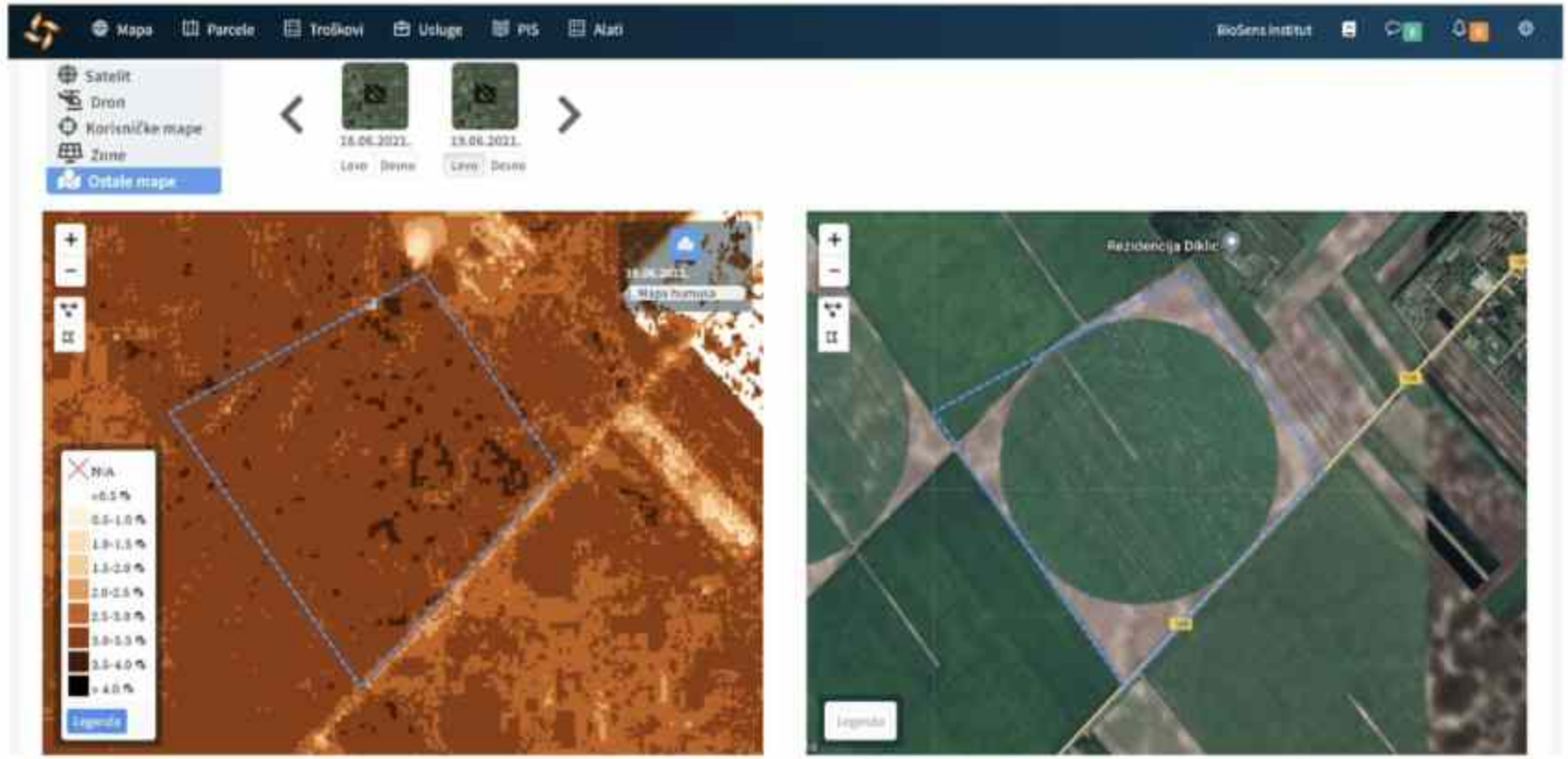




Weather forecast for the location of the parcel

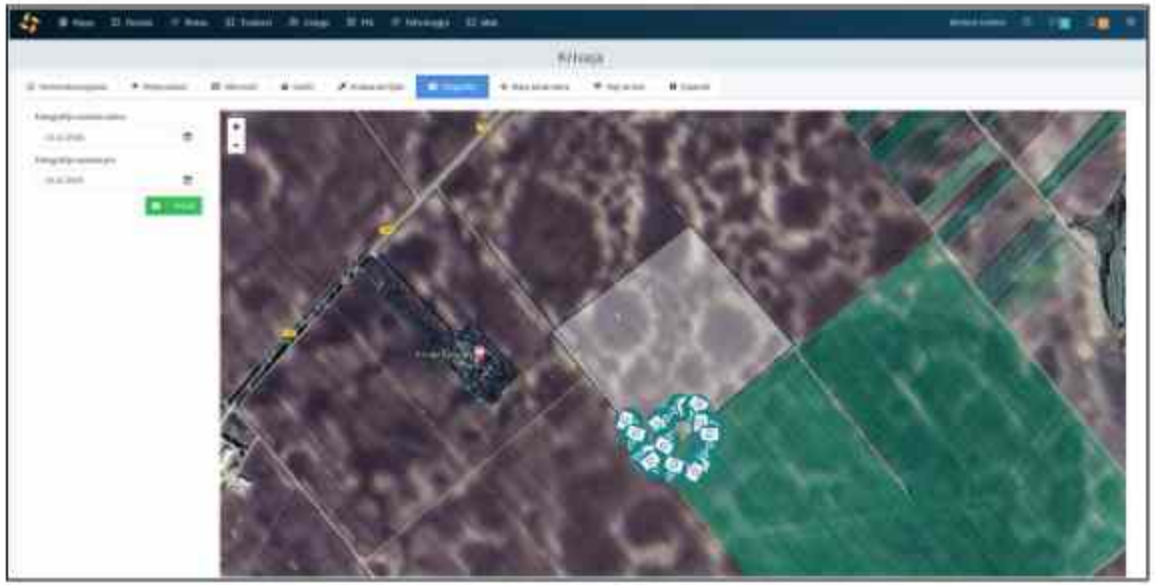
Satellite indices of crops that describe plant growth, photosynthesis intensity and the availability of water and nutrients

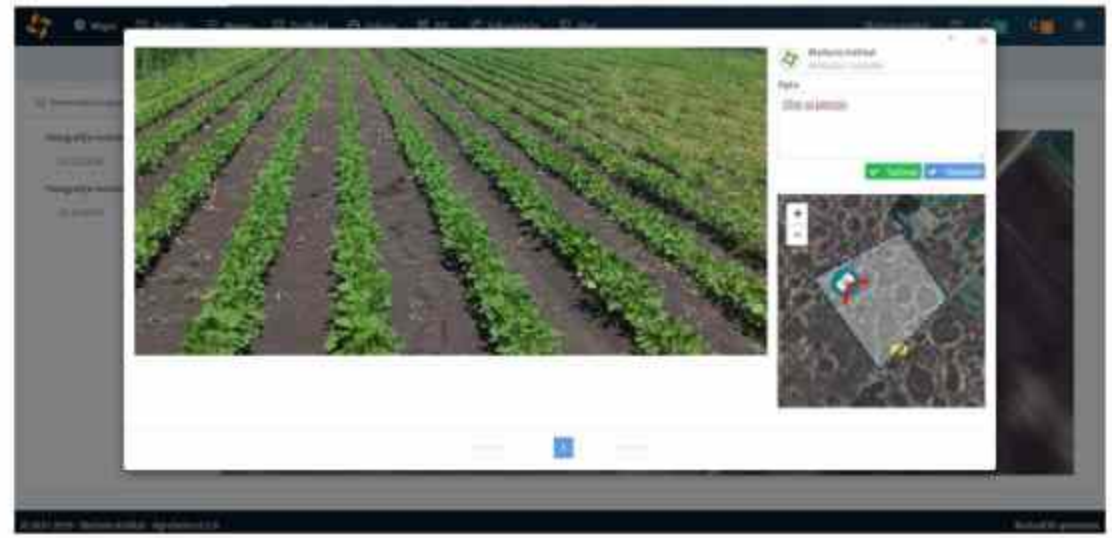
Co-funded by the European Union



Overview of soil

Co-funded by the European Union



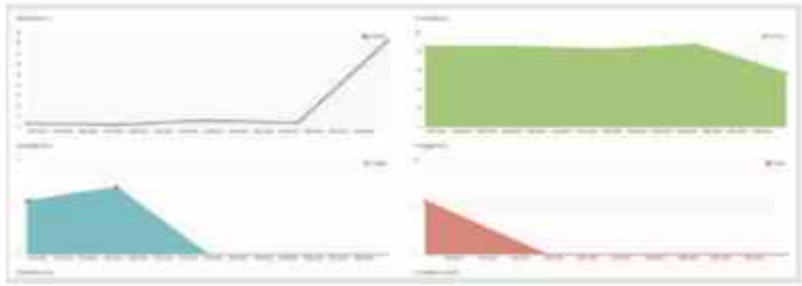


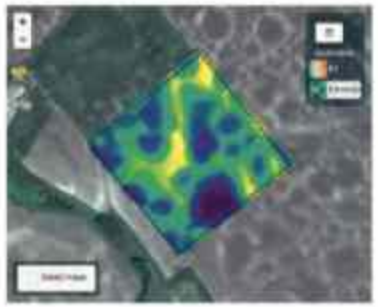
Overview of photographs of crops

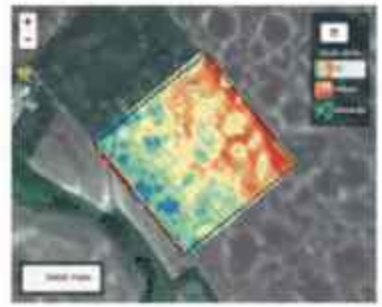
Co-funded by the European Union

Latest information about the occurrence of pests and plant diseases

Co-funded by the European Union







The following **additional services**, custom-made to fit their needs, are available to **premium users**:

- Collection, visualisation and analysis of data from their own sensors: meteorological stations, soil and leaf moisture sensors…
- Storage and visualisation of data from their own sensors mounted on agricultural machinery (yield and moisture maps, terrain profile maps)
- Storage and visualisation of maps of physical and chemical properties of the soil
- Delineation of management zones
- Visualisation and analysis of drone images
- Incorporation of other data, defined by user, into the system

Co-funded by the European Union

Mokrin Becomes the First Digital Village in Serbia

The first village in Serbia to undergo the digital transformation process within the project is **Mokrin**. Its advantage is reflected in having a large number of individual agricultural producers and a simple installation of wireless digital infrastructure.

At the moment, 30 agricultural holdings are included in the project, and over 100 farmers from Mokrin are expected to join by the end of the project implementation. **The project will improve all social aspects of living in a village and prevent migration.** The goal is to also transfer good practices to other villages in the future.

Co-funded by the European Union

Find out more on…

BioSense Institute

https://www.google.com/search?q=biosense+institute&source=lmns&bih=635&biw=1440&rlz=1C5CHFA_enRS924RS924&hl=sr&sa=X&ved=2ahUKEwjP0pvuie2CAxXmhv0HHX2zAm4Q_AUoAHoECAEQAA#fpstate=ive&vld=cid:eccf14d4,vid:6O4bu7wk8hM,st:0

Digital Farm

https://www.youtube.com/watch?v=h9hZ90T7lOM

Agrobot LALA

https://www.youtube.com/watch?v=seU82D8w9RA&t=5s

Digital Village

https://www.youtube.com/watch?v=xgKLVCzPQeU

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Thank you for your attention!

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UNS COURSES

Undergraduate Academic Studies
Disaster Risk Management and Fire Safety
Course: Social resilience to hazards

Basic Information:

ECTS: 5

Category: Academic-general educative

Scientific field: DRM and Fire Safety

Interdisciplinary: yes

Education goal:

The objective of the course is to introduce students with social challenges and necessary activities for creating resilience to different hazardous events. During the course students will gain practical knowledge of how to contribute social resilience and maintain sustainable development of society.

Educational outcomes:

Students acquire knowledge in the field of safety and sustainable development of the society, as well as the importance of the concept of resilience in the context of sustainability. Students will be able to independently and critically analyse social and ethical issues related to risk, to analyse the vulnerability, safety and sustainability of the society under conditions of risk uncertainty.

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UNS COURSES

Undergraduate Academic Studies
Disaster Risk Management and Fire Safety
Course: Social resilience to hazards

Course content:

The course is designed with particular focus on critical thinking in relation to societal safety and sustainability. It is structured in modules with a lecture related to scientific, societal and ethical issues concerning risk, resilience, safety and sustainability in uncertain, complex and dynamic environment. During the course students will analyse societal resilience on the base of society's ability to anticipate, recognize and adapt risk, and to learn and remember. Students will learn concepts for improvement of societal resilience with consideration to human conditions and needs and to societal goals for economically, socially and ecologically sustainable development.

1. Components of risk
2. DRM and DRM cycle
3. Quantitative and qualitative models for risk assessment
4. Theoretical vulnerability frameworks - PAR model
5. Theoretical vulnerability frameworks – Turner and BBC conceptual framework
6. World Risk Index
7. Indicators for resilient cities
8. Sustainability initiatives: SDG, Sendai Framework, Paris agreement
9. Risk financing – ex ante and post ante financing
10. Munich Climate Risk Insurance Initiative

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1FUTURE

jOiNEd For sUsTainability - bUilding climate REsilient communities in WB and EU

IoT for Sustainable Development

Prof. dr Srđan Popov

srdjanpopov@uns.ac.rs

Date: 04 December 2023
Place: Novi Sad, Serbia

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Between givenness and normality

- **Givenness**:
  - IoT devices are small physical devices.
- **Normality:**
  - Sustainable Development Goals (SDGs).

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Operating point in the IoT technology zone

- IoT devices are normally small, built-in or separate devices with a set of different functions.
- IoT products are often capable of larger-scale operations.
- The idea is to use information locally.

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IoT drives sustainable development

- Leveraging real-time data.
- Enabling process optimization.
- Efficiency improvements.
- Reduction of waste and wastage in different sectors.

Co-funded by the European Union

Global e-Sustainability Initiative (GeSI)

- Potential to reduce global greenhouse gas emissions up to 20 percent by 2030.
- The Internet of Things could play a key role in the fight against climate change.

Co-funded by the European Union

Studies by Intel

- IoT solutions, energy consumption reductions of up to 30 percent.
- Real-time data monitoring optimize energy usage, and drive sustainable practices.

Co-funded by the European Union

Studies by the World Economic Forum (WEF)

- IoT implementation in precision agriculture can increase crop yields and reduce water consumption.
- IoT systems can gather critical data on soil moisture, nutrient levels, and weather patterns.

Co-funded by the European Union

Studies by The United Nations

- IoT deployment in smart cities could generate worldwide savings, while reducing greenhouse gas emissions.
- IoT-enabled infrastructure, enhances efficiency, improves public services, and promotes sustainability.

Co-funded by the European Union

Studies by Cisco

- IoT reduce logistics costs and improve delivery times
- Real-time tracking and monitoring of goods leading to cost savings and reduced environmental footprint.

Co-funded by the European Union

IoT services for sustainability

- OCR meter reading
- Water leak management
- Predictive maintenance
- Environmental monitoring

Co-funded by the European Union

Potential outcomes

- Alignment with sustainability commitments
- Reduce costs from inefficiencies
- Full-stack solutions
- Enhanced network security
- Convert sustainability data into actions

Co-funded by the European Union

UNS courses on IoT technology and sustainable development

- Internet of Things (17.SIT062)
- IoT technologies and edge computing (22.EAI019)
- Intelligent risk management in medical data (22.EAI050)

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Objective of the course **Internet of Things**

- Training students to implement Internet of Things (IoT) applications and systems on a wide variety of devices and platforms that use Internet technologies and protocols for mutual communication.

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Content of the course **Internet of Things**

- Basics of IoT concepts.
- Creation of mini applications.
- Presentation of theoretical foundations.
- Overview and implementation of REST API, complex SOA architecture.

Co-funded by the European Union

Outcome of the course **Internet of Things**

- Skills for implementing IoT applications.

Co-funded by the European Union

Objective of the course **IoT technologies and edge computing**

- Core of the infrastructure within the concepts of Edge/Fog computing.
- Architecture of IoT devices.
- Protocols of higher layers for connecting IoT devices with IoT servers in the network.

Co-funded by the European Union

Content of the course **IoT technologies and edge computing**

- Architecture of IoT devices: from sensors to microcontrollers.
- Practical teaching Computer and laboratory the exercises accompanying this course are designed in such a way that through practical work with existing software tools and on appropriate hardware platforms, they illustrate all the theoretical concepts that will be covered in the lectures.

Co-funded by the European Union

Outcome of the course IoT technologies and edge computing

- Understand the basic:
  - Architecture of IoT systems;
  - IoT end devices and the possibilities for data processing;
  - Communication protocols for connecting IoT devices to the infrastructure;
  - Information processing in different parts of the system;
  - IoT framework and applications offered by 5G technology;
  - Concepts of security in IoT technologies.

Co-funded by the European Union

Objective of the course **Intelligent risk management in medical data**

- Mastering the theoretical knowledge and advanced methods and techniques of research in the field of reducing the risk of events with disastrous consequences in medical based helth situations, the development of a multidisciplinary approach and internet of medical things (IoMT) based tools.

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Content of the course **Intelligent risk management in medical data**

- Contemporary trends in the development of engineering aspect of reducing the risk.
- Methods , models , regulations and aspects of risk assessment.
- Analysis of the flow of information.
- Probabilistic methods of analysis of hazards.

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Outcome of the course **Intelligent risk management in medical data**

- Ability to independently engage in research activities.
- The ability to follow modern internet of medical things (IoMT) achievements in the field of reducing the risk of events with disastrous consequences in medical based helth situations.

Co-funded by the European Union

Thank you for your attention!

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jOiNEd For sUsTainability - bUilding climate REsilient communities in WB and EU

Unmanned Aerial Vehicle (UAV) based mapping in engineering surveys

Asociate Professor Marko Marković grad. geod. eng.

UNS Study visit

University of Novi Sad (UNS)

Date: 04.12.2023.
Place: Novi Sad

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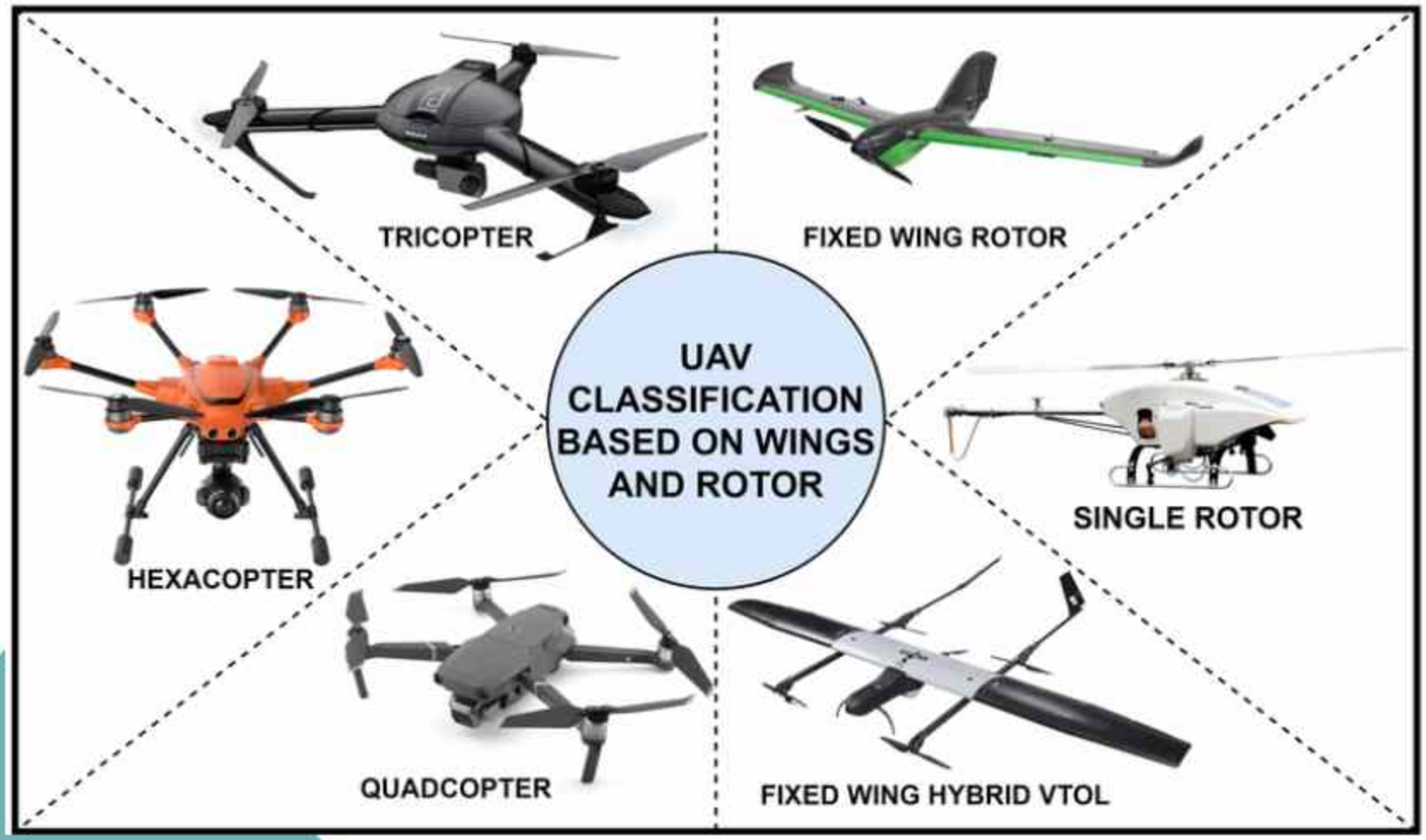
Unmanned Aircraft Vehicle (UAV)

- UAV, also known as Drone, represents an vehicle controlled by a ground operator or computer located within the vehicle.
- UAV is a part of UAS (Unmanned Aerial System) that usually consists of an aircraft platform mounted with one or more sensors combined with a ground-based control station from where it is operated.

- Based on landing, they can be divided into:
- Horizontal Takeoff and Landing (HTOL)
- Vertical Takeoff and Landing (VTOL)

Co-funded by the European Union

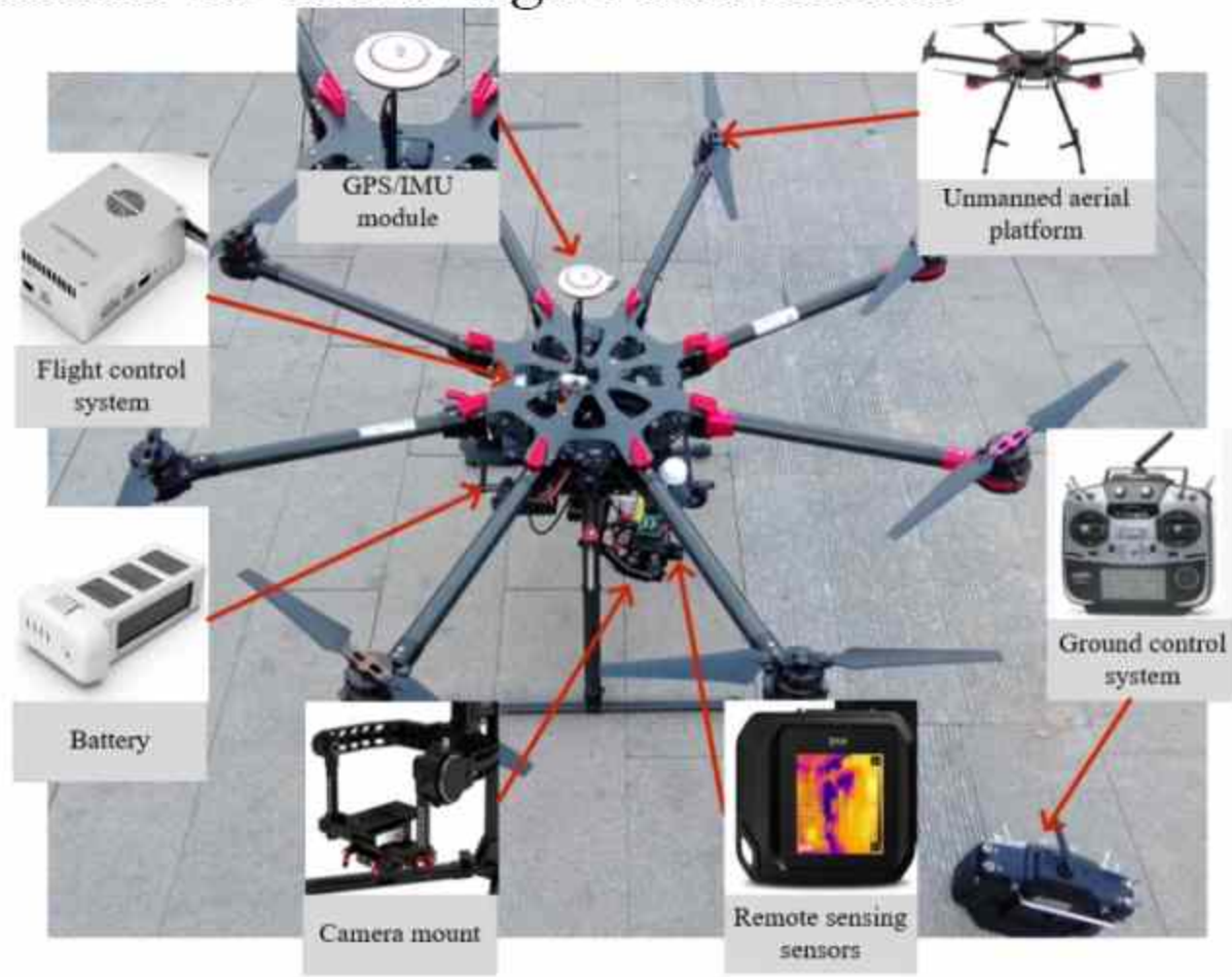
Types of UAVs for mapping



Co-funded by the European Union

Components of the UAV system

- The body of the UAV system is made of ultra-light materials
- Electro engine;
- Servo motors;
- Batteries;
- Communication system:
  - control station;
  - radio transmitter.



Components of the UAV system

- Sensors:
  - GNSS;
  - Gyroscope;
  - Barometer;
  - Accelerometer;
  - Magnetometer;
  - Inertial Measurement Unit (IMU);
  - LiDAR (Light Detection and Ranging);
  - Obstacle avoidance system;
  - Cameras: RGB, Multispectral, Near Infrared, Thermal.
- Software for flight planning, mapping, takeoff and landing.
- Software for data processing.

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Legal regulation

- In 2016, the Directorate for Civil Aviation of the Republic of Serbia issued the Rulebook on UAVs, which contains all applicable regulations.

Some of the articles of the rulebook:

- The operator must have a certificate that he has successfully passed the test of knowledge of aviation regulations under the jurisdiction of the Directorate for Civil Aviation of the Republic of Serbia
- For each flight, the UAV operator submits a request for airspace allocation to the Civil-Military Coordination Unit within Air Traffic Control.
- The flight of foreign UAVs in the airspace of the Republic of Serbia is not permitted without the permission of the ministry responsible for defense affairs.

Co-funded by the European Union

Digital photogrammetry using UAVs

- Digital photogrammetry is a method of collecting geospatial data about physical objects, through the process of acquisition, analysis, and interpretation of digital images.

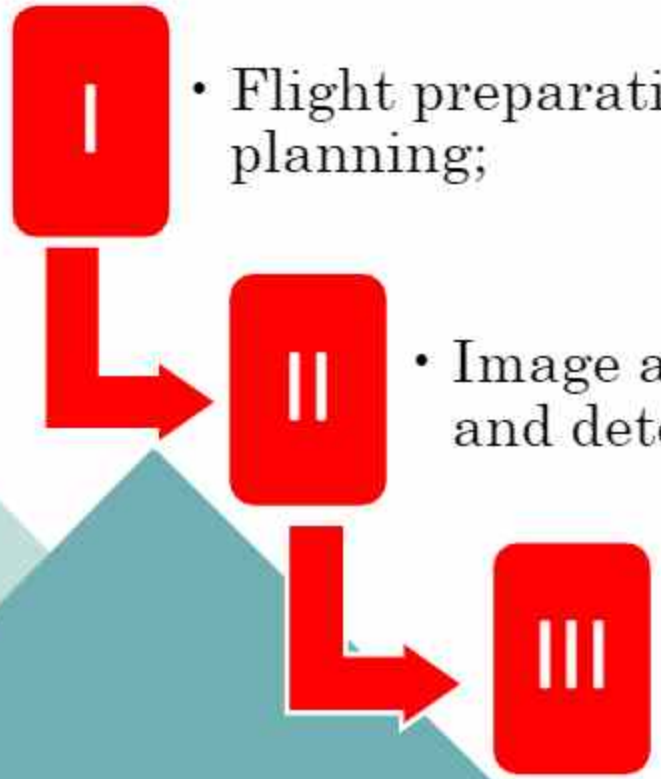
- In the data collection process, the object of interest must be captured from at least two camera positions to obtain information on three spatial coordinates (X, Y, and Z).

- The created image represent a stereo pair that enables the creation of a 3D model of the object that provides information about its actual dimensions (shape, position, and size).

Co-funded by the European Union

Digital photogrammetry using UAVs

- The process of collecting geospatial data using the digital photogrammetric method using UAVs is performed through three phases:



- Flight preparation and planning;
- Image acquisition, materialization and determination of control points
- Processing of collected data.

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Phase I: Flight preparation and planning

- The flight preparation and planning phase includes defining the target area, resolution, and flight details.
- In the phase of flight preparation and planning, the following parameters need to be defined:
  - flight mode;
  - flight trajectory;
  - UAV speed;
  - side and frontal overlap of images;
  - camera angle;
  - flight altitude;
  - distance from the target area.

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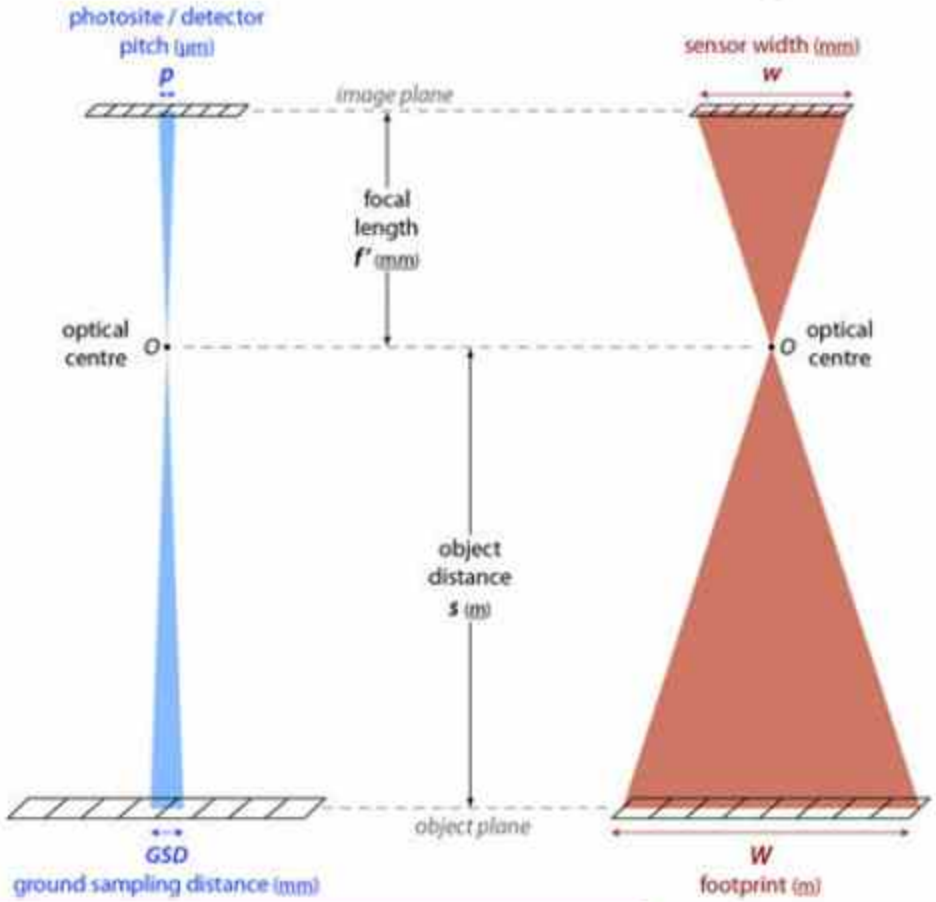
Phase I: Flight preparation and planning

- The pixel size on the ground (Ground Sampling Distance - GSD) is determined based on the given flight altitude and camera parameters.



$$\frac{p}{GSD} = \frac{f'}{s} = \frac{w}{W}$$

$$GSD = \frac{s}{f'}p$$

$$s = \frac{f'}{p}GSD$$

$$W = \frac{w}{p}GSD$$

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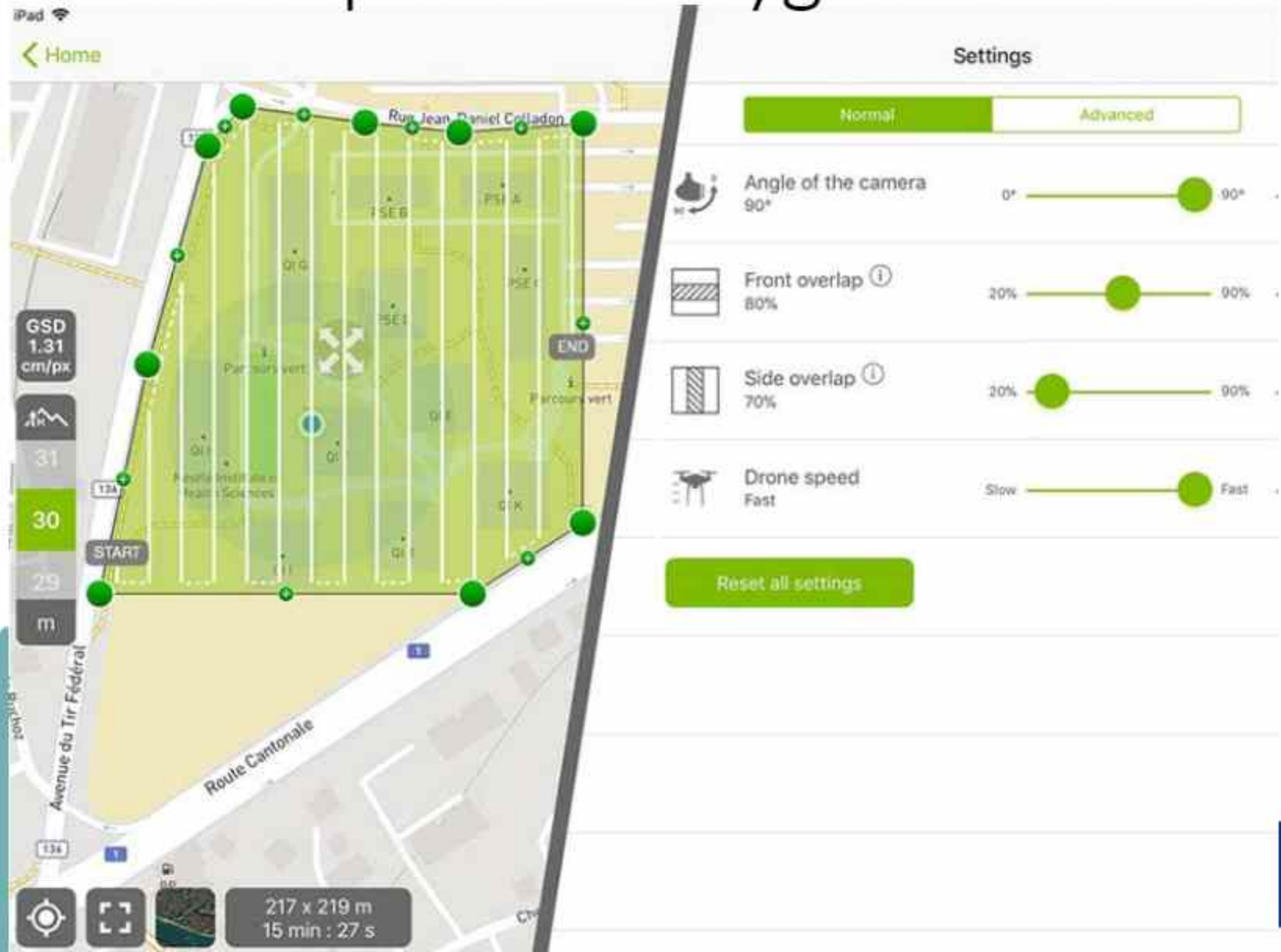
Phase I: Flight preparation and planning

- The choice of optimal flight parameters depends on the mission goal and the performances of the available UAV
- Factors that should also be considered in the flight preparation and planning process are battery capacity limitations, legal regulations, and weather conditions.
- Flight preparation and planning are performed within the respective applications:
  - DroneDeploy;
  - Drone Harmony;
  - Dronelink;
  - PIX4Dcapture;
  - DJI Pilot 2.

Co-funded by the European Union

PIX4D Capture – Polygonal mission



Co-funded by the
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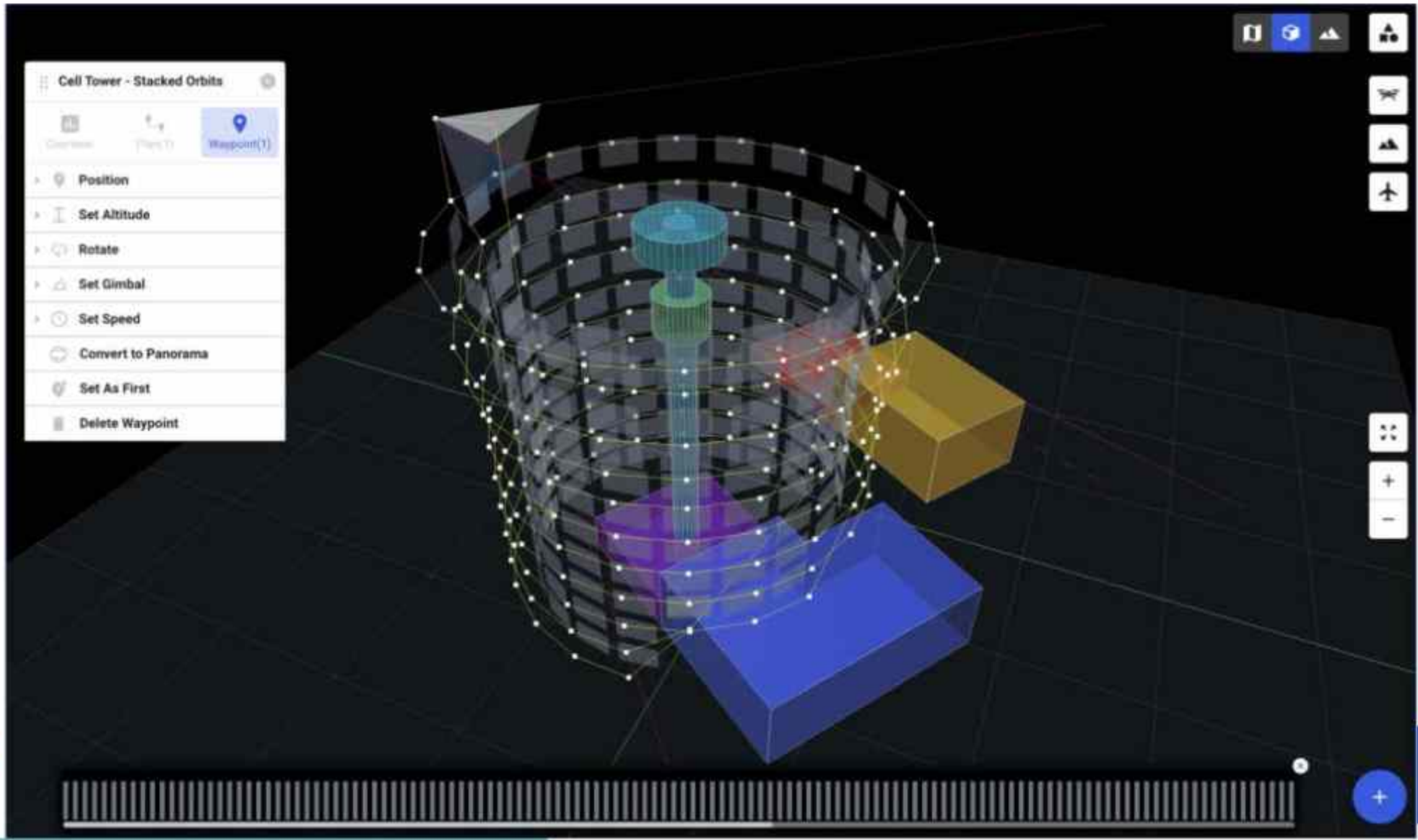
Drone Harmony – Circular mission



Co-funded by the European Union

Phase II: Acquisition of images

- The flight can be performed in automatic or manual mode.
- In automatic mode, the flight trajectory is defined based on projected points that the UAV's navigation system (GNSS/IMU) will follow using the autopilot.
- In manual mode, the UAV is remotely controlled by the operator using a ground control station and the image acquisition process usually results in irregular photo overlap and acquisition geometry.
- The ground control station provides insight into flight data such as the position of the UAV, speed, altitude and distance of the UAV and battery capacity.

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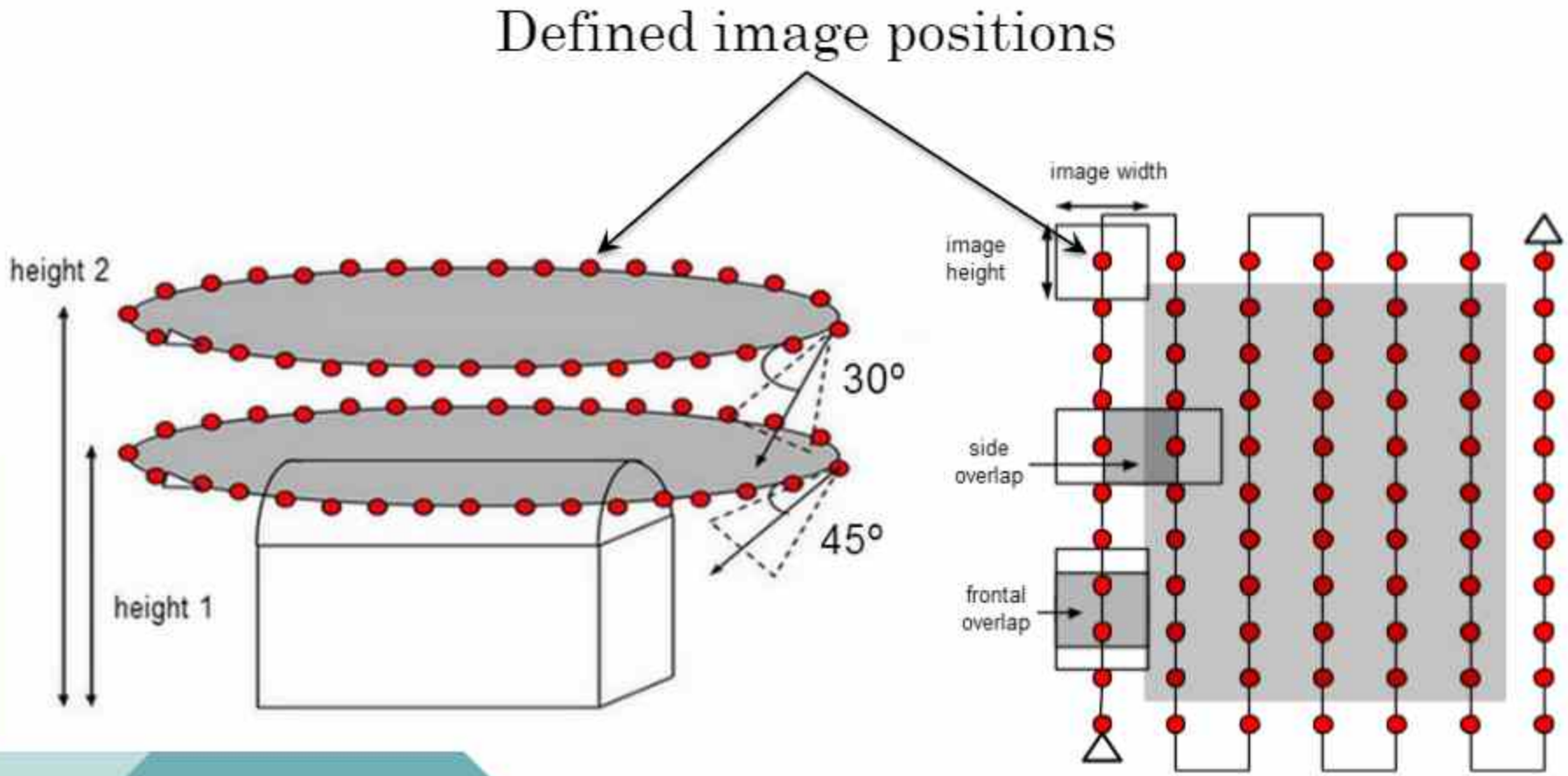
Phase II: Acquisition of images



Typical overlap values are 60 to 80%

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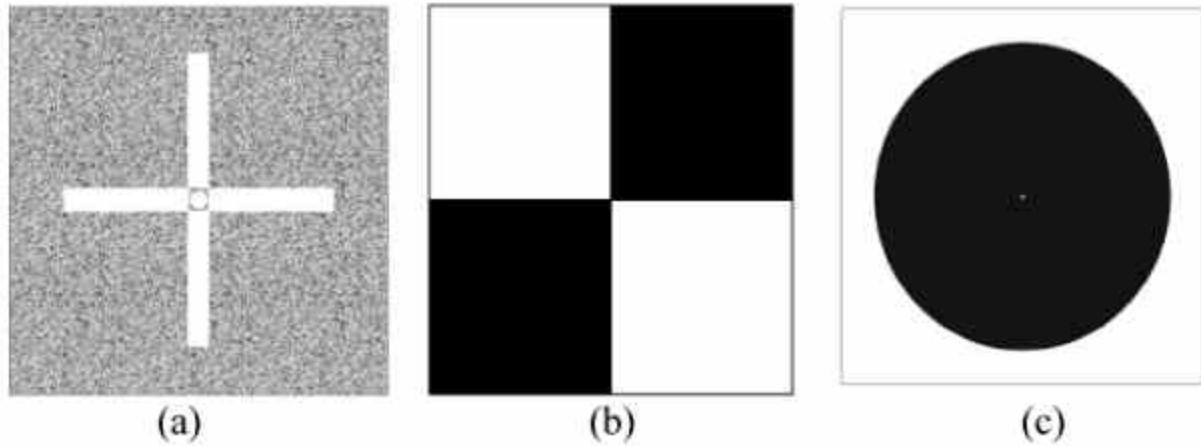
Phase II: Calibration and georeferencing

- For the purpose of calibration and georeferencing of the collected data, Ground Control Points (GCPs) are set up on the ground.



(a) (b) (c)

Co-funded by the European Union

Phase II: Calibration and georeferencing

GNSS RTK

Polar method using total station

Co-funded by the European Union

Phase II: Calibration and georeferencing

- Newer generations of UAVs have a dual-frequency GNSS receiver that enables operation in PPK and RTK mode, so GCPs are not necessary.

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Phase III: Processing of collected data

- The data processing phase includes photogrammetric processing of collected images, generation of a dense point cloud, digital surface model, digital terrain model, digital elevation model, orthomosaic, 3D mesh.
- The processing of collected data is performed within the framework of specialized software solutions.

PIX4D

Agisoft Metashape

OpenDroneMap

Co-funded by the European Union

Phase III: Structure from Motion algorithm

- Structure from Motion (SfM) is an approach that makes it possible to create 3D models of objects or terrain topography based on 2D overlapping images, which were created from multiple locations and differently oriented images.
- The SfM algorithm is a combination of:
  - algorithm for finding characteristic points in images;
  - algorithm for connecting characteristic points from multiple images;
  - algorithm for reconstruction of 3D space from connected characteristic points.

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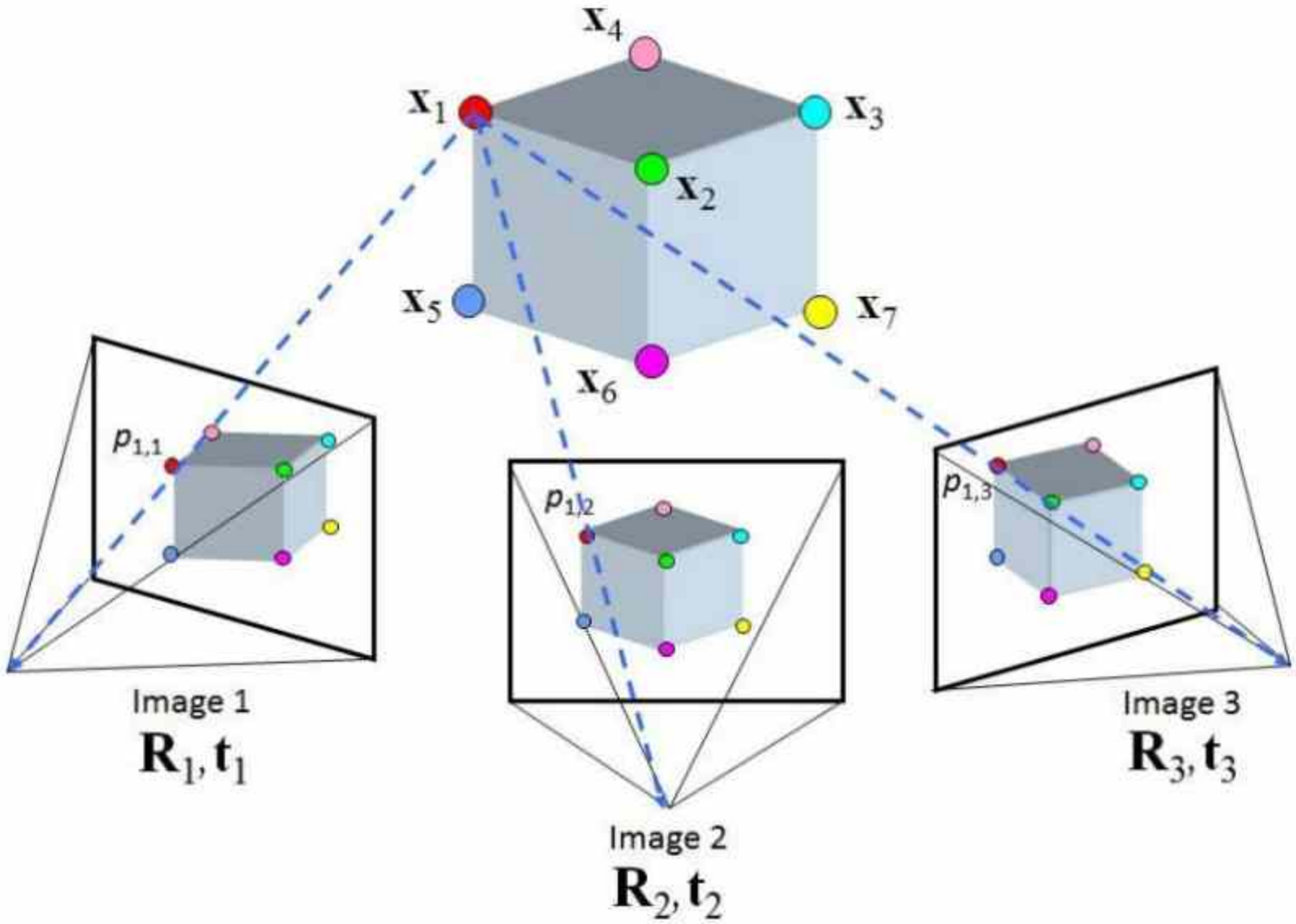
Phase III: Structure from Motion algorithm



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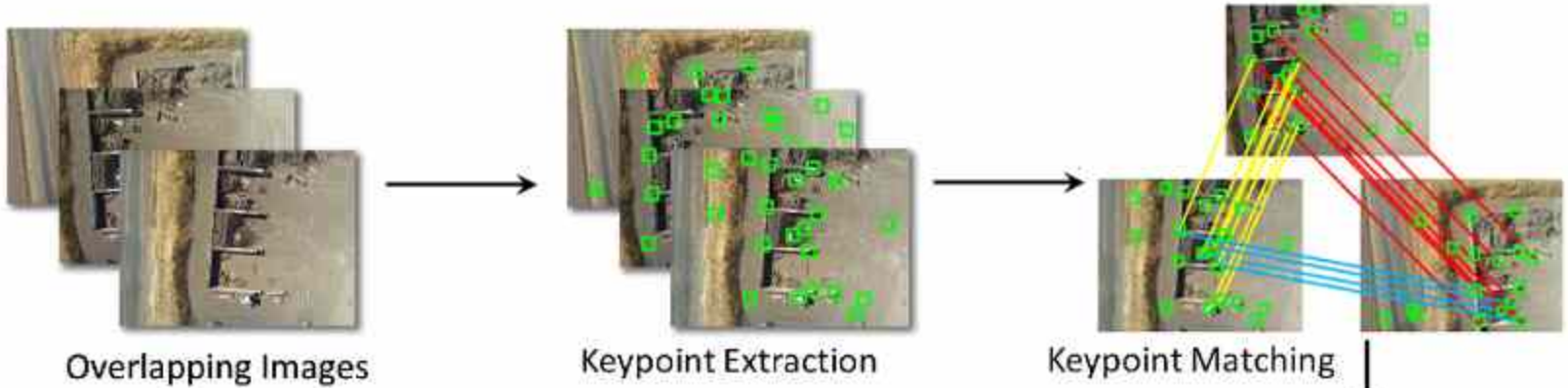
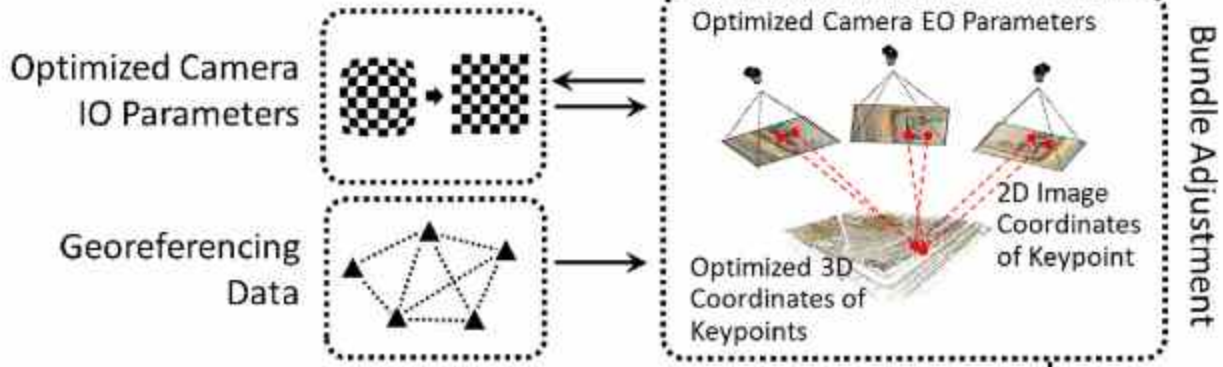
Phase III: SfM Algorithm Operation Process





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Results of mapping using a UAV

3D model

Digital elevation model

Point cloud

Orthophoto map/image

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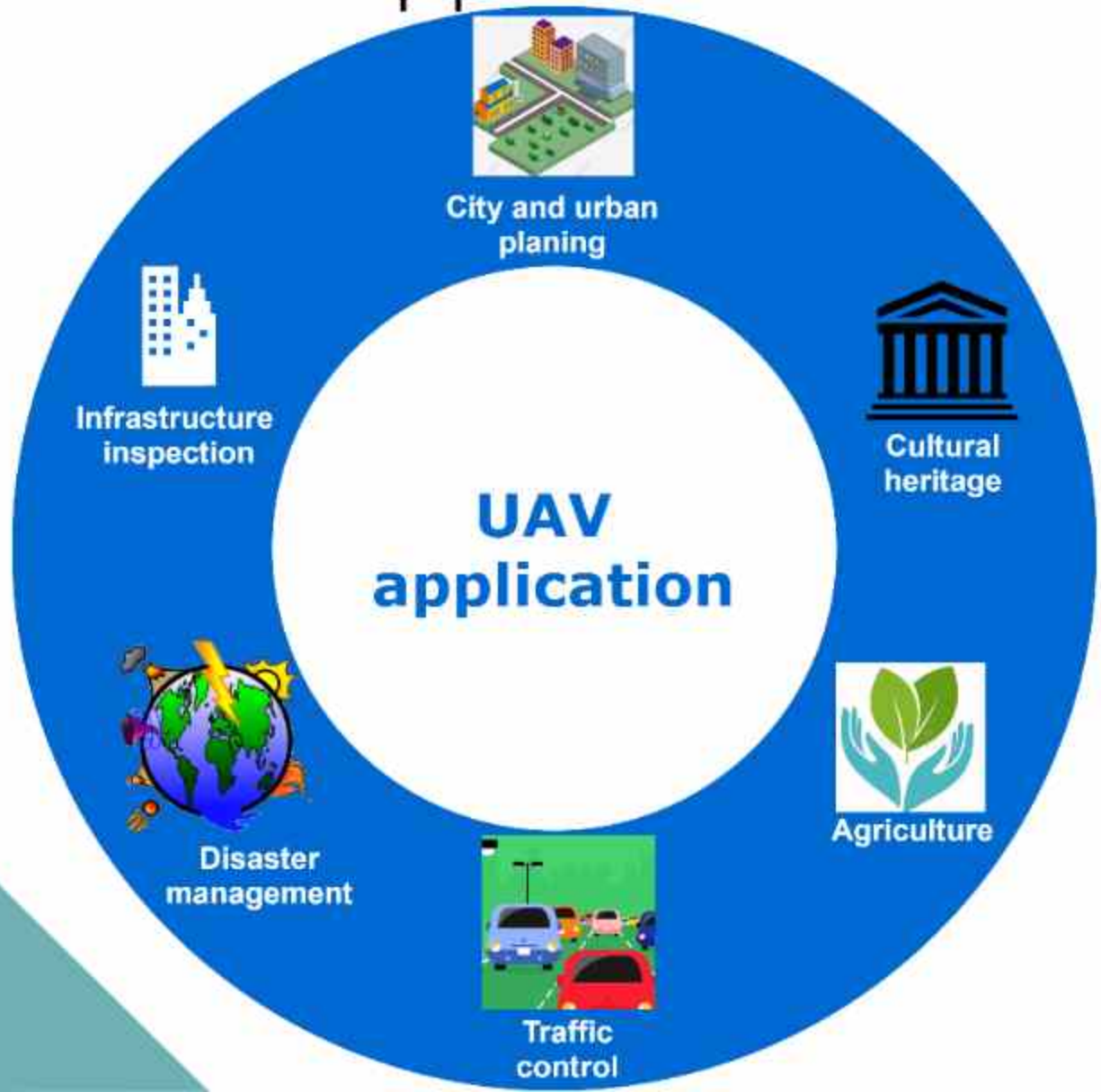
Areas of application of UAVs



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Case study

UAV mapping of floods in Krupanj, Republic of Serbia

- In May 2014, the municipality of Krupanj was affected by intense rainfall that led to floods and the activation of landslides.

- Consequently, there was the demolition and damage of numerous buildings of critical infrastructure as well as residential buildings, a certain number of which became unusable for living and use.

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Case study

UAV mapping of floods in Krupanj, Republic of Serbia

- ✓ Flight altitude: 140 m
- ✓ UAV speed: 10 m/s
- ✓ Area: 12 km²
- ✓ 444 images
- ✓ 4 missions
- ✓ 25 GCPs
- ✓ GSD 13 cm
- ✓ Accuracy 11 cm
- ✓ Processing: Pix4D
- ✓ Data analysis: ArcMap

UAV SenseFly eBee	
Weight	≈ 0,69 kg
Wingspan	96 cm
Drive	Electric pusher propeller
Battery	11,1 V; 2150 mAh
Camera	12 MP
Max. flight time	50 minutes
Max. one flight coverage	12 km²
GSD	1,5 cm per pixel
Orthomosaic/3D model accuracy	1-3 x GSD
Apsol. horiz./vert. accuracy (with GCPs)	up to 3 cm / 5 cm
Apsol. horizon./vert. accuracy (without GCPs)	1 – 5 m
Automatic flight planning	Yes

Result – Point Cloud

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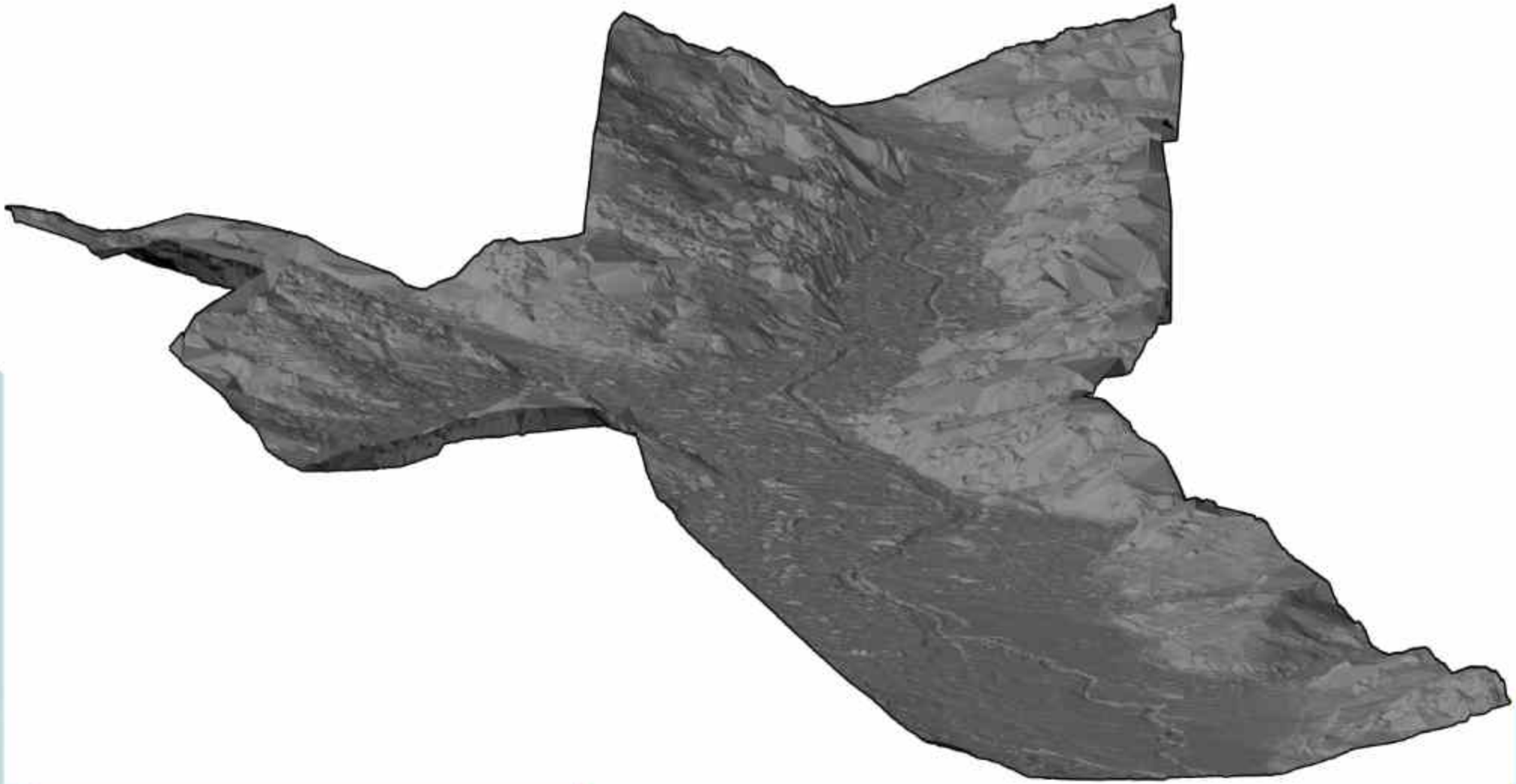
Result – Digital Terrain Model



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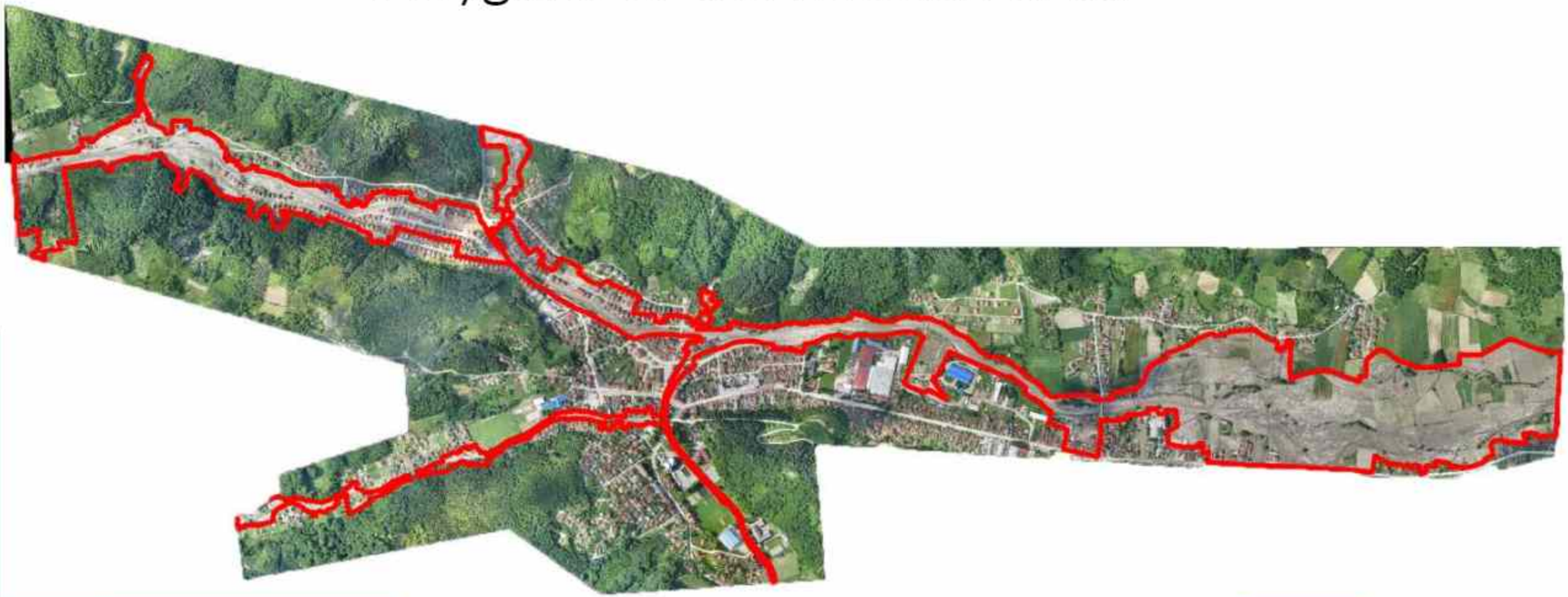
Result
Polygons of the flooded area



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Result

digitized objects - 364 objects

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Result
digitized critical infrastructure

- a. 2 damaged bridges
- b. 14 damaged roads

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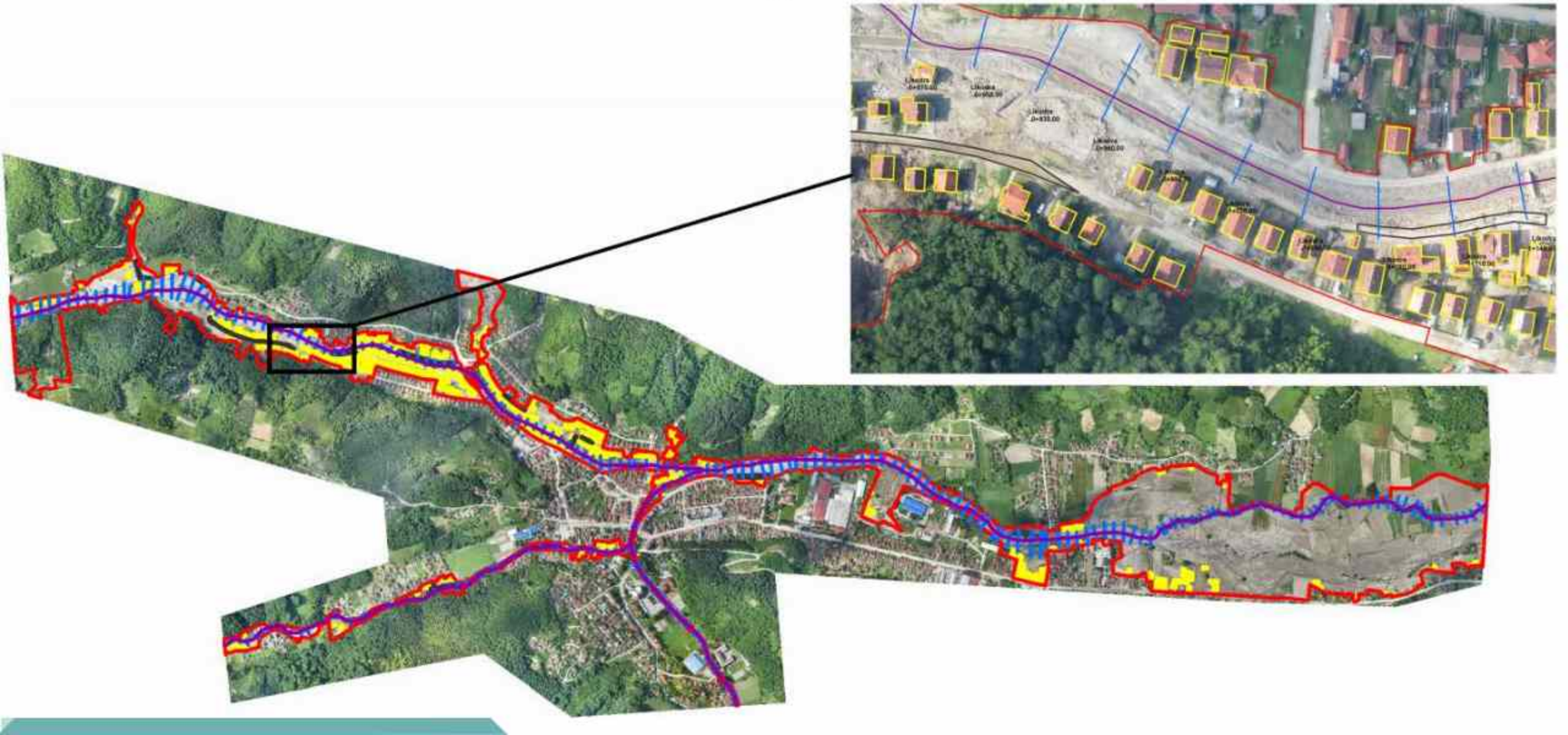
Result – integrated data



Pros and Cons of using digital photogrammetry using UAVs

- Pros:
  - relatively cheap technology;
  - usually lightweight and compact technology;
  - the images contain all the information needed for the 3D reconstruction of the object;
  - lower power requirements and,
  - easy servicing or replacement.
- Cons:
  - requires minimizing the distance from the target area for high-resolution results;
  - the negative impact of sunlight directed at the UAV camera and the negative impact of shadows on the target area;
  - dependence on data from other sources (GNSS or total station provides scale, orientation, and absolute position) and,
  - longer data processing time.

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Conclusion

- First of all, it is necessary to consider the project requirements:
  - what is the subject of the mapping;
  - what is the required accuracy;
  - what is the required resolution (GSD) and,
  - in what time frame it is necessary to collect the data and deliver the processed results to the client.
- In certain cases, consider the integration of several different surveying technologies to obtain better quality results.
- UAV technology has an extremely wide range of application areas and is constantly being improved, and as such represents the optimal solution for use in solving a large number of potential tasks.
- Possibilities to improve data processing:
  - Increasing automation and
  - Minimization of time spent.

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Thank you for your attention

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