ZBORNIK RADOVA

Ekspertska konferencija

MEĐUNARODNA PRIVREDNA SARADNjA KLASTERA JUGOISTOČNE EVROPE KAO PRAVAC RAZVOJA POSLOVNO-OBRAZOVNOG TURIZMA GRADA NIŠA

- Izazovi, iskustva, pravci daljeg razvoja –

27. avgust 2020, Niš, Srbija

PROCEEDINGS OF CONFERENCE

INTERNATIONAL ECONOMIC COOPERATION OF THE CLUSTER OF SOUTH-EAST EUROPE AS A DIRECTION FOR THE DEVELOPMENT OF BUSINESS AND EDUCATIONAL TOURISM IN THE CITY OF NIŠ

- Challenges, experience, directions of future development –

August 27th, 2020, Niš, Serbia

Poštovane kolege i prijatelji,

Zadovoljstvo nam je da možemo, u ime Organizacionog odbora medjunarodne ekspertske konferencije, da pozdravimo najeminentnije stručnjake iz oblasti univerzitetskog obrazovanja niškog univerziteta, kao i goste-predavače i da ih pozovemo da svojim aktivnim učešcem doprinesu razmeni iskustava i ideja i ostvarenju ciljeva konferencije.

Učesnici konferencije će, kroz svoja izlaganja, osvetliti nova shvatanja, aktuelne teme i tendencije u neformalnom obrazovanju i time dati presek stanja u ovoj oblasti u niškom regionu, uz osvrt na evropska dostignuća i naše pozicioniranje u osavremenjivanju naše edukacione ponude, kao potencijala za privlačenje turista-studenata u naš grad.

Cilj konferencije je i predstavljanje obrazovnih kurseva u oblasti novih tehnologija, koje još uvek nisu postale deo formalnog obrazovnog sistema, ali za njima postoji potreba kako na domaćem tako i na tržištu regiona.

Na konferenciji će biti prezentovani planirani domaći, međunarodni i susedski edukacioni projekti, kao i moguće ideje i pravci za umrežavanje zajedničke turističke ponude regiona.

Koristimo priliku da ovim putem zahvalimo autorima i koautorima stručnih radova koji su svojim trudom doprineli izradi ovog zbornika radova.

Takođe želimo da zahvalimo Kancelariji za lokalni ekonomski razvoj i projekte grada Niša, generalnom sponzoru ove konferencije, koja je, uz Centar za permanentnu edukaciju, Građevinsko-arhitektonski fakultet Niš, omogućila održavanje ove konferencije.

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- Centar za permanentnu edukaciju Niš
- Kancelarija za lokalni ekonomski razvoj i projekte grada Niša

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1. INTEGRALNI TURISTIČKI RAZVOJ JUGO-ISTOČNE SRBIJE[1]

Dr. Danka Milojković[2]

Prezentacija je realizovana za potrebe Turističke organizacije Niš, a u skladu je sa Godišnjim programom rada, sa finansijskim planom Turističke organizacije Niš u 2020.godini. Grad Niš je finansirao izradu dokumenta, a Prirodnomatematički fakultet u Nišu je odgovoran za sadržinu dokumenta.

Prostorni okvir:

- Nišavski okrug
- Pirotski okrug
- Jablanički okrug
- Toplički okrug
- Pčinjski okrug
- Knjaževac
- Park prirode Stara planina
- Soko-banja

Studija sadrži:

•analizu stanja u sektoru turizma;

•poređenje stanja turizma sa stanjem u identifikovanim zemljama u regionu

•analize razvojnih dokumenata i službenih politika republike srbije i u njima iskazanih razvojnih određenja;

•ocena izveštaja meritornih internacionalnih institucija o stanju, pravcima i perspektivama razvoja ekonomije i turizma u južnoj i istočnoj Srbiji.

JUŽNA I ISTOČNA SRBIJA POSEDUJE ZNAČAJAN ATRAKTIVAN POTENCIJAL

- pravna regulativa daje okvir za savremenu i efikasnu organizaciju i razvoj turističke i sa njom povezane industrije;

[1] Studija razvoja Turističke organizacije Niš za 2020. godinu

[2] Direktorka Turističke Organizacije Niš

- Turistički sektor - još nije uređen, upravljanje i marketing turizma imaju ozbiljan manjak kapaciteta, a oklevalo se i u sprovodenju nužnih javnih investicija, što je usporilo proces razvoja proizvoda i njihove komercijalizacije;

- Negativne komponente razvoja - uglavnom proizlaze iz internih prepreka koje je nužno otkloniti u kratkom roku.

PERSPEKTIVE RAZVOJA:

• južna i istocna srbija – bice globalno prepoznata turistička destinacija kao Rezultat uspostavljenog sistema razvoja i održivog upravljanja resursima I Koordinaciji aktivnosti svih subjekata od značaja za razvoj turizma

• turizam i sa njime povezane delatnosti ce postati jedna od dominantnih privrednih Grana koja efikasno obezbeđuje novu dodatu vrednost i održivo zapošljavanje i bitno doprinosi lokalnom i regionalnom razvoju

• sektor turizma južne i istocne Srbije će biti u stanju da efikasno i fleksibilno usklađuje svoju ponudu sa savremenim trendovima na globalnom turističkom tržištu i ponudi autentična iskustva, doživljaje i proizvode visokog kvaliteta, što ce, uz tradicionalno gostoprimstvo, biti osnova prepoznatljivosti u odnosu na konkurenciju

• turizam će postati vodeći promoter imidža jugo-istočne Srbije u

svetu kao moderne i za posete, odmor i poslovanje - poželjne

destinacije, ostvarujući stalnu inovativnu funkciju u primeni

savremenih standarda, novih tehnologija i zaštiti prirode;

• svojim stalnim osavremenjavanjem, prihvatanjem i

preuzimanjem globalnih standarda i modela poslovanja i

upravljanja, turizam će postati poželjan sektor za zapošljavanje

i razvoj karijere, posebno za mlade;

• Posmatrani prostor će na svetskoj lestvici konkurentnosti

turizma postati visokorangirana i popularna destinacija.

PRAVNA REGULATIVA I POLITIKA RAZVOJA:

• U skladu sa zakonom o turizmu razviti i uspostaviti poseban Sistem upravljanja turističkim područjima i uspostaviti Destinacijske menadžment organizacije (DMO) u turizmu južne i istočne Srbije,

• unaprediti institucionalnu saradnju sa svim javnim, nevladinim, društvenim organizacijama udruženjima građana i naučnim institucijama povezanim s turizmom,

• ukljucivanje inkluzivnog razvoja turizma u program rada Turističkih organizacija pod sloganom „turizam za sve”,

• uskladiti celovito regulisanje trgovine i drugih javnih službi obzirom na interese i prioritete turistički aktivnih destinacija;

CILJEVI BUDUĆEG RAZVOJA:

• rast udela hotelskih i sličnih ugostiteljskih objekata za smeštaj u ukupnim smeštajnim objektimana od 50%;

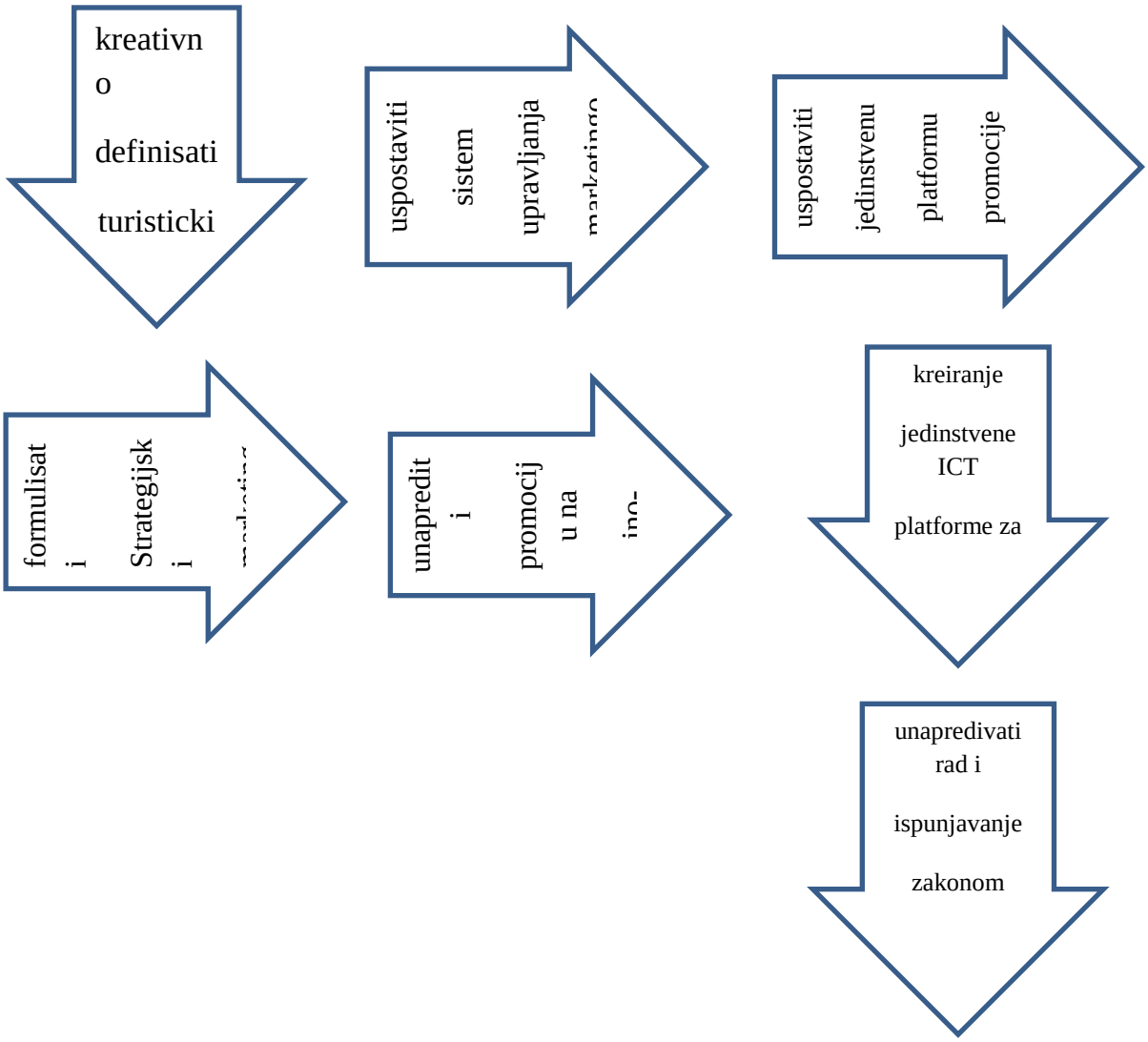
• dostizanje ukupne popunjenosti smeštajnih kapaciteta (smeštajnih jedinica) od 30%;

• povećanje jedinične potrošnje turista (po noćenju) za 50%;

• povećanje udela stranih noćenja turista

• povećanje broja direktno zaposlenih u turizmu za najmanje 50% i povećanje broja zaposlenih u turizmu i komplementarnim delatnostima do tri puta;

• povećanje direktnih investicija.



PRIORITETNE AKTIVNOSTI:

• marketing/promocija;

• unapređenje turisticke infrastrukture i suprastrukture

• podrška turističkim agencijamau oblasti receptivnog turizma;

• razvoj ONLINE rezervacionih sistema;

• izgradnja i uređenje atrakcija (npr. tematski parkovi, adrenalin sadržaji i sl);

• konferencije i organizacije događaja

• razvoj DMO (destinacijska menadžment organizacija)

• razvoj i primena međunarodnih standarda kvaliteta

• aktivnosti istraživanja, edukacije i treninga u turizmu;

• kreiranje regionalnih turističkih proizvoda;

• razvoj inovacija i preduzetništva u turizmu.

Turistička organizacija Niš poziva strateške partnere da kroz projekte razvoja i promocije turizma u Nišu i na jugoistoku Srbije, obezbede razvoj i rast sopstvenog poslovanja i doprinesu održivom ekonomskom razvoju na jugoistoku srbije.

Dobro došli u Niš, carski grad u srcu Balkana!

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2. MEDJUNARODNA I REGIONALNA SARADNJA KLASTERA I MSP NA PRIMERU NOVE EVROPSKE METODOLOGIJE – OPEN HOUSE[3]

Biljana Avramović[4]

Rezime: *Nova metodologija u razvoju, nazvana OPEN HOUSE, ima za cilj da razvije i primeni zajedničku transparentnu metodologiju, koja će dopuniti postojeće metodologije za ocenu projektovanja i izgradnje održivih gradjevina koristeći otvoreni pristup i zajedničku tehničku platformu. Metodologija se zasniva na na postojećim metodama za ocenu održive gradnje (BREEAM, DGNB, LEED,...), na postojećim Evropskim standardima (ISO TC 59/SC 17, CEN/TC 350), EPBD Direktivi i njihovim nacionalnim transpozicijama i metodologijama za ocenu održivosti gradnje na medjunarodnom, evropskom i nacionalnom nivou.*

Ključne reči: *Ocena gradjevina, održiva gradnja, evropske norme, ekološka gradnja, energetska efikasnost, lokacija*

Summary: *The overall objective of OPEN HOUSE is to develop and to implement a common European transparent building assessment methodology, complementing the existing ones, for planning and constructing sustainable buildings by means of an open approach and technical platform. OPEN HOUSE will develop a transparent approach able to emerge collectively in an open way across the EU. This approach will be communicated to all stakeholders and their interaction and influence on the methodology will be assured in a transparent way. The baseline will be existing standards (both CEN/TC 350 and ISO TC59/SC17), the EPBD Directive and their national transpositions and methodologies for assessing building sustainability at international, European, and national level.*

Keywords: *building assessment, sustainable building, European norms, ecologic building, energy efficiency, building location*

[3] Istraživanje je odobreno i finansirano od strane Kancelarije za lokalni ekonomski razvoj i projekte (KLERP) Grada Niša;

[4] Construction Cluster "Dundjer", Niš, Srbija.

1. UVOD

Naučni i tehnički ciljevi projekta OPEN HOUSE su bili:

- Definisati OPEN HOUSE pristup: otvorena i transparentna Evropska platforma za održivu gradnju,
- Promovisati OPEN HOUSE pristup i definisati mehanizme interakcije izmedju projekta i faktora odlučivanja,
- Izgraditi OPEN HOUSE platformu: podržati pan-Evropske napore za zajednički pogled na održivu gradnju,
- Učvrstiti način primene i ocene metodologije: izbor test-primera i mehanizama za donošenje odluka,
- Oceniti i poboljšati metodologiju koristeći rezultate test-primera i drugih sličnih slučajeva, kao i druge primedbe faktora odlučivanja,
- Dalje širenje i korišćenje OPEN HOUSE metodologije.

Osnove metodologije čine sledeće ocene:

- Ekološki kvalitet,
- Socijalno-funkcionalni kvalitet,
- Ekonomski kvalitet,
- Tehničke karakteristike,
- Kvalitet procesa (projektovanja i gradnje),
- Položaj zgrade (lokacija).

Na OPEN HOUSE projektu je učestvovalo 11 zemalja EU i zemlje zapadnog Balkana. Aktivan saradnik na projektu (FP7-ENV 2009) bio je Gradjevinski klaster „Dundjer“ iz Niša.

Na osnovu izloženog materijala formirani su nacrti programa nastave iz oblasi ocene kvaliteta zgrada. Nastava se može držati na srpskom i engleskom jeziku, kako za domaće, tako i za inostrane polaznike. Predvidjeno je formiranje 7 jednosemestralnih predmeta na nivou bachelor i master, uz vrlo široke mogućnosti istraživanja u oblasti, koja mogu dovesti do doktorskih studija. Projektom je obradjena metoda ocene zgrade i date osnove za izradu odgovarajućeg softvera, što će biti sledeći zadatak u oblasti OPEN HOUSE. U ovom pregledu naglasak je dat na principe i metode procene kvaliteta zgrada, a posebna pažnja je obraćena raspoloživoj i korišćenoj literaturi za primenu metode.

BREEAM REJTING poslovnih zgrada je najrasprostranjenije korišćeno sredstvo za preispitivanja i poboljšanje ekoloških performansi poslovnih zgrada. To je industrijski standard za merenje koliko je poslovna zgrada održiva i za istraživanja uticaja zgrade na životnu sredinu. Procena se može vršiti i na novim i na postojećim poslovnim zgradama – bilo da su prazne ili zauzete.

Koji su glavni faktori u pravcu dobijanja BREEAM rejtinga?
• Dobri upravljački management zgrade
• Kako zgrada doprinosi zdravlju i dobrobiti zaposlenih
• Smanjenje emisije CO_2 od građevinskih poslova i transporta do i od zgrade
• Mesto i pristup za osoblje
• Efikasnost u korišćenju vode (npr. toaleti niskog protoka vode), merenje vode, sistemi za detekciju curenja
• Upotreba materijala koji odgovorno koriste resurse, onih sa niskom proizvodnom i eksploatacionom potrosnjom energije i recikliranih materijala
• Najbolja upotreba lokacije zgrade i instalacija
• Minimiziranje zagađenja

Nivo do koga je ovo razmatrano, kao deo projekta zgrade, će imati uticaj na to koliko će visok BREEAM rejting biti dodeljen.

LEED® standardi, predstavljaju lidere u projektovanim standardima zaštite životne sredine, kao sertifikacioni program koji je osmišljen 1994. od strane američkog Saveta Zelene gradnje (USGBC; osnovanog 1993.) da podstakne praksu održivog razvoja i dizajna putem alata i kriterijuma za merenje učinka. To je "dobrovoljni, na konsenzusu zasnovan, sistem za tržišnog rejtinga zgrada, baziran na postojećoj dokazanoj tehnologiji." USGBC je uspostavio standarde kako za novoizgradjene objekte i objekte opsežnog renoviranja, tako i za postojeće objekate.

Pet ključnih oblasti, postavljenih od strane USGBC, koje su u fokusu pažnje, su "održivi razvoj zgrade, štednja vode, energetska efikasnost, izbor materijala i kvalitet životne sredine u zatvorenom prostoru."

1. Održivi razvoj zgrade podrazumeva, kad god je to moguće, ponovnu upotrebu postojećih objekata i očuvanje životne sredine u okruženju. Podstiče se i uključivanje zemljanih skloništa, krovnih vrtova i sadnica širom i oko zgrada.

2. Očuvanje čistote vode različitim sredstvima, uključujući čišćenje i recikliranje otpadne (ranije korišćene) vode i instalacija od zgrade do zgrade slivnika za kišnicu. Praćenje upotrebe vode i pribora.

3. Energetska efikasnost se može povećati na različite načine, na primer, orijentisanje zgrada da u potpunosti iskoriste sezonske promene u položaju sunca i korišćenjem raznovrsnih i regionalno odgovarajućih energenata, što uključuje, zavisno od geografske lokacije, solarnu energiju, energiju vetra, geotermalnu energiju, biomasu, vodu, ili prirodni gas.

4. Najpoželjnija materijali su oni koji su reciklirani ili obnovljivi i oni koji zahtevaju najmanje energije za proizvodnju. Idealno bi bilo da su lokalnog porekla i bez štetnih hemikalija. Oni su napravljeni od nezagađenih sirovina i trajni su i mogu se reciklirati.

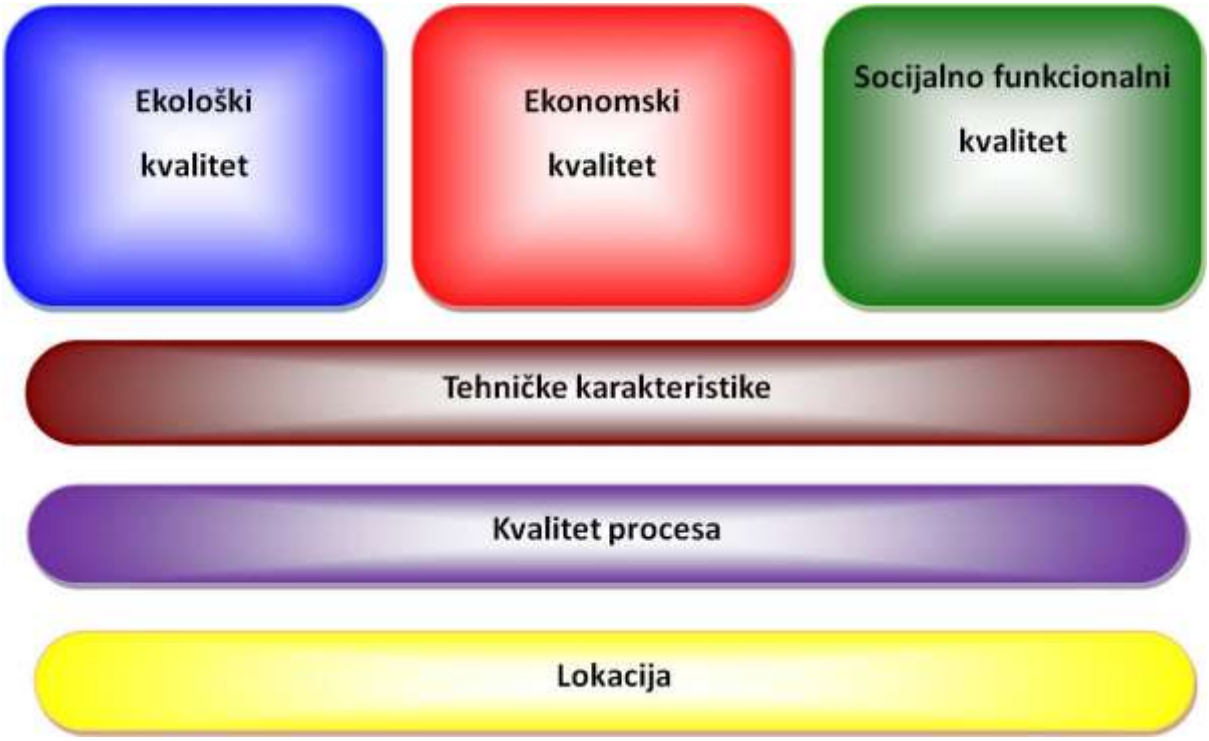
5. Kvalitet životne sredine zatvorenog prostora bavi se pitanjima koja utiču na način kako se pojedinac oseća u prostoru i uključuje funkcije kao što su kontrola prostora, ventilacije, kontrola temperature i upotreba materijala koji ne emituju toksične gasove.

2. OPEN HOUSE METODOLOGIJA

Open House metodologija se bazira na oceni 6 osnovnih grupa inikatora (parametara):

1. Kvalitet životne sredine
2. Socijalno - funkcionalni kvalitet
3. Ekonomski kvalitet
4. Tehničke karakteristike
5. Kvalitet procesa
6. Lokacija

Pri ocenjivanju se posebna pažnja posvećuje životnom ciklusu zgrade (Life Cycle Assessment): LCA rezultati zgrade koja se ocenjuje biće računati na standardizovan način i vrednovani ocenom pomoću benchmarkinga. Cilj svih LCA proučavanja je da se analiziraju i docnije vrednuju performanse odgovarajućeg “životnog ciklusa” zgrade, kao što je dato u nastavku.



EKOLOŠKI KVALITET (1)

1 Kvalitet životne sredine

1.1 Potencijal globalnog zagrevanja (GWP)
1.2 Potencijal uništavanja ozonskog omotača (ODP)
1.3 Potencijal acidifikacije (Beta-AP)
1.4 Potencijal eutrofikacije (EP)
1.5 Potencijal kreiranja fotohemijski Ozona (POCP)
1.6 Rizici od materijala
1.7 Biodiverzitet i praznjenje staništa
1.8 Svetlosna zagađenja
1.9 Zahtevi neobnovljive primarne energije (PEnr)
1.10 Ukupni zahtevi primarne energije i procenat obnovljive primarne energije
1.11 Vode i otpadne vode
1.12 Korišćenje zemljišta
1.13 Otpad
1.14 Energetska efikasnost opreme zgrada (liftovi, eskalatori i pokretne stepenice)

Indikatori 1.1 do 1.5, 1.9 i 1.10 su bazirani na oceni životnog ciklusa zgrade, LCA (Life Cycle Assessment). LCA ocene zgrade se izračunavaju na standardizovan način i vrednuju se prema utvrdjenim reperima (tzv. benchmark). Indikatori su kvantitativni. U saglasnosti sa standardima EN ISO 14040 i 14044, LCA ocenjivanje se vrši u četiri koraka: definisanje cilja i obima istraživanja, inventar – popis elemenata zgrade, ocena uticaja i interpretacija rezultata. Delovi zgrade koji se uključuju u ocenu su:

1. Spoljni zidovi i zidovi podruma uključujući prozore i zaštitne slojeve,
2. Krov,
3. Plafoni uključujući podove i podne prekrivače i premaze,
4. Podne ploče uključujući podove, podni prekrivači; podne ploče iznad vazdušnog sloja,

5. Temelji,
6. Unutrašnji zidovi uključujući premaze i stubove,
7. Vrata,
8. Uredjaji za proizvodnju toplote.

Za analizu faze korišćenja, treba postaviti sistem za konzumiranje i disipaciju, kao i za reparature. Podaci se uzimaju iz nacinalnih interpretacija EPDB (EU Energy Performance of Buildings Directive). Uredjaji za grejanje, kao i proračun potrebne električne energije se uzimaju iz odgovarajućih ESUCO (European Sustainable Construction Database) podataka. Za popravke treba kalkulacije praviti za sve materijale, ugradne komponente i površine sa servisnim ciklusom manjim od 50 godina. Izvor podataka je uputstvo za održivu gradnju („Guideline for Sustainable Building“) za gradjevinske materijale i VDI 2067 za opsluživanje – servise u zgradama. Za poslednju fazu života zgrade („end-of-life stage“) treba napraviti plan recikliranja i odlaganja gradjevinskog materijala. Potrebno je izabrati jednu od opcija vezanu za ESUCO podatke:

- Metali -> reciklaža -> “reciklažni potencijal metala“,
- Mineralni gradjevinski materijali -> reciklaža -> „prerada gradjevinskog otpada“,
- Materijali sa toplotnom vrednošću -> termička reciklaža -> odgovarajuća grupa materijala u ESUCO bazi,
- Proizvodjači toplote -> Set podataka u saglasnosti sa procesom proizvodnje,
- Svi ostali materijali koji se mogu deponovati na mesta za otpad -> odlaganje na mesta za otpad -> odgovarajući ESUCO podaci.

Neki indikatori koji se vrednuju imaju i pod-indikatore. Na primer, indikator 1.14, Energetska efikasnost opreme (liftovi, eskalatori i pokretne staze) , u skladu sa BREAM, imaju sledeće podindikatore:

1.14.1 Projektovanje stepenica i rampa
1.14.2 Dizajn lifta i njegova efikasnost
1.14.3 Projektovani eskalator i njegova efikasnost
1.14.4 Pokretne staze i njihova efikasnost

Literatura (Indikator 1.1-1.5, 1.9-1.10)

1. ISO 14040: 2009-11: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization
2. ISO 14044: 2006-10: Environmental management – Life cycle assessment – Principles and framework. International Organization for Standardization.
3. FprEn 15978:2011: Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method. European Committee for Standardization CEN.
4. FprEn 15804:2010: Sustainability of construction works – Environmental product declaration - Core rules for the product category of construction products. European Committee for Standardization CEN.
5. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.
6. Kreißig, J., Binder, M. (2007): Methodische Grundlagen – Ökobilanzbasierte Umweltindikatoren im Bauwesen. Methodenbericht zum BMVBS-Projekt „Aktuelisieren, Fortschreiben und Harmonisieren von Basisdaten für das nachhaltige Bauen“ (AZ 10.6.03 – 06.119) Mai 2007, www.baufachinformation.de/literatur.isp
7. United Nations (1998): Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998, http://unfccc.int/resource/docs/convkp/kpeng.pdf
8. Bundesministerium für Verkehr, Bau- und Wohnungswesen: Guideline for Sustainable Building, Eigenverlag, 2001.

9. Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.
10. VDI 2067: Economic Efficiency of building installations – Fundamentals and economic calculation. Verein Deutscher Ingenieure, 2000.

Literatura (Indikator 1.6))

11. http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm
12. http://www.hse.gov.uk/reach/
13. http://ec.europa.eu/consumers/safety/prod_legis/GPSD_en.pdf
14. http://ec.europa.eu/legislation_summaries/consumers/consumer_information/121253_en.htm
15. http://www.blauer-engel.de/en/index.php
16. http://en.wikipedia.org/wiki/The_Blue_Angel
17. http://www.nordic-ecolabel.org/
18. http://www.norden.org/en/nordic-council-of-ministers/councils-of-ministers/nordic-council-of-ministers-for-the-environment-mr-m/nordic-ecolabel
19. http://www.bambo-nature.com/nordic-swan-eco-label.html
20. http://ecophon.com/ch/Technische-Eigenschaften/Ecophon-und-die-Umwelt/Umweltvertraglichkeit/The-Nordic-Swan-Eco-label/
21. http://www.ecolabelindex.com/ecolabels/Pst=category=building_products

Literatura (Izvori podataka Indikator 1.7)

22. BREEAM: LE 4 Mitigating Ecological Impact

Literatura (Izvori podataka Indikator 1.8)

23. BREEAM Europe Commercial 2009 Assessor Manual
24. LEED Reference Guide for Green Building Design and Construction 2009 Edition
25. ANSI/ASHRAE/IESNA Standard 90.1-2007, Energy Standard for Buildings Except Residential Lighting, Section 9 (without amendments).
26. Lighting for Exterior Environment RP-33-99, by the Outdoor Environment Lighting Commitee of Illuminating Engineering Society of north America (www.iesna.org) (IESNA, 1999)
27. International Dark-Sky Association (www.darksky.org)

Literatura (Indikator 1.11)

28. DGNB 14 – Freshwater Demand

Literatura (Indikator 1.12)

1. DGNB 2009: 15 Space Demand
29. BNB 2011: 1.2.4 Demand of Space
30. http://www.nachhaltigesbauen.de

Literatura (Indikator 1.13)

31. BREEAM Wst 3 – Recyclable Waste Storage and Wst 5 – Composting

Literatura (Indikator 1.14)

32. VDI 4707. Guidelines on lifts energy efficiency. Association of German Engineers.

33. prEN ISO 25745: Energy performance of lifts and escalators (joint standardisation work between ISO and CEN).
34. BREEM Europe Commercial 2009: Ene 8 – Lifts , and Ene 9 – Escalators and trawelling walkways.

SOCIJALNO-FUNKCIONALNI KVALITET (2)

2.1 Pristupačnost bez barijera
2.2 Lična bezbednost i sigurnost korisnika
2.3 Toplotni komfor
2.4 Kvalitet unutrašnjeg vazduha
2.5 Kvalitet vode
2.6 Akustična udobnost
2.7 Vizuelni komfor
2.8 Udobnost za rad
2.9 Kvalitet usluge
2.10 Elektromagnetna zagađenja
2.11 Javna Pristupačnost
2.12 Buke od zgrada i lokacije gradilišta
2.13 Kvalitet dizajna i urbanog razvoja zgrade i lokacije
2.14 Efikasnost površina
2.15 Konverzija izvodljivosti
2.16 Komfor za bicikle
2.17 Odgovorno poreklo materijala
2.18 Lokalni materijal

EKONOMSKI KVALITET (3)

3.1 Troškovi životnog ciklusa zgrada (LCC)
3.2 Stabilnost vrednosti zgrade

Građenje sa osvrtom na troškove tokom eksplatacionog veka objekta

Građenje sa osvrtom na troškove tokom eksploatacionog veka objekta je ekonomska metoda koja ima za cilj da pruži informacije pri donošenju odluka i da ukaže na uštede pri odabiru adekvatnog projektnog rešenja uljučujući cenu proizvoda, servisiranje, energetsku efikasnost.
Analizom troškova eksploatacionog veka objekta treba uzeti u obzir troškove koji treba da budu u skladu sam opisom i veličinom objekta poznatim prilikom procene. Za potrebe ove analize proračunski period je ograničen na 50 godina. Početna investicija se razmatra kada se zgrada (ili neki drugi objekat) preda investitoru, spremnu za korišćenje. Ova cena uključuje projekat objekta, sisteme, instalacije i komponente, priključke sa dostavljačima energenata i puštanje u rad. To su troškovi koje se prezentuju investitoru.

3.1 Troškovi životnog ciklusa zgrada (LCC)

a. Proračuni troškova za različite faze životnog ciklusa

Obavljanje proračuna za različite faze životnog ciklusa podrazumeva bodovanje po sledećem principu:

Faza 1 Konstrukcija i materijali 30 poena
Faza 2a Operativni troškovi 5 poena
Faza 2b Troškovi energenata 20 poena
Faza 2c Potrošnja vode 10 poena

Faza 3 Demontaža ili rušenje 5 poena

b. Izbor opreme

Procena je bazirana na ispunjenje sledećih 5 zahteva:

- Izbor opreme
- Način održavanja
- Kvalitet materijala
- Adaptiranje na unutrašnje/spoljašnje uticaje
- Korišćenje (edukacija…)

Izbor opreme	**Poeni**
Svih pet uslova su zadovoljeni	15
Četiri od pet uslova je zadovoljeno	12
Tri od pet uslova je zadovoljeno	9
Dva od pet uslova je zadovoljeno	6
Jedan od pet uslova je zadovoljen	3

c. Tip podataka korišćen za procenu

Tip podataka korišćen za procenu	**Poeni**
Specifični podaci	15
Opšti podaci	10

d. Analiza osetljivosti

Analiza osetljivosti energije pokazuje uticaj prilikom povećanja troškova energija od 10% do 20% zbog dodatnih uslova (ili fleksibilnosti).
Prilog: Obično se za proračunsku temperaturu prostorije usvaja 19°C. U realnim uslovima, potrošači mogu povećavati temperaturu u prostorijama do 23°C, što za posledicu ima povećanje troškova od 10% do 30%.
Takođe, treba se pokazati uticaj promene životnih troškova i cene opreme.
Procena pokazatelja je bazirana na proveri sledećih uslova:

- Stabilnost troškova energije povezanih sa temperaturnim uslovima i varijacijama u potrošnji energije
- Stabilnosti životnih troškova
- Stabilnost valute

Analiza osetljivosti	**Poeni**
Sve tri analize osetljivosti su izvršene	100
Dve od tri analize osetljivosti su izvršene	75
Jedna od tri analite osetljivosti je izvršena	50
Nijedna analiza osetljivosti nije izvršena	0

Literatura (Indikator 3.1)

35. VDI 2067 : Economic efficiency of building installations – Fundamentals for economic calculation
36. EN 15459 : Energy performance of buildings – Economic evaluation procedure for energy systems in buildings
37. EN ISO 15686-5 : Buildings and constructed assets — Service life planning - Part 5: Life cycle costing
38. EN ISO 15686-9 – Buildings and constructed assets – Part 8 Reference service life and service life information

3.2 stabilnost vrednosti zgrade

e. Fleksibilnost i mogućnosti adaptacije zgrada

Ovaj pokazatelj sadrži informacije o:

- Modularnosti i fleksibilnosti objekata: proširivanju objekta, oslonaca, nosećoj strukturi, instalacijama, snabdevanju energentima, zagrevanju, ventilaciji, hlađenju, vodovodnoj i kanalizacionoj mreži
- Fleksibilnosti korišćenja
- Prilagodljivost korisnicima
- Efikasnost površina

Procena je bazirana na ispunjenosti sledećih uslova:

- Prohodnost za osobe sa invaliditetom
- Efikasnost površina
- Mogućnost reorganizacije

Fleksibilnost i mogućnost adaptacije zgrada	**Poeni**
Ako je rezultat tri indikatora veći od 50 poena, merodavni rezultat je srednja vrednost tri indikatora	50-100
Ako je rezultat jednog indikatora manji od 50 poena, merodavni rezultat je srednja vrednost tri indikatoda, ali ne veći od 50 poena	10-50
Ako je rezultat jednog indikatora manji od 10 poena, merodavni rezultat je srednja vrednost tri indikatora, ali ne veći od 10 poena	0-10

f. Energetska zavisnost i zavisnost od vode

Ovaj pokazatelj obuhvata informacije o:

- Potražnji za energijom i proizvodnjom
- Potrošnji vode i odlaganju otpadnih voda

Energetska zavisnost i zavisnost od vode	Poeni
Ako je rezultat tri indikatora veći od 50 poena, merodavni rezultat je srednja vrednost tri indikatora	50-100
Ako je rezultat jednog indikatora manji od 50 poena, merodavni rezultat je srednja vrednost tri indikatora, ali ne veći od 50 poena	10-50
Ako je rezultat jednog indikatora manji od 10 poena, merodavni rezultat je srednja vrednost tri indikatora, ali ne veći od 10 poena	0-10

Literatura (Indikator 3.2)

39. Meins, Wallbaum et al. (2010). Sustainability and property valuation: a risk-based approach. Building Research & Information. Building Research & Information 2010, 38(3), 281-301.
40. Upgrading the flexibility of buildings, Rob P. Geraedts, CIB World Congress, April 2001.
41. Recommendation SIA 112/1, 2004: Sustainable Building –Building Construction; Swiss Society of Engineers and Architects.
42. Six steps resulting in a flexibility index of the building. Source: LEnSE: Methodology Development towards a Label for Environmental, Social and Economic Buildings, Indicator: Increase Ease of Building Adaptability.

Izrazi značajni za prevod napred navedene literature tokom ocenjivanja su:

- Building Extensions: Ease with which a building can be extended, both vertically and horizontally.

- Support and infill: Adaptability can only be achieved when a distinction is made between support and infill. The technical and functional lifetime of technical installations, building structure, carpentry, internal walls, etc. all differ.
- Bearing structure: Both the horizontal grid of supporting members as well as the floor height determine the different functionalities that can be incorporated
- Building envelope: The buildings are designed so that the following changes are easily achieved, without the need to alter the building structure or causing large scale disruption.
- Technical installations: Building services are of increasing importance in building construction and are often 1/3 of the total building cost. Unfortunately, replacing or changing technical installations that have a shorter lifetime is often difficult.
- Infill: Interior walls, suspended ceilings, doors, furniture, carpet, etc. often require removal when re-arranging the interior of a building. These changes should take place with the least disruption and damage to the bearing structure or remaining components as possible.

TEHNIČKE KARAKTERISTIKE (4)

4.1 Zaštita od požara
4.2 Trajnost i robustnost konstrukcije
4.3 Čišćenje i održavanje
4.4 Otpornost na kišu, oluje, visoke vode i zemljotres
4.5 Zaštita od buke
4.6 Kvalitet omotača zgrade
4.7 Jednostavnost rušenja, reciklaže i demontaže

Literatura (Indikator 4.1)

43. DIN EN 15269-2 “Extended application of test results for the fire resistance and/or smoke control for door, shuter and openable window assemblies, including their elements of building hardware – Part 2: fire resistance of hinged and pivoted steel doorsets, German version prEN 15269 – 2:2009”; http://www.neubau.din.de/
44. EN 13501 “Fire classification of construction products and building elements”, Part 1: 2007, Classification using data from reaction to fire tests; German version EN 13501-1:2007 + A1:2009; http://www.beuth.de/langanzeige/DIN-EN-13501-1/de/117205992.html; Part 2:2007, Classification using data from reaction to fire test, excluding ventilation services; German version EN 13501-2:2007+A1:2009: http://www.beuth.de/langanzeige/DIN-EN-13501-2/de/117206020.html; Part 3:2005, Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers; German version EN 13501-3:2005+A1:2009: http://www.beuth.de/langanzeige/DIN-EN-13501-3/de/117237246.html
45. EN 1634 “Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware”, Part 1:2000, Fire resistance for door and shutter assemblies and openable windows, Part 2:2008, Fire resistance characterisation test for elements of building hardware, Part 3:2004, Smokecontrol test for door and shutter assemblies.

Literatura (Indikator 4.2)

46. COST Action TU0601 Robustness of Structures, STRUCTURAL ROBUSTNESS DESIGN FOR PRACTISING ENGINEERS

Literatura (Indikator 4.3)

47. DGNB - 40 Ease of cleaning and maintenance
48. BNB 2011 - 413 Cleaning and Maintenance

Literatura (Indikator 4.5)

49. DIN 4109:1989
50. DIN 4109/Supplement 2

Literatura (Indikator 4.6)

51. EN ISO 6946
52. EN ISO 10211
53. EN ISO 13788
54. EN 12207
55. EN 15026
56. EN 13829: 2001-02 (Procedure A)

Literatura (Indikator 4.7)

57. Council Directive 89/106/EEC of 29 September 2003 on the approximation of laws and regulations of the Member States: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1989L0106:20031120:en:PDF
58. Regulation on the protection from hazardous substances of 23 December 2004 adapted to the Directive 98/24/EC: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31998L0024:EN:HTML.
59. Regulation on Implementation of Directive 2002/44/EC (http://eurlex. europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:177:0013:0019:EN:PDF) and Directive 2003/10/EC (http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:042:0038:0044:EN:PDF) on the protection of workers against risks from noise and vibrations of 6 March 2007.

KVALITET PROCESA (5)

5.1 Kvalitet pripreme projektovanja
5.2 Integrisano projektovanje
5.3 Optimizacija i kompleksni pristup projektovanju
5.4 Dokaz o održivosti tokom izrade tendera i dodele posla
5.5 Uticaj lokacije gradnje na proces gradnje
5.6 Kvalitet izvodjača-podizvodjača / Predkvalifikacija i reference
5.7 Garancija kvaliteta izvedenih radova
5.8 Tehnički prijem, upotrebna dozvola, puštanje u rad
5.9 Monitoring, korišćenje i funkcionisanje objekta

5.1 Kvalitet pripreme projektovanja

Održivost zgrada počinje u ranim fazama projektovanja. Poboljšanje održivosti zgrada mora početi već u fazi razrade ideje, zato što razvoj projekta i mogućnost optimizacije u toku idejnog projekta za održive zgrade je velika i troškovi izmena elemenata na zgradi i konstrukciji su mali.

60. Literatura (Indikator 5.1)

61. DGNB International Criterion 43: Quality of project preparation
62. BNB: Bewertungssystem Nachhaltiges Bauen (Germany), Criterion 5.1.1: Projektvorbereitung, www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_511.pdf

63. Demand planning: ISO 9699: 1994 "Performance standards in building -Checklist for briefing - Contents of brief for building design
64. Agreement on objectives: SIA 112-1, www.eco-bau.ch/resources/uploads/SIA_112-1_2005_d-Auszug.pdf
65. Annex 1 of the BMVBS Guide, www.nachhaltigesbauen.de/fileadmin/pdf/PDF_Leitfaden_Nachhaltiges_Bauen/Anlage_1.pdf
66. Architectural competition: UIA guide on international competitions: www.uia-architectes.org/texte/england/Menu-7/UIAguideIC.html

5.2 Integralno planiranje (DGNB, LEED, BREEM)

Učešće projektana različitih profila i učešće zainteresovanih strana, počinje u ranoj fazi projektovanja.

Integrisano planiranje pokriva celokupan eksploatacioni vek zgrade; od ranih idejnih projekata do rušenja/demontaže zgrade. Realizacija održivih zgrada zahteva poboljšanje kvaliteta planiranja kao i optimizacije procesa planiranja. Stoga, neophodan je multidisciplinarni projektni tim kao i dobra komunikacija i interakcija između svih učesnika projektovanja. Ovo može biti dostignuto korišćenjem metode participacije.

Participacija podrazumeva blisku saradnju sa različitim ciljnim grupama i lokalnom zajednicom već u ranoj fazi projektovanja. Multidisciplinarni tim razmatra zahteve budućih korisnika i drugih relevantnih zainteresovanih strana u ranom procesu projektovanja i razvoja integrisanog koncepta sa sveobuhvatnom strategijom održivosti da bi smanjili potrošnju energije i zagađivanje životne okoline. Participacija budućih korisnika zgrade i drugih zainteresovanih strana, projektanata i planera dovode do održivosti i funkcionalnosti zgrade. Ove aktivnosti ogledaju se u socijalnim, ekološkim kao i ekonomskim olakšicama.

Literatura (Indikator 5.2)

67. Switzerland
    - Recommendation SIA 112/1, 2004: Sustainable Building –Building Construction; Swiss Society of Engineers and Architects
68. Germany
    - “Bürogebäude mit Zukunft”, TÜV-Verlag
    - HOAI § 15, WPH 2 to 5 and WPH 8
    - Architektengesetz der einzelnen Länder sowie Satzungen der Architekten- und Ingenieurskammern– www.partizipation.at/handbuch-oeffbet.html
69. UK
    - National Charrette Institute (www.charretteinstitute.org)
      Non-profit educational institution that help communities achieve healthy transformation through collaborative planning processes that harnesses the talents and energies of all interested parties to create and support a buildable plan.
    - Planning for Real (www.nifonline.org.uk)
      Is a participative planning initiative.
    - For a guide to neighbourhood renewal and various resources see: www.renewal.net
    - Design Quality Indicator (www.dqi.org.uk)
    - Method to assess the design quality of buildings.
    - Commission for Architecture and the Built Environment (www.cabe.org.uk)
70. USA
    - ANSI/MTS 1.0 Whole Systems Integrated Process Guide (WSIP)-2007 for Sustainable Buildings & Communities©".
    - Draft ANSI/MTS 2.0 Integrative Process Standard for Design and Construction of Sustainable
    - Buildings and Communities (this document is intended as an updated improvement to Version 1.0 above.)
71. Potential Technologies & Strategies (LEED 2012)

- Reinforce corporate/institutional commitments to environmental health and community responsibility.
- Use cross discipline design, decision-making, and charrettes. Use goal-setting workshops and build a team approach to the project.
- Prepare checklists for points and strategies prior to beginning the design process; refer to the checklist at milestones during the design process.
- Engage owner, staff, contractors, user groups and community groups, educating them on the benefits of green design and bringing them into the design process at key points in the decision-making process.
- Participate in peer-to-peer information exchange and problem solving.
- Consider performance-based incentives in professional contracts that reward achievement of Integrative Design Goals and Project Vision.
- Contractually apportion professional fees to create specific line items for the Integrative Design Charrette and subsequent monitoring and follow-up meetings.
- Consider seeking foundation support for integrative design initiatives.

5.3 Optimizacija i kompleksnost pristupu projektovanja (DGNB-BNB)

Projektovanje održive zgrade zahteva kompleksan pristup pri određivanju ciljeva. Kreiranje koncepta uključuje ekološke, ekonomske, sociološko-kulturološke, funkcionalne i tehničke aspekte. Potrebno je konzistentno, sistematsko razmatranje održivosti u pogledu konstrukcije zgrade i menadžmenta.

Optimizacija procesa planiranja je veoma važna za poboljšanje održivosti zgrade.

Ovo mora početi još u fazi projektovanja, zato što su u toj fazi projektovanja, mogućnosti optimizacije održivih zgrada velike i uticaj promena na cenu zgrade i konstrukcije je mali.

Literatura (Indikator 5.3)

72. DGNB International, Criterion 45: Optimisation and complexity of planning method
73. BNB: Bewertungssystem Nachhaltiges Bauen (Germany), Criterion 5.1.3: Komplexität und Optimierung der Planung, http://www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_513.pdf
74. Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile constructions sites (eighth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)
75. Construction Design and Management Regulations (UK)
76. Contents of the French Global (PGCSPS) and Particular (PPSPS) Health and Safety Plan

5.4 Dokaz održivosti tokom formiranja ponude i poveravanja posla

Još tokom formiranja ponude (tendera) potrebno je razmotriti sve aspekte održivosti. Integraciju svih aspekata održivosti potrebno je zadržati i u fazi dodele posla.

Literatura (Indikator 5.4)

77. DGNB - 46 Evidence of sustainable aspects in call for and awarding of tenders
78. BNB - 5.1.4 Sustainablity Issues in Tender and Placing http://www.nachhaltigesbauen.de/fileadmin/pdf/BNB_Steckbriefe_Buero_Neubau/aktuell/BNB_BN_514.pdf (in German)

5.5 Uticaj gradilišta/ procesa gradnje

Uticaj gradilišta na okolinu treba minimizirati uz istovremenu brigu o zdravlju svih učesnika. Interesantni su pod-indikatori, koji se procenjuju.

1.5.1 Smanjenje otpada na gradilištu i recikliranje
1.5.2 Smanjenje buke na gradilištu
1.5.3 Smanjenje prašine ne gradilištu
1.5.4 Zaštita prirodne okoline na i oko gradilišta

Ocena se vrši na sledeći način:

Zaštita prirodne okoline na gradilištu	Poeni
U dokumentima poziva za tender i ponude izričito je uzeto u obzir zaštita prirodne okoline. Preduzeti su koraci da se osigura da drveće, vode i zemljište budu zaštićeni od hemijskih zagađivača ili štetnog mehaničkog uticaja. Dokumentacija menadžmenta gradilišta potvrđuje zaštitnu životne okoline tokom izgradnje objekta.	100
U dokumentima poziva za tender i ponude izričito je uzeta u obzir zaštita prirodne okoline. Preduzeti su koraci da se osigura da drveće, vode i zemljište budu zaštićeni od hemijskih zagađivača. Dokumentacija menadžmenta gradilišta potvrđuje zaštitu životne okoline tokom izgradnje objekta.	50
U dokumentima poziva za tender i ponude izričito je uzeto u obzir zaštita prirodne okoline. Preduzeti su koraci da se osigura da drveće, vode i zemljište budu zaštićeni u skladu sa nacionalnim propisima.	10
Nisu preduzeti koraci na zaštiti životne sredine tokom izgradnje objekta.	0

Literatura (Indikator 5.5)

79. DGNB 48 Construction Site / Construction Process
80. BREEAM LE 3 - Ecological Value of Site and Protection of Ecological Features
81. Risk and Safety Statements: http://ec.europa.eu/environment/chemicals/dansub/pdfs/annex3_en.pdf
82. Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile construction sites: http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1992L0057:20070627:EN:PDF , http://www.ekt.bme.hu/CM-BSC-MSC/FIEC-Directive9257EEC.pdf
83. Low-waste construction site, Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0030:en:PDF
84. Low-noise construction site Directive 2000/14/EC of the European Parliament and of the Council of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors: http://ec.europa.eu/environment/noise/pdf/d0014_en.pdf
85. Low-dust construction site, Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work (fourteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC): http://www2.unitar.org/cwm/publications/cbl/ghs/Documents_2ed/C_Regional_Documents/215_EU_Directive9824EC.pdf
86. BRE/EA publications 'Control of Dust from Construction and Demolition Activities' (BRE, 2003). Pollution Control Guide Parts 1-5 (BRE, 2003).
87. Environmental protection at the construction site Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:024:0008:0029:en:PDF

88. Proposal for a European Parliament and Council Directive of 22 September 2006 setting out a framework for soil protection and amending Council Directive 2004/35/EC: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:263:0009:0011:EN:PDF

1.6 Kvalitet izvodjača radova / kvalifikacije (reference)

Kvalitet izvođača radova / kvalifikacije	Poeni
Ponuđačke firme su ocenjene prema standardu ISO 14001 ili istim kriterijumima (na primer, kompanijski menadžment kvaliteta) vlasnika zgrade ili predstavnika vlasnika zgrade.	100
Samo izvođači čija pouzdanost, ekspertiza i visoke mogućnosti su potvrđeni standardom ISO 9001 dobijaju ugovor ili, Pouzdanost, ekspertiza i visoke mogućnosti izvođača su potvrđene dugogodišnjom saradnjom.	50
Izvođači čije kvalifikacije nisu potvrđene dobijaju ugovor.	0

Literatura (Indikator 5.6)

89. The Government Procurement Agreement (GPA): http://www.wto.org/english/tratop_e/gproc_e/gp_gpa_e.htm
90. Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:134:0001:0113:en:PDF
91. Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:134:0114:0240:en:PDF
92. ISO 9001:2008 “Quality management systems - Requirements”: http://www.iso.org/iso/catalogue_detail?csnumber=46486
93. ISO 14001:2004 “Environmental management systems - Requirements with guidance for use”: http://www.iso.org/iso/catalogue_detail?csnumber=31807 http://www.praxiom.com/iso-14001-2004.htm
94. GUIDE TO THE COMMUNITY RULES ON PUBLIC WORKS CONTRACTS: http://ec.europa.eu/internal_market/publicprocurement/docs/guidelines/works_en.pdf

1.7 Osiguranje kvaliteta izvodjenja radova

Sledeći sub-indeksi su poentirani:

5.7.1 Dokumentacija materijala, pomoćnih materijala i podaci o sigurnosti
5.7.2 Merenja radi kontrole kvaliteta

Literatura (Indikator 5.7)

95. Directive 91/155/EEC of 5 March 1991 defining and laying down the detailed arrangements for the system of specific information relating to dangerous preparations in implementation of Article 10 of Directive 88/379/EEC: http://www.dehp-facts.com/upload/documents/webpage/document34.pdf
96. DIN 276-1 Building costs – Part 1: Building construction http://www.beuth.de/cn/J01586CD9D7B736D60E87E40C4ECDA708.4/bGV2ZWw9dHBsLUxhbmdhbnplaWdlJnNtb2lkPTExMTA1MjY3NiZsYW5ndWFnZWlkPWVu.html
97. DGNB - 50 Quality assurance for construction
98. BNB 2011 - 522 Quality Assurance of the Building Construction

5.8 Tehnički prijem, upotrebna dozvola, puštanje u rad

5.8.1 Organizacija tehničkog prijema i dokumentacija

Literatura (Indikator 5.8)

99. Code of Practice for Project Management for Construction and Development, Chartered Institute of Building, 2010, Wiley-Blackwell, UK
100. A BSRIA guide: Commissioning Job Book, BSRIA, 2010, by Glen Hawkins
101. White Paper: Commissioning for Great Buildings, February 2005, Building Commissioning Association, US,
102. Best Practices in Commissioning Existing Buildings, Building Commissioning Association,
103. ACG Commissioning Guideline, www.commissioning.org
104. Whole Building Design Guide, Building commissioning, National Institute of Building sciences, US, www.wbdg.org/project/buildingcomm.php)
105. Smernica za naročila javnih gradenj (Guidelines for public tendering), The Slovenian Chamber of Engineers, 2011
106. DGNB 51 Commissioning.

5.9 Monitoring, korišćenje i funkcionisanje objekta
(BREEM, DGNB-BNB, LEED)

5.9.1 Efikasno praćenje / merenje
5.9.2a Projektna dokumentacija
5.9.2b Uputstva za servisiranje, kontrolu, funkcionisanje i održavanje
5.9.2c. Adaptacija projekta i proračuni za završenu zgradu
5.9.2d. Uputsvo za korisnike

Svaka od sledećih 7 kategorija mora biti ocenjena:

- Energija: potrošnja energije
- Voda: potrošnja vode
- Materijal i otpad: proizvodnja otpada
- Zdravlje i dobar osećaj: zadovoljstvo stanara
- Zagađenje: curenje rashladnih uređaja
- Korišćenje zemljišta i ekologija: biodiverzitet
- Kontrola stanja menadžmenta

Literatura (Indikator 5.9)

107. BREEAM in use, 2009
108. LEED for Existing Buildings, Operation & Maintenance, 2008
109. LEED for New Construction and Major Renovations, 2009
110. DGNB, Criterion 47: Creation of conditions for an Optimal Use and Management
111. NBB, 2011, Criterion 5.1.5: Conditions for optimal management
112. A Specifications Guide for Performance Monitoring Systems http://cbs.lbl.gov/performance-monitoring/specifications/pdf/PM%20Spec%20Guide%20Version%201_2007-03-23.pdf

OCENA LOKACIJE ZGRADE (6)

6.1 Rizici na lokaciji građevine
6.2 Uslovi na lokaciji građevine
6.3 Opcije za transport
6.4 Izgled i stanje lokacije i susedstva
6.5 Udaljenost raznih sadržaja
6.6 Bliskost medija, infrastrukture, razvoj

6.1 Rizici na lokaciji gradjevine

Cilj ovog kriterijuma je da se izbegne izgradnja gradjevina, prolaza ili parkirališta u područjima visokog rizika, u nepogodnim područjima i da se redukuje rizik od zemljišta, vode, opasnosti koje je generisao čovek i terorizma. Za ocenu rizika na mestu gradnje koriste se karte opasnosti i rizika ESPON 2006. (Eureopean Spatial Planning Observation Network, projekat „The spatial effects and management of natural technological hazards in general and in relation to climate change“. U okviru ovog indikatora vrši se procena rizika datih u narednoj tabeli.

Tlo, geologija, seizmologija, vulkani

6.1.1 Zemljotresi
6.1.2 Klizišta
6.1.3 Vulkanske erupcije
6.1.4 Cunami - Vremenski uslovi/klima
6.1.5 Ektremne tempearture
6.1.6 Šumski požari
6.1.7 Suše
6.1.8 Poplave
6.1.9 Oluje
6.1.10 Lavine

Opasnosti koje je prouzrokovao čovek

6.1.11 Tehnološki rizik / Havarija u hemijskim fabrikama
6.1.12 Tehnološki rizik/Oslobadjanje zagadjivača i eksplozije
6.1.13 Tehnološki rizik/Radioaktivnost prouzrokovana havarijama u nuklearnim elektranama

Terorizam

6.1.14 Teroristićki napadi

Literatura (Indikator 6.1)

113. Website of ESPON (European Spatial Planning Observation Network) where all hazards and risk maps presented in this document are kept up to date, i.e. www.espon.eu
114. Website of RMS, which is the world's leading provider of products, services, and expertise for the quantification and management of catastrophe risk, i.e. www.rms.com www.preventionweb.net
115. BREEAM Europe Commercial 2009 Assessor Manual (Issue Pollution 5: Flood risk)
116. LEED Reference Guide for Green Building Design and Construction 2009 Edition
117. HQE Guide Pratique du référentiel pour la qualité environnementale des bâtiments.

6.2 Uslovi na lokaciji (BREEAM, DGNB, LEED)

Cilj ovog kriterijuma je da se ocene uslovi na lokaciji koji mogu imati uticaj na zdravlje i dobrobit ljudi (stres, smanjena produktivnost, dugotrajni zdravstveni problemi).

6.2.1 Kvalitet spoljašnjeg vazduha (DGNB)
6.2.2 Nivo ambijetelne buke (DGNB)
6.2.3 Šema zagadjenja tla i zgrade (DGNB, BREEM)
6.2.4 Prisustvo radona
6.2.5 Efekat urbanog toplotnog ostrva
6.2.6 Vizuelna veza sa urbanim pejzažom

Literatura (Indikator 6.2)

118. EN 13779:2007 : Ventilation for non-residential buildings – Performance requirements for ventilation and room-conditioning systems
119. WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global update 2005 – Summary of risk Assessment http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf
120. EEA Progress in Management of contaminated sites http://www.eea.europa.eu/data-and-maps/indicators/progress-in-management-of- contaminated-sites
121. An overview of radon surveys in Europe – G. Dubois. European Commission – DG oint Research, Centre, Institute for Environment and Sustainability. http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=5450&dt_code=NWS&lang=en

6.3 Mogućnosti transporta (DGNB)

Kako dobar pristup transpotnim sistemima ima pozitivan uticaj na ekološke performanse zgrade, cilj ovog indikatora je da definiše efektivna i najkraća rastojanja u metrima od glavnog ulaza u zgradu do lokalnih sredstava javnog prevoza. Ocenivaće se sledeći pod-indikatori.

6..3.1 Pristupačnost najbližoj železničkoj stanici od glavnog ulaza zgrade (DGNB)
6.3.2 Pristupačnost najbližeg javnog lokalnog prevoza (autobus, brzi gradski voz, tramvaj, metro) (DGNB)
6.3.3 Pristupačnost modernog transportnog sredstva sa niskom emisijom : gradska biciklistička mreža, strukture za punjenje električnih/hibridnih vozila, električne/hibridne autobuske linije
6.3.4 Pristupačnost pešačkih i biciklističkih staza (DGNB)

Literatura (Indikator 6.3)

122. DGNB International Criterion 59: Connection to Transportation
123. BNB Criterion 614 Public Transport Connections
124. BREEAM Criterion Tra 3 - Alternative modes of transport
125. LEED Criterion Credit 4.1: Alternative Transportation – Public Transportation Access

6.4 Imidž i uslovi lokacije i susedstva (DGNB)

Cilj je da se okarakteriše slika i stanje u susedstvu da bi ova informacija bila dostupna za studije lokacije.

6.4.1 Vizualni aspekt okolnog pejsaža
6.4.2 Stopa kriminaliteta (DGNB)
6.4.3 Sinergijski potencijal (DGNB)

Literatura (Indikator 6.4)

126. HQE Guide Pratique du référentiel pour la qualité environnementale des bâtiments.
127. DGNB - 58 Image and Condition of the Location and Neighbourhood
128. BNB 2011 - 613 Image and Character of Location and Quarter

6.5 Bliskost medija, infrastrukture, razvoj (DGNB)

Cilj je da se oceni infrastruktura tako da podrži ekološke ciljeve i spreči rizike. Radi toga se moraju ispuniti razni infrastrukturni zahtevi, uz lokalni razvoj.

6.5.1 Pristup energetskim mrežama
6.5.2 Pogodnost za korišćenje solarne energije
6.5.3 Telekomunikacione veze
6.5.4 Kišna kanalizacija

Literatura (Indikator 6.5)

129. Typical solar systems and their components: EN 12975-2 /EN 12976-2 / EN 12977-
130. Example of German Standards for drainage systems:
- DIN EN 752, Issue 2008-04 drainage system
- DIN EN 12056 "Gravity drainage systems inside buildings"
http://www.solarserver.com

131. Typical solar systems and their components: EN 12975-2 /EN 12976-2 / EN 12977-
132. Example of German Standards for drainage systems:
- DIN EN 752, Issue 2008-04 drainage system
- DIN EN 12056 "Gravity drainage systems inside buildings"
http://www.solarserver.com

3. UTICAJ PROJEKTA NA TRANSNACIONALNO STRUČNO OBRAZOVANJE I LOKALNI / REGIONALNI RAZVOJ

Ocenjivanje zgrade iz različitih aspekata predstavlja važan zadatak svih činioca koji učestvuju u izgradnji. Evropskim projektom Open House postavljene su osnove za primenu kriterijuma ocene kako u daljem razvoju teorije, tako u neposrednoj praksi. Važan segment u diseminaciji ideje je pretvaranje rezultata projekta u planove i programe nastave, posebno u oblasti stručnog obrazovanja (VET). Metoda je razvijena i testirana, pa je u toku adaptacija na uslove u praktičnom radu. Deo koji se odnosi na energetsku efikasnost i NZEB (Near Zero Energy Building) već je predmet primene u praksi, no, ostaje da se razrade programi nastave i primene kako u nastavi, tako u praksi i to na regionalnom, nacionalnom i transnacionalnom nivou. Programi će biti predmet prilagodjavanja i razmene na evropskom nivou, u prvoj fazi izmedju Srbije, Rumunije, Poljske i Slovenije, a potom i šire. To će

omogućiti i medjusobna priznavanja stečenih kvalifikacija, sa omogućavanjem transfera VET kredita unutar EU (ECVET: European Credit System for Vocational Education and Training), i obezbedjivanje kvaliteta obrazovanja u stručnom formalnom i neformalnom obrazovanju (EQAVET: European Quality Assurance in Vocational Education and Training). Sistem bi trebalo da obezbedi i slobodan pristup svim edukacionim resursima (OER - open educational resources) kao i korišćenje ICT (Information and Communication Technologies).

Pored velikog privredno-ekonomskog uticaja ovog projekta na čitav Niški region, medjunarodna saradnja sa partnerima iz Rumunije, Poljske i Slovenije ima veliki uticaj na razvoj poslovno-obrazovnog turizma Grada Niša. Kao krajnje korisnike, ovaj projekat imaće veći broj subjekata, od kojih su najvažniji:

- Turistička privreda Grada Niša sa znatno uvećanim brojem stranih gostiju u okviru privredne i obrazovne razmene (privredna saradnja, zajednički projekti, dualno obrazovanje, specijalističke studije),
- master i doktorske studije, tematski seminari i obuke, itd.
- Mala i srednja preduzeća Grada Niša (MSP), sa mogućnošću plasmana u tri ciljne zemlje Jugoistočne Evrope (Rumunija, Poljska, Slovenija), a takodje i druge zemlje u okviru COSME grupe zemalja.
- Obrazovna privreda (prevashodno, ali ne i jedino, Univerzitet u Nišu), sa privlačenjem stranih studenata i inženjera na dodatno školovanje, specijalizacije i doktorske studije, kao i medjunarodnom istraživačkom saradnjom sa RDI organizacijama i institucijama iz Južne i Istočne Evrope, u okviru projekata EU ili medjudržavnih ugovora.

Svi navedeni korisnici imaju kapacitete za znatno uvećanje privredno-obrazovnih aktivnosti, sa posebnim afinitetima ka medjunarodnoj saradnji. Prezentovani projekat, svojim mnogobrojnim aktivnostima umrežavanja i saradnje, a posebno program ClusterXchange, utiče na znatno bolju prezentaciju obrazovno-privrednih kapaciteta Grada Niša.

BUILDING ASSESSMENT INFORMATION														
BUILDING LIFE CYCLE INFORMATION														SUPLEMENTARY INFORMATION BEYOND THE BUILDING LIFE CYCLE
A1 – 3			A4 – 5		B1 – 7					C1 – 4				D
PRODUCT STAGE			CONSTRUCTION PROCESS		USE STAGE					END OF LIFE STAGE				Benefits and loads beyond the system boundary
A1 Raw materials Supply	A2 Transport	A3 Manufacturing	A4 Transport	A5 Construction – installation process	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	C1 Deconstruction	C2 Transport	C3 Waste processing for reuse, recovery or recycling	C4 Disposal	Reuse Recovery Recycling Potential
					B6 Operational Energy use									
					B7 Operational Water use									

Table 1: Building Life Cycle Phases according to FprEN 15978 (adapted)

3. PRIMER SARADNJE KLASTERA JUGOISTOČNE EVROPE U OBLASTI ENERGETSKE EFIKASNOSTI[5]

Đorđe Đorđević[6], Biljana Avramović[7]

Rezime: *Medjunarodna privredna saradnja klastera Jugoistočne Evrope, pored direktnih privrednih rezultata, ima priličan značaj za poslovno-obrazovni turizam svih partnera na projektu, a posebno za Grad Niš. Glavni cilj projekta pod nazivom SMART4NZEB (Smart for Near Zero Energy Building) je da uspostavi održivu saradnju, uzajamnu obuku i izgradnju kapaciteta izmedju partnera – menadzera klastera i članova klastera, kao i predstavnika relevantnih institucija za nZEB (near Zero Energy Building – gradnja sa minimalnom potrošnjom energije i potrošnjom bliskom nuli) tržište u odabranim zemljama Centralne i Istočne Evrope, sa ciljem da postigne izvrsnost u radu angažovanih klasterskih menadžmenata uz podršku medjuregionalnih partnerstava radi razvoja konkurentnih proizvoda i tehnoloških rešenja za nove i postojeće gradjevine, što će voditi prodoru na tržište gradnje zgrada sa minimalnom (blizu nule) potrošnjom energije u gradnji, korišćenju i ponovnom korišćenju (reuse). Cilj je da se klasteri orijentišu ka inovativnim i modernim klasterima koji će biti sposobni da realizuju medjusektorsku i medjugraničnu saradnju svojih članova, uz podršku glavnim izazovima zaštite okoline, ekonomije i socijalne gradnje.*

Ključne reči: *Klasteri, Menadžment, Pasivne kuće, Energetska efikasnost, Jugoistočna Evropa*

Summary: *International industrial cooperation of clusters of South-East Europe, in addition to strict industrial outcomes, has important influence on business-educational tourism of all partners, in our case, City of Nis.The main objective of SMART4NZEB is to create a sustainable collaboration, co-learning and capacity building between the involved partners - cluster managers and cluster members and relevant stakeholders representative for the nZEB market in the selected Central and East-European countries, with a view to develop the involved clusters management excellence and to support interregional partnerships to facilitate the development of competitive products and technological solutions intended for new and existing buildings, which will lead to market penetration of nearly zero energy buildings, related to their production, use and reuse. The objective is to drive clusters towards innovative and modern clusters being able to address cross-sectoral and cross border collaboration and tackling main environmental, economic, and social challenges of their members.*

Keywords: *Clusters, Management, Passive house, Energy Efficiency, Southeast Europe*

[5] Istraživanje je odobreno i finansirano od strane Kancelarije za lokalni ekonomski razvoj i projekte (KLERP) Grada Niša;

[6] Construction Cluster "Dundjer", Niš, Srbija, Građevinsko-arhitektonski fakultet u Nišu, Niš, Srbija;

[7] Construction Cluster "Dundjer", Niš, Srbija.

4. OPŠTI CILJEVI PROJEKTA

Zgrade u svetu i u Evropi, prema proračunima, troše oko 40% primarne energije, čime značajno doprinose emisiji CO_2. Kombinacija mera za povećanje energetske efikasnosti i korišćenje većeg procenta obnovljive energije u globalnoj potrošnji je znači ključni faktor za rešavanje globalnog izazova u vezi sa klimatskim promenamai i smanjenja korišćenja fosilnih goriva. Šta više, postizanje značajnog smanjenja u korišćenju energije i emisije ugljen-dioksida u ovoj oblasti zahteva mnogo više od inkrementalnog povećanja energetske efikasnosti. Prema Direktivi o energetskim performansama zgrada (EPBD), države članice su u obavezi da aktivno marketinški promovišu zgrade sa malim emisijama ugljen-dioksida i vrlo malom ili nultom potrošnjom primarne energije, sprovodeći nacionalne planove sa jasnim definicijama i ciljevima njihovih aktivnosti.

Takozvani koncept nZEB (near Zero Energy Buiding – gradnja sa potrošnjom energije bliskom nuli) još ne izgleda lako primenljiv u mnogim Evropskim zemljama, posebno u zemljama/regionima ciljanih ovim projektom (Rumunija, Srbija, Slovenija i Poljska). Ranija istraživanja su pokazala da su potrebne investicije i optimalna integracija tehnologija pogodnih u izgradnji i/ili rekonstrukciji na nivou nZEB, zajedno sa primenom relevantnog znanja i veština svih ključnih učesnika, medju glavnim preprekama u realizaciji (Rezultati projekta Slovenija[8] i Rumunija[9]). Štaviše, sticanjem poverenja gradjevinske industrije i vlasnika zgrada u stvarne energetske performanse sistema nZEB i umanjenjem stvarnih rizika vezanih za nove tehnologije, postavljaju se kao strateški zadaci čije rešenje bi moglo omogućiti angažovanje velikih investicionih ulaganja potrebnih za procedure povećanja energetske efikasnosti postojećih grupa zgrada.

U tom kontekstu, projekat SMART4NZEB ima za cilj da pojača konkurentnost i podrži jačanje 577 MSP koja deluju u sektorima gradnje, energetske efikanosti i obnovljive energije, pomoću jačanja kapaciteta 5 reprezentativnih klastera kao motornoj snazi inovativnosti u Centralnoj i Istočnoj Evropi (Poljska, Rumunija, Srbija i Slovenija) uz realizaciju medjunarodne razmene I strateških partnerstava sa fokusom na razmenu iskustava o različitim praktičnim rešenjima, razlikama u veštinama, politikama u poslovanju, predvidjenim rezultatima i stepenu angažovanja u cilju realizacije gradnje u sistemu potrošnje energije bliskoj nuli (nZEB).

Glavni cilj projekta SMART4NZEB je da se uspostavi održiva saradnja, uzajamno učenje i izgradnja kapaciteta izmedju angažovanih partnera – klasterskih menadžera i članova klastera, kao i odgovarajućih predstavnika relevantnih institucija za nZEB tržiste u odabranim zemljama Centralne i Istočne Evrope, sa ciljem da se postigne izvrsnost u radu angažovanih klasterskih menadžmenata uz podršku medjuregionalnih partnerstava radi razvoja konkurentnih proizvoda i tehnoloških rešenja za nove i postojeće gradjevine, što će voditi prodoru na tržište gradnje zgrada sa minimalnom (blizu nule) potrošnjom energije u gradnji, korišćenju i ponovnom korišćenju. Takodje, cilj je da se klasteri orijentišu ka inovativnim i

[8] SKILLS4SB.SI, Building Skills for Sustainable Building in Slovenia, IEE BUILD UP Skills Slovenia

[9] BUILD UP Skills Romania - ROBUST, Roadmap for National Qualification of Building Workforce

modernim klasterima koji će biti sposobni da realizuju medjusektorsku i medjugraničnu saradnju svojih članova, uz podršku glavnim izazovima zaštite okoline, ekonomije i socijalne gradnje.

Predložene aktivnosti su u saglasnosti sa politikom i uputstvima definisanih Strateškim okvirom za ekonomsku politiku EU – cirkularna ekonomija i ekonomija niske potrošnje ugljenika, uz rešavanje problema gradnje sa potrošnjom energije bliskom nuli (nZEB), obnovljivim izvorima energije, efikasnosti resursa, itd., uz podršku ciljeva saradnje u oblasti specijalizacija u jačanju inovativnosti u Evropskim regionima („Strengthening Innovation in Europe's Regions"). To zahteva jaču stratešku kooperaciju, održivu povezanost i investicije izmedju regionalnih ekosistema prateći lance vrednosti, radi maksimiziranja Evropskog inovacionog potencijala pametnim specijalizacijama i klasterima[10].

Specifični ciljevi projekta (**SO1-SO7**) su dati u daljem tekstu.

5. JAČANJE IZVRSNOSTI KLASTERSKOG MENADŽMENTA (**SO1**)

Jačanje izvrsnosti klasterskog menadžmenta pet reprezantivnih klastera u Centralnoj i Istočnoj Evropi usavršavanjem veština klasterskih menadžera, formalnim sertifikovanjem klasterskih menadžmenata (Cluster Management Excellence) i unapredjenjem ili novim razvojem inovacionih strategija sa ciljem obezbedjenja vrhunskog kvaliteta usluga za povezana mala I srednja preduzeća (MSP – SME) je prvi strateški cilj.

Ovaj specifični cilj je fokusiran na poboljšanje menadžerskih veština partnerskih klastera generisanjem usluga za podršku stvaranja dodatne vrednosti klasterskih organizacija, a radi rasta i povećanja konkurentnosti svojih MSP članova. Ovo će biti realizovano uz razmenu iskustava medju partnerima u analizi, kreiranju i implementaciji unapredjene pojedinacne strategije za svaki klaster, kao i u zajednickoj strategiji i odgovarajućim uputstvima za implementaciju za konzorcijum klastera u skladu sa industrijskim trendovima i politikom prioriteta od značaja za primenu nZEB, posebno za dekarbonizaciju i efikasnost svih resursa u gradjevinskom sektoru.

Klasteri koji učestvuju u ovom projektu su reprezantivni u ovoj oblasti (nZEB), pokrivajući gradjevinski sektor (visokogradnja), energetsku efikasnost i oblasti obnovljivih izvora energije i locirani su u 3 zemlje članice EU (Poljska, Slovenija i Rumunija) i 1 zemlju učesnicu u COSME programu u skladu sa članom 6 COSME pravilnika (Srbija). Šema strukture projekta data je na sl.1.

Izvrsnost klasterskog menadžmenta će biti ojačana učešćem 18 osoba uključenih u menadžment klastera, tako što će formirati konzorcijum u programima za obuku i konsultacije u okviru WP5 – Radni paket 5 (videti Sliku 2. Šema radnih aktivnosti na projektu). Eksperiza uradjena u okviru programa ClusterXchange u fazi WP5, zajedno sa sertifikacijom klasterske izvrsnosti u fazi WP2 i saradnjom na unapredjenju strategija razvoja & inovacija u WP4 će dalje unaprediti izvrsnost menadžmenta klastera i njenu sposobnost da obezbedi vrhunski kvalitet usluga za povezana mala i srednja preduzeća (MSP).

[10] The role of clusters in smart specialisation strategies, DG Research, 2013.

Unapredjen ili nov razvoj i inovativne strategije će inicirati stratešku analizu klasterskog potencijala za rast i inovativnost pomoću prednosti strategije pametne specijalizacije u regionu. Takodje, biće pripremljen okvir mera za podršku klastera u partnerskim zemljama koje su potrebne za tranziciju ka izvrsnosti klasterskog menadžmenta.

6. JAČANJE INOVATIVNOG BIZNIS MODELA, MARKETINGA I PRODAJNIH VEŠTINA (**SO2**)

Drugi strateški cilj je jačanje inovativnog biznis modela, marketinga i prodajnih veština kako za menadžere participirajućih klastera i projektne menadžere, tako i za povezana MSP (članovi klastera).

Iako su zakonske obaveze za nove zgrade za postizanje nivoa performansi u skladu sa nZEB date za sve EU zemlje na nacionalnom nivou u skladu sa EPBD (Energy Performanse of Buildings Directive, donesena 2010. i dopunjena 2018.), koncept nZEB se još uvek smatra sporednim segmentom na tržištu.

Primena nZEB standarda u praksi zahteva tehnološka i praktična znanja koja omogućavaju ispravni koncept, projektovanje, izvršenje, evaluaciju i korišćenje zgrada u skladu sa ekonomskom, socijalnom i ekološkom tačkom gledišta. Sa naučne tačke gledišta, koncept nZEB se oslanja na napredne tehnologije, tj. energetski efikasne sisteme, korišćenje obnovljivih izvora energije, nanomaterijale, itd. Iz aspekta energetske efikasnosti i gradjevinskog sektora, primena nZEB zahteva definisanje i primenu novih poslovnih modela, koji mora da budu razumljivi za učesnike na tržištu, posebno za MSP koja su u principu inovativno fleksibilnija. Obuka, saradnja I razmena, ali takodje i akcije komunikacije i diseminacije predvidjene ovom akcijom omogućiće pozitivan socijalni i ekonomski efekat formiranjem inovativno orijentisanog “poslovnog ekosistema”, podrškom povećanju razmene u istraživanju i inovativnosti i trensferu (od istrazivačko-razvojno-inovativnih članova ka marketinškim), uz poštovanje problem-orijentisane filozofije koja se bazira na praktičnim unapredjenjima i aplikacijama poteklih iz tržišno orijentisanih analiza. To će biti ostvareno predvidjenom saradnjom izmedju angažovanih klastera I njihovih članova.

Na osnovu rezultata baziranog na test analizama planiranim u WP2 (videti Sliku 2), strategije razvoja i inovativnosti koje će biti definisane u WP4 sadrzaće sledeće:

- Ocena oblasti klasterskih aktivnosti I tehnološke podrške;
- Identifikacija aktuelnog stanja u razvoju, kao i trendova;
- Analiza značajnih tehnoloških oblasti potrebnih za unapradjenje energetskih performansi novoizgradjenih i rekonstruisanih postojećih zgrada i inovacionih performansi članova klastera;
- Analiza medjunarodne orijentacije i pozicioniranja klastera na medjunarodnoj sceni;
- Analiza aktuelne situacije i trendova na tržištu kao i raspoloživog eksternog finansiranja radi uvodjenja klasterskih proizvoda i usluga na trzište, nacionalno I transnacionalno.
- Analiza usluga transfera tehnologije potrebnih za klastere putem direktnih akcija ili specifičnih usluga koje treba omoguciti od klastera ka njihovim članovima.

Postizanje ovog strateškog cilja (SO2) je podržano zajedničkom ekspertskom kontrolom benčmarking analize, učešćem u programima obuka i savetovanja, ciljnim aktivnostima i dogadjajima organizovanim u okviru Xchange poseta, kao i aktivnim učešćem na drugim dogadjajima na nacionalnom nivou.

7. JAČANJE KONKURENTNOSTI ČLANOVA (**SO3**)

Jačanje konkurentnosti i podrška rastu 577 MSP u oblasti gradnje, energetske efikasnosti i obnovljivih izvora energije biće ostvareno pomoću unapredjenih i pogodnih usluga od strane klastera baziranih na specifičnim potrebama uključenih MSP.

Povećanje konkuennosti i podrška rastu za ciljne MSP biće postignuta poglavito ukazivanjem na nZEB koncept kao integratora različitih postojecih tehnologija (servisi za gradnju i održavanje, oprema, materijali, efikasno snabdevanje energijom, tehnologija obnovljivih izvora energije, itd.). Ovo će voditi diverzifikaciji postojećih proizvoda i usluga kompanija, a takodje novim uslugama za novo tržiste (nZEB). Programi obuke za nZEB i kampanja komunikacije biće stubovi za postizanje ovog specifičnog cilja.

Specifičnim potrebama MSP i drugim relevantnim članovima klastera biće odgovoreno u okviru testiranja (benčmarking), dok će direktan pristup pojedinačnim MSP, koji su zastupljeni kao članovi klastera, biti realizovan kroz njihove specifične mreže.

Efektivno učešće u primenjenim programima obuka i savetovanja i aktivnosti ClusterXchange, u specifičnim kampanjama promocije, sa savetovanjima i akcijama uključenim u strategije razvoja i inovacija, podržaće jačanje konkurentnosti i rastu ciljanih MSP.

8. JAČANJE STRATEŠKOG I ODRŽIVOG PARTNERSTVA (**SO4**)

Ovaj cilj sadrži oblikovanje strateškog i održivog partnerstva u EU dizajniranjem strategije partnerstva i aktivnostima saradnje kao što je formiranje mreže komplementarnih partnera za saradnju MSP na medjunarodnom tržištu putem učešća 55 značajnih institucija u programu ClusterXchange.
Strategija dugovremene kolaboracije izmedju povezanih klastera i proširenje novokreirane mreže pomoći će razvoju navedenih sektora u saglasnosti sa politikom EU. Nameravane aktivnosti saradnje klaster-klaster pomoći će članovima konzorcijuma da se udruže na Evropskom nivou i koriste sinergije bazirane na strategiji uzajamnog partnerstva kao business-to-business (B2B) kolaborativne aktivnosti (na pr. kao uparivanje na nacionalnom i medjunarodnom nivou). Fokus ovih aktivnosti će biti na naporima za podršku internacionalizacije, istraživanju tržišta, transferu znanja i tehnologije i promocije usvajanja inovativnosti, naprednih tehnologija i novih poslovnih modela, niske emisije CO_2, efikasnog korišćenja resursa i unapredjenju stručnosti.

Program ClusterXchange ima za cilj da promoviše učenje izmedju klastera, razmenu znanja i specijalnosti izmedju klasterskih organizacija u projektnom konzorcijumu i uključuje uparivanje, umrežavanje, B2B sastanke i druge obrazovne aktivnosti kao što su stručni kursevi, direktne posete, obuke i savetodavne akcije za klasterske organizacije i njihove članove (posebno MSP). Fokus kratkoročnih poseta (5-6 dana) biće na promociji novih mogućnosti rasta za MSP i industrijske transformacije navedenih sektora radi realizacije razvoja nZEB trzišta i adaptacije članova klastera na nove zahteve uslovljene nZEB izazovom, podrškom kolaboracionih napora radi organizacije razvoja novih naprednih tehnologija za nisko-ugljenična i resursno efikasna rešenja, primenu novih poslovnih modela i stvaranje novih nZEB zanata.

Najmanje 10 kratkoročnih razmena biće organizovano i realizovano radi podrške izgradnje izvrsnosti klastera uz predvidjenih 10 praktičnih obuka za gostujuće učesnike, uz podsticanje razmene iskustava i informacija izmedju gostujućih i domaćih organizacija (10 radnih sesija,

10 direktnih poseta, 10 umreženih sesija i B2B sastanaka) o preprekama i izazovima, kao i potencijalnih rešenja u unapred izabranim oblastima, pomoću poboljšanog pristupa trzistu i identifikacije potencijalnih partnera za nove i postojeće klasterske organizacije/ MSP/ tehnološke centre i podrškom umrežavanja izmedju participirajućih klastera i klastera iz različitih COSME participirajućih zemalja, razmenom znanja i iskustva.

9. IZGRADNJA SINERGIJE I LANACA VREDNOSTI (**SO5**)

Strateški cilj ove akcije je izgradnja sinergije i lanaca vrednosti izmedju 3 ključna sektora: izgradnja, energetska efikasnost (EE) i izvori obnovljive energije (Renewable energy sources – RES), radi oblikovanja efektivne implementacije koncepta nZEB pomoću medjusektorske saradnje i transferzalne obuke u efikasnom korišćenju resursa, dekarbonizaciji (minimalna emisija CO_2), nZEB, EE, RES.

Takodje, cilj je i razvoj detaljne strategije za pojedine klastere, s obzirom na podršku rasta i kompetentnosti njihovih članova, kao i uputstvo za realizaciju strategije. To se prenosi na podršku MSP u najboljem iskorišćenju poslovnih mogućnosti korišćenjem naprednih tehnologija, kreativnosti i svih oblika inovativnosti, kao i specifičnih nZEB proizvodnih trendova i aspekata održivosti tokom vremena. Mogućnosti strateškog razvoja koje će biti analizirane za participirajuće klastere biće fokusirane na naizgled uski sektor predstavljen zgradama u skladu sa nZEB zahtevima, ali pristup će obuhvatiti vazne (velike) sektore gradjevinarstva, energetske efikasnosti, obnovljive izvore energije i ekologije, uz analizu moguće veze sa sličnim sektorima i industrijama u nastajanju, tehnološke i ekonomske transformacije i održivosti.

Strategija razvoja klastera uključuje promociju strateške saradnje izmedju klasterskih menadžera i drugih važnih faktora regionalnih inovacionih ekosistema, tj. regionalnih vlasti odgovornih za politiku klasterskog udruživanja. Ovo će omogućiti povezanost i usaglašenost sa regionalnim prioritetima, posebno u kontekstu primene novih istraženih strategija specijalizacije uz iskorišćenje regionalnog javnog i privatnog istraživanja, inovativnosti i dinamike infrastrukturnih investiranja.

Strategija i odgovarajući plan za svaku klastersku organizaciju i partnerstva uopšte biće razvijeni uz uključenje merljivih ciljeva i verifikativnih indikatora uticaja radi praćenja tokom vremena, kao i povećanja prihoda i poslova, inovacionih projekata i patenata, novih ili usavršenih proizvoda i usluga.

Postizanje ovog specifičnog cilja podićiće konkurentnost uključenih klastera i doprineće implementaciji strategija inteligentnih specijalizacija u regionima u kojima klasteri funkcionišu.To će se odnositi na sledece poslovne aspekte:

- Strateške konsultacije i saradnja sa regionalnim vlastima;
- Analiza lanaca vrednosti, uključujući identifikaciju potencijalnih novih lanaca vrednosti, medju njima i medjunarodnih;
- Analiza inovativnih potencijala i potencijala rasta klastera;
- Medjusektorske i trend analize u smeru digitalizacije, kreativna ekonomija, kao i resursna efikasnost, dekarbonizacija i cirkularna ekonomija.

Štaviše, poboljšanjem sinergija i diverzifikacionih lanaca vrednosti specifičnih za tri ključna sektora, stvoriće se povećani promet članova klastera, nova radna mesta (posebno novi ili usavrseni zanati – veštine za nZEB gradnju i nove ili rekonstruisane zgrade u saglasnosti sa

nZEB karakteristikama), povećanje inovacionih projekata i patenata vezanih sa razvoj tehnologije, novi proizvodi i usluge.

10. RAZVOJ I IMPLEMENTACIJA KOMUNIKACIJE I DISEMINACIJE (**SO6**)

Razvoj i implementacija komunikacije i akcije diseminacije radi promocije i eksploatacije rezultata projekta i promocija koncepta nZEB u cilju povećanja potražnje i poboljšanja performansi novih i rekonstruisanih zgrada su obuhvaćeni ovim strateškim ciljem.

Kampanja komunikacije i diseminacije biće realizovana u saglasnosti sa zajedničkom strukturom i biće posebno podešena za primenu u svakoj državi – regionu, sa sledećim ciljevima:

- Promovisati programe obuke sa ciljem povećanja interesovanja ciljne grupe uz obezbedjenje njene održivosti po završetku projekta;

- Unaprediti svest o unapredjenoj ili razvijenoj strategiji klastera i partnerstava uspostavljenih u okviru projekta radi korišćenja rezultata;

- Povećati zainteresovanost za program ClusterXchange isticanjem prednosti učešća u takvom programu sa ciljem privlačenja maksimalnog broja kandidata;

- Promovisati nZEB koncept medju relevantnim uticajnim krugovima sa ciljem povećanja zahteva za nZEB i povećanje kvaliteta novih i rekonstruisanih zgrada.

Pažljivom definicijom i skrojenom implementacijom kampanje komunikacije & diseminacije, članovi pet klastera biće informisani i aktivirani, ciljna grupa za plan obuke & podučavanja biće obezbedjena i efikasna razmena biće ostvarena tokom usvojenog programa.

11. PODRŠKA PREPOZNAVANJU ULOGE KLASTERA (**SO7)**

Ovaj strateški cilj obuhvata povećanje priznavanja uloge klastera, udruživanja u klasterske organizacije i povećanje broja MSP u participirajucim klasterima.

Priznavanje kapaciteta i izvrsnosti klastera na nacionalnom-regionalnom nivou i medjunarodnom nivou biće realizovano pomoću sertifikacije „Cluster Management Excellence“, programa obuke i podučavanja, strategije novog i revidiranog razvoja, učešća u ClusterXchange programu, što će dovesti do povećanog kapaciteta za saradnju i koordinaciju, sa privlačenjem i uključenjem novih 5 MSP u svaki klaster na kraju projekta kao rezultatom.

12. KRAJNJI KORISNICI PROJEKTA

Ciljna grupa – odijum predloženog projekta je raznolik i obuhvata različite grupe:

- Menadžeri klastera i osoblje u menadžmentskim timovima, kao i ostali članovi;
- MSP u: arhitekturi, gradjevinarstvu, gradnji i rekonstrukciji zgrada, energetskoj efikasnosti, održivoj i obnovljivoj energiji, generisanju energije i obnovljivim izvorima, novim ili renoviranim uslužnim procesima, snabdevanju materijala, tehnologiji i komponentama;
- Izvršioci cirkularne ekonomije u gradjevinskom sektoru (servisi za rušenje ili rastavljanje);

- Javna vlast (nacionalna, regionalna) kao investitori, korisnici i vlasnici i javni dobavljači;
- Poslovne mreže & udruženja;
- Istraživanje & obrazovanje;
- Povezane industrije, na primer, specijalne nZEB tehnologije u agroindustriji (biogoriva, korišćenje vune, trske, slame ili drugih obnovljivih materijala za izolaciju), ICT (menadžment u gradjenju/energiji, pametne elektromreže) ili drugi sektori.

U okviru test anlize (benchmarking – WP2), biće obavljeno mapiranje značajnih učesnika sa ciljem identifikovanja njihovih potreba i odgovornosti vezanih za postojeće strategije razvoja. U posebnom fokusu će biti javne vlasti (nacionalne i regionalne) kao investitori, korisnici i vlasnici, kao i javni dobavljači, sa ciljem oblikovanja korelacije sa nacionalnim i regionalnim strategijama i akcionim planovima - uputstvima vezanim za izgradnju, energetsku efikasnost i obnovljivim resursima, ali takodje i sa relevantnim aspektima vezanim za pametnu specijalizaciju, ekologiju (cirkularna ekonomija), obrazovanje, radnu i socijalnu zaštitu.

Programi obuke i podučavanja (WP3) su posvećeni poglavito klasterskim menadžerima i osoblju u menadžerskim timovima, ali takodje i drugim relevantnim članovima klastera (uključujući MSP) i nacionalnim i regionalnim vlastima.

Glavni korisnici novih ili revidiranih strategija razvoja (WP4) su partnerski klasteri i njihovi članovi, privlačeći i druge uticajne faktore kao što su nacionalne i regionalne vlasti, povezujući potrebe tržista sa kreiranjem propisa javnih vlasti.

U programu ClusterXchange (WP5) 55 osoba će učestvovati u ukupnom predstavljanju MSP, kao i menadžeri klastera, poslovne mreže, tehnološki centri i ostale podržavajuće organizacije.

Kampanja komunikacije i diseminacije (WP6) je posvećena svim učesnicima kroz specifična obaveštavanja i aktivnosti za svaku ciljnu grupu sa ciljem da se aktivno i efektivno svi angažuju u svim fazama projekta.

13. OPIS RADNE METODOLOGIJE I SREDSTAVA ZA REALIZACIJU

Metodologija rada uključuje aktivnosti kao što je identifikacija tipa usluga koje stvaraju najveću dodatnu vrednost i načine za isporuku tih usluga na najefektivniji način. Te pomoćne usluge mogu pokriti, izmedju ostalih, napore za pospešivanje internacionalizacije, istrazivanje trzišta, transfer tehnologije i znanja, promociju usvajanja inovacija od MSP, napredne tehnologije, digitalizaciju, usluge, nove poslovne modele, niski ugljenik, efikasna rešenja sa resursima, kreativnost i dizajn, unapredjenje veština.

Unapredjenje veština klasterskih menadžera trebalo bi da uzme u obzir korist od umrežavanja i kvalitetnog učenja, posebno s obzirom na buduće sinergije i izgradnju dugotrajnih partnerstava radi formiranja integracije klasterskih učesnika u postojeće ili nove industrijske lance vrednosti. Takve koristi mogu nastati pomoću organizovanja povezanih aktivnosti, kao što je na primer, uparivanje članova, mentorstvo, medjusobno usaglašavanje, vrhunska obuka, razmena znanja i kursevi za aktivno učenje, razvoj platformi za razmenu znanja, uzajamne studijske posete unutar svakog konzorcijuma, kao i izmedju konzorcijuma izabranih pod ovim projektnim pozivom.

Glavni cilj projekta SMART4NZEB je jačanje izvrsnosti klasterskog menadžmenta pet reprezentativnih klastera u Centralnoj i Istočnoj Evropi pomoću posebnog radnog plana koji je kreiran tako da odgovori na sedam specifičnih ciljeva, da bi obezbedio kvalitetne usluge za njihove povezane članove, MSP. Počevši od test analize u kojoj će biti ocenjene kompleksnost trzišta i spremnost za nZEB svakog tipa članova, biće ocenjene performanse

menadžmenta klastera za postizanje izvrsnosti u menadžmentu klastera (Cluster Management Excellence – WP2). To će uključiti utvrdjivanje potrebe za obuku za menadžement klastera i relevantnih učesnika radi razvoja programa za obuku za unapredjenja njihovih veština putem učešća u programima obuke i podučavanja (WP3) i preporuka za budući razvoj klastera koje će biti korišcene za pregled i ocenu strategija razvoja i inovativnosti (WP4).
Nadalje, radni plan je kreiran tako da omogući medjunarodnu, medjuregionalnu, sektorsku i medju-sektorsku kooperaciju izmedju klastera i njegovih članova pomoću posebno kreiranog podešenog programa - ClusterXchange Program (WP5). Ovo će biti postignuto pomoću efikasne koordinacije projekta (WP1) i biće podržano kampanjom jake komunikacije i diseminacije (WP6) koja će takodje stvoriti održivu saradnju izmedju angažovanih partnera i predstavnika relevantnih faktora za tržište nZEB u odabranim zemljama.
Radni paketi i njihova medjusobna povezanost su prezentovani na sl. 2.

14. UTICAJ PROJEKTA NA LOKALNI/REGIONALNI RAZVOJ

Pored velikog privredno-ekonomskog uticaja ovog projekta na čitav Niški region, medjunarodna saradnja sa partnerima iz Rumunije, Poljske i Slovenije ima veliki uticaj na razvoj poslovno-obrazovnog turizma Grada Niša. Kao krajnje korisnike, ovaj projekat imaće veći broj subjekata, od kojih su najvažniji:

- Turistička privreda Grada Niša sa znatno uvećanim brojem stranih gostiju u okviru privredne i obrazovne razmene (privredna saradnja, zajednički projekti, dualno obrazovanje, specijalističke studije, master i doktorske studije, tematski seminari i obuke, itd.)
- Mala i srednja preduzeća Grada Niša (MSP), sa mogućnošću plasmana u tri ciljne zemlje Jugoistočne Evrope (Rumunija, Poljska, Slovenija), a takodje i druge zemlje u okviru COSME grupe zemalja.

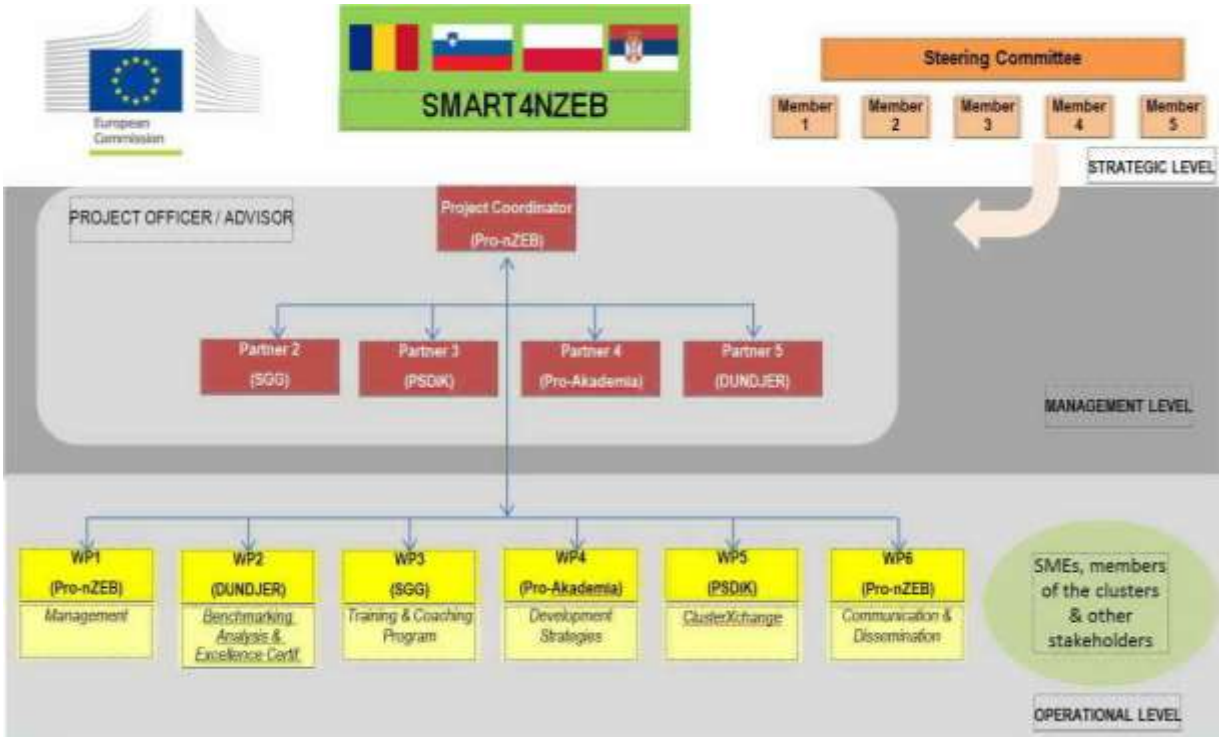
- Obrazovna privreda (prevashodno, ali ne i jedino, Univerzitet u Nišu), sa privlačenjem stranih studenata i inženjera na dodatno školovanje, specijalizacije i doktorske studije, kao i medjunarodnom istraživačkom saradnjom sa RDI organizacijama i institucijama iz Južne i Istočne Evrope, u okviru projekata EU ili medjudržavnih ugovora.

Svi navedeni korisnici imaju kapacitete za znatno uvećanje privredno-obrazovnih aktivnosti, sa posebnim afinitetima ka medjunarodnoj saradnji. Prezentovani projekat, svojim mnogobrojnim aktivnostima umrežavanja i saradnje, a posebno program ClusterXchange, utiču na znatno bolju prezentaciju kapaciteta obrazovno-privrednih kapaciteta Grada Niša.

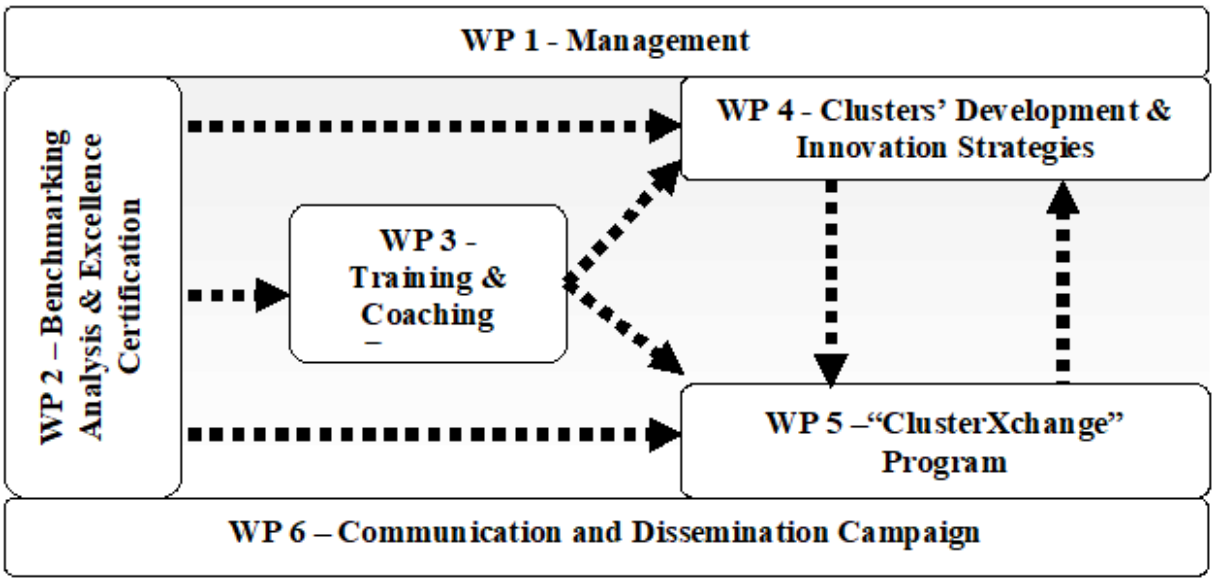
LITERATURA

[1] EN 15459 *: Energy performance of buildings – Economic evaluation procedure for energy systems in buildings.*
[2] EN ISO 15686-5 : *Buildings and constructed assets — Service life planning - Part 5: Life cycle costing.*
[3] EN ISO 15686-9 : *Buildings and constructed assets – Part 8 Reference service life and service life information.*
[4] *Eurostat, Statistics in Focus, 7/2010. The EU-27 construction sector: from boom to gloom.*
[5] *World Insulation Report – Freedonia Group Inc, February 1, 2009 – Publ. ID: FG2703472.*

[6] *Guidelines EP and EC 2008/98 on waste.*
[7] *Upgrading the flexibility of buildings*, Rob P. Geraedts, CIB World Congress, April 2001.
[8] Recommendation SIA 112/1, 2004: *Sustainable Building – Building Construction*; Swiss Society of Engineers and Architects.
[9] *Six steps resulting in a flexibility index of the building*. Source: LEnSE: Methodology Development towards a Label for Environmental, Social, and Economic Buildings, Indicator: Increase Ease of Building Adaptability.



Slika 1. Šema organizacije projekta SMART4NZEB



Slika 2. Šema radnih aktivnosti na projektu

4. DEVELOPMENT OF BASIC CURRICULA FOR VET TRAINING IN PV SOLAR ENERGY[12]

Tomislav Pavlović[13], Đorđe Đorđević[14], Dragoslav Stojić[15], Biljana Avramović[16]

Summary: *In the frame of Erasmus+ project line for partners from Romania, Poland, Slovenia, and Serbia, for realization of Strategic partnership and Sector Skills Alliances in the field of education and training it is expected to develop inovative curricula for education and training and intensive dissemination and exploitation activities. Sector Skill Alliances aim at tackling skills gaps, by identifying sector specific labour market needs and demand for new skills with regard to one or more occupational profiles or by enhancing the responsiveness of initial and continuing VET system, at any level, to sector specific labour market needs.*
The need for additional education, not being part of system of formal education and prevailing of practical nature is especially noticed in the field of energy efficiency, ecological building, and solar energy. These three fields are recognized as very prosperitive and promissing in construction sector. It has to be realized by establishing close relations with educational and R/D institutions, and by forming transnational dual education system. It is expected that all partners offer inovative courses that would improve production processess and procedures using reserach results and improved competences of workers.

Key words: *Solar energy, Dual Education, Energy Efficiency, VET, NZEB (Near Zero Energy Building), Passive House*

Rezime: *U okviru programa Erasmus+ za partnere iz Rumunije, Poljske, Slovenije i Srbije, za realizaciju Strateških partnerstava i Saveza sektoskih veština u području obrazovanja i obuka očekuje se razvijanje inovativnih sadražaja za obrazovanje i obuke, kao i intenzivne aktivnosti u diseminaciji i eksploataciji rezultata. U oblasti Saveza veština cilj je da se popune praznine, identifikacijom specifičnih potreba tržišta rada u datoj oblasti kao i zahteva za novim veštinama – zanatima, s obzirom na jedan ili više obrazovnih profila ili usavršavanje reprezentativnih inicijalnih ili unapredjenih stručnih edukacija i obuka, na svim nivoima za potrebe tržišta rada u datoj oblasti. Potreba za dodatnim obukama zaposlenih, koje nisu deo formalnog sistema obrazovanja, već su pretežno praktične obuke, uočena je naročito u oblasti energetske efikasnosti, ekološke gradnje i korišćenja solarne energije. Ove tri oblasti su prepoznate kao prosperitetne u gradjevinskom sektoru, gde se može izvršiti povezivanje privrede sa naučno-obrazovnim i razvojnim institucijama, uspostavljanjem dualnog obrazovanja radi unapredjivanja proizvodnih procesa i procedura kroz implementaciju naučnih dostignuća i unapredjenje kompetencija zaposlenih. Očekuje se da svi partneri ponude inovativne kurseve koji će unaprediti procese i procedure proizvodnje koristeći rezultate istraživanja i unapredjene kompetencije radnika.*

Ključne reči: *Solarna energije, Dualno obrazovanje, Energetska efikasnost, Stručno obrazovanje (VET), NZEB (izgradnja sa potrošnjom energije bliskom nuli), Pasivne kuće*

[12] Research is approved by Office for Local Economic Development and Research (KLERP) of City of Niš; Initial vesion of this paper for purpose of dual education was printed in [6] (in Serbian);

[13] University of Niš, Faculty of Sciences and Mathematics, Niš, Serbia;
[14] Construction Cluster "Dundjer", Niš, Serbia;
[15] Faculty of Civil Engineering and Architecture, University Niš, Serbia;
[16] Construction Cluster "Dundjer", Niš, Serbia.

15. INTRODUCTION

In frame of this program the curricula is proposed for professions:

1. Technician of Solar Energy (TSE),
2. Bachelor of Solar Energy (BSE)
3. Master of Solar Energy (MSE)

For given professions are proposed the following subjects:

SE-1. Introduction to Use of Solar Energy.
SE-2. Calculation of Solar Capacity of Micro-locations of Buildings/Locations Using Appropriate Software.
SE-3. Solar Cells and Panels – Surway of Technology.
SE-4. Connecting Panels in Bigger Solar Systems.
SE-5. Solar DC/AC Convertors – Methods of Connections in Systems (Solar Plants).
SE-6. Actual Legal Regulations, National and International Legislative and Contracts, New Demands in the Field of Production and Applying of Solar Energy.

The curricula of courses SE-1, SE-2, and SE-3 are taken from available sources and publications by first author. The important practical courses (SE-4 and SE-5) are generated in collaboration with known German firm SMA, based on courses delivered to members of Cluster Dundjer in Niš, Serbia and Sofia, Bulgaria, as well as in SMA Solar Academy (SMA Solar Academy, see [4]). The subject SE-6 deals with legislative in the solar energy sector, FIDIC oriented to solar energy, as well as new demands and challenges in the field and will be subject of special presentation.

16. CURRICULA FOR EDUCATION AND TRAINING (VET) Level SE-4

SE-4. COMPOSING PANELS IN BIGGER SOLAR SYSTEMS

I. **SE-4.1. PV SYSTEMS UP TO 30 kWp (RESIDENTIAL SYSTEMS FOR PRIVATE APPLICATIONS)**

II. **SE-4.2. PV SYSTEMS UP TO 250 KWp (COMMERCIAL APPLICATIONS)**

III. **SE-4.3. VISUALIZATION AND CONTROL OF PV SYSTEMS**

IV. **SE-4.4. SERVICE AND MAINTENANCE OF PV SYSTEMS WITH A DECENTRALIZED SYSTEM STRUCTURE**

V. **SE-4.5. DESIGNING OF PV PLANTS WITH THE SUNNY TRIPOWER 60 INVERTER AND THE MEDIUM VOLTAGE STATION**

VI. **SE-4.6. DESIGNING OF LARGE-SCALE PV PLANTS WITH SUNNY CENTRAL INVERTERS AND THE MEDIUM VOLTAGE POWER STATION**

The curricula for above noted courses are as follows.

SE-4.1. PV SYSTEMS UP TO 30 kWp (RESIDENTIAL SYSTEMS FOR PRIVATE APPLICATIONS)

This seminar will give an overview of SMA's product solutions for the installation of self-consumption-optimized PV systems in the private application segment with an output of up to 30 kWp. It starts with a discussion about the possible reasons end customers might want to install a PV system and looks into possible ways of reducing household energy costs. In addition to SMA inverters, you will of course also become familiar with power electronics close to the module. We also cover the communication and monitoring services and self-consumption optimization systems that SMA offers. Using a sample system design, one will learn what makes system planning and dimensioning possible. One will learn how to select just the right products for intended application and will consolidate the skills one have learned in a workshop on system design.

This seminar is part of training block on residential and commercial PV solutions. This block consists of four seminars:

1. "PV systems up to 30 kWp (residential systems for private applications)", SE-4.1,
2. "PV systems up to 250 kWp (commercial applications)", SE-4.2,
3. "Visualization and control of PV systems", SE-4-3,
4. „Service and maintenance of PV systems with a decentralized system structure". SE-4.4.

All seminars can be visited as stand-alone trainings, but if one would like an even deeper and more encompassing understanding, we suggest to attend the entire block.

LANGUAGE: English

TARGET GROUP: Installer, solar technology specialist, technical system planner, electrically qualified person.

REQUIREMENTS: Basic knowledge of solar power systems, PC skills, personal internet-enabled terminal (BYOD – Bring Your Own Device).

SE-4.2. PV SYSTEMS UP TO 250 KWp (COMMERCIAL APPLICATIONS)

This seminar will give an overview of SMA's product solutions for the installation of self-consumption-optimized PV systems in the commercial application segment with an output between 30 and 250 kWp. In addition to SMA inverters, one will also become familiar with power electronics close to the module. Of course, for this system size we will also look into the added value of an electric storage solution and discuss aspects regarding its use in the commercial domain. Using a sample system design, one will learn what makes system planning and dimensioning possible. One will learn how to select just the right products for your intended application and will consolidate the skills you have learned in a workshop on system design.
This seminar is part of our training block on residential and commercial PV solutions. This block consists of four seminars,

1. "PV systems up to 30 kWp (residential systems for private applications)",
2. "PV systems up to 250 kWp (commercial applications)",
3. "Visualization and control of PV systems",
4. „Service and maintenance of PV systems with a decentralized system structure".

All seminars can be visited as stand-alone trainings, but if you would like an even deeper and more encompassing understanding, we suggest you attend the entire block.

LANGUAGE: English

TARGET GROUP: Installer, solar technology specialist, technical system planner, electrically qualified person

REQUIREMENTS: Basic knowledge of solar power systems, PC skills, please bring an internet-enabled terminal with you (BYOD – Bring Your Own Device) for the workshop on system planning (participants require W-LAN Access).

SE-4.3. VISUALIZATION AND CONTROL OF PV SYSTEMS

This seminar provides you with an overview of the various options available for visualizing and controlling PV systems. In addition to SMA data interfaces and data loggers, we will also introduce SMA's online service options. On this training day, one will of course also have the opportunity to apply what have learned in a practical workshop. In small groups, we will set up the training systems and configure them to send data to the SMA monitoring system. Furthermore, we will look at the possibilities of manufacturer-neutral system communication using the Modbus Protocol, and for this system size we will also talk about the added value of an electric storage solution and clarify aspects regarding its use in the commercial domain. Using a sample system design, one will learn what makes system planning and dimensioning possible. One will learn how to select just the right products for his intended application and will consolidate the skills which had learned in a workshop on system design.

This seminar is part of our training block on residential and commercial PV solutions. This block consists of four seminars,

1. "PV systems up to 30 kWp (residential systems for private applications)",
2. "PV systems up to 250 kWp (commercial applications)",
3. "Visualization and control of PV systems"
4. „Service and maintenance of PV systems with a decentralized system structure".

All seminars can be visited as stand-alone trainings, but if one would like an even deeper and more encompassing understanding, we suggest attending the entire block.

LANGUAGE: English

TARGET GROUP: Installer, solar technology specialist, technical system planner, electrically qualified person.

REQUIREMENTS: Knowledge of solar power systems and SMA components, PC skills, please bring a mobile device with a web browser (IE, Firefox, Safari) with you for the workshop on system communication

SE-4.4. SERVICE AND MAINTENANCE OF PV SYSTEMS WITH A DECENTRALIZED SYSTEM STRUCTURE

Only PV systems that work reliably and fault-free guarantee maximum yields over the long term.

You will help your customers achieve this through regular maintenance operations and prescribed measurements, your service and a customer-specific PV system monitoring concept.

This seminar qualifies you to undertake maintenance on PV systems with decentralized inverters and battery-storage systems, and perform a targeted analysis of anomalies.

Key points covered by this seminar include basic information on photovoltaics, PV arrays, inverters, battery-storage systems and other system components. Building on this

information, you will learn how to professionally examine a PV system, how to carry out potential measurements and how these are used in troubleshooting and quality assurance. You will receive suggestions on how to prepare the relevant documentation and how to maintain yields through PV system monitoring as well as how to optimize yields by updating and upgrading components.

In a series of practical exercises, you will perform and evaluate measurements on sample systems, check system communications, localize existing errors and formulate troubleshooting advice.

This seminar is part of our training block on residential and commercial PV solutions. This block consists of four seminars:

1. “PV systems up to 30 kWp (residential systems for private applications)”,
2. “PV systems up to 250 kWp (commercial applications)”,
3. “Visualization and control of PV systems“
4. „Service and maintenance of PV systems with a decentralized system structure“.

All seminars can be visited as stand-alone trainings, but if you would like an even deeper and more encompassing understanding, we suggest attending the entire block.

LANGUAGE: English

TARGET GROUP: Service technicians, solar technology specialists, installers, experts.

SE-4.5. DESIGNING OF PV PLANTS WITH THE SUNNY TRIPOWER 60 INVERTER AND THE MEDIUM VOLTAGE STATION

The planning of decentralized large-scale PV plants is getting more and more attractive because of several advantages this technology offers. This technical seminar qualifies you to design modern decentralized large-scale PV plants connected to the medium-voltage grid using the successful SMA solution: the Sunny Tripower 60 inverter and the Medium Voltage Station. The main topics are the topology, functions, protections and sizing of the Sunny Tripower 60 inverters and Medium Voltage Stations. The seminar also covers the designing of the PV plants using the latest version of the SMA software Sunny Design and the configuration of the Medium Voltage Station according to specific project requirements.

Please do not forget to bring your laptop and a pocket calculator. This seminar consists of two days and includes lessons and workshops with software.

This seminar is part of our training block on large-scale PV systems. This block consists of two seminars:

1. “Designing of PV Plants with the Sunny Tripower 60 Inverter and the Medium Voltage Station”
2. “Designing of Large-Scale PV Plants with Sunny Central Inverters and the Medium Voltage Power Station”.

All seminars can be visited as stand-alone trainings, but if you would like an even deeper and more encompassing understanding, we suggest you attend the entire block.

LANGUAGE: English

TARGET GROUP: Renewable energy professionals

REQUIREMENTS: We recommend previous knowledge of PV modules, PV inverters, medium-voltage transformers, AC voltage, AC current, active and reactive power, Ethernet, and Modbus.

SE-4.6. DESIGNING OF LARGE-SCALE PV PLANTS WITH SUNNY CENTRAL INVERTERS AND THE MEDIUM VOLTAGE POWER STATION

The planning of centralized large-scale PV plants has become much easier because of turnkey solutions by SMA. This technical seminar qualifies you to design modern centralized large-scale PV plants connected to the medium-voltage grid using the successful SMA solution: The Medium Voltage Power Station. The main topics are the topology, functions and protections of the Medium Voltage Power Station, including the designing of PV plants using the latest version of the SMA software Sunny Design and the configuration of the Medium Voltage Power Station according to specific project requirements.
Please do not forget to bring your laptop and a pocket calculator. This seminar consists of three days and includes lessons, workshops with software and a visit to the Sunny Central factory.
This seminar is part of our training block on large-scale PV systems. This block consists of two seminars:

1. “Designing of PV Plants with the Sunny Tripower 60 Inverter and the Medium Voltage Station”
2. “Designing of Large-Scale PV Plants with Sunny Central Inverters and the Medium Voltage Power Station”.

All seminars can be visited as stand-alone trainings, but if you would like an even deeper and more encompassing understanding, we suggest you to attend the entire block.

LANGUAGE: English

TARGET GROUP: Renewable energy professionals

REQUIREMENTS: We recommend the successful participation in our seminar “Designing of PV plants with the Sunny Tripower 60 inverter and the Medium Voltage Station”

17. CURRICULA FOR EDUCATION AND TRAINING (VET) Level SE-5

SE-5. SOLAR DC/AC CONVERTERS – METHODS OF INTEGRATION IN SYSTEMS (SOLAR PLANTS)

I. **SE-5.1. STORAGE SYSTEMS IN THE SMA SMART HOME (SMA INSTALATIONS)**

II. **SE-5.2. DESIGNING OF OFF-GRID HYBRID ENERGY SYSTEMS WITH SUNNY ISLAND BATTERY INVERTERS AND THE MULTICLUSTER BOX**

III. **SE-5.3. COMMISSIONING OF OFF-GRID HYBRID ENERGY SYSTEMS WITH SUNNY ISLAND BATTERY INVERTERS AND THE MULTICLUSTER BOX**

IV. **SE-5.4. DESIGNING OF HYBRID ENERGY SYSTEMS WITH THE SMA FUEL SAVE CONTROLLER VERSION 2.0**

V. **SE-5.5. COMMISSIONING OF HYBRID ENERGY SYSTEMS WITH THE SMA FUEL SAVE CONTROLLER VERSION 2.0**

VI. SE-5.6. WEBINAR SUNNY TRIPOWER CORE1 - FUNCTIONS, DESIGN, INSTALLATION AND COMMISSIONING

VII. SE-5.7. WEBINAR OVERVIEW SMA UTILITY SOLUTIONS – PORTFOLIO AND OPPORTUNITIES

The curricula for above noted courses are as follows.

SE-5.1. STORAGE SYSTEMS IN THE SMA SMART HOME (SMA INSTALATIONS)

In the face of continuously rising energy prices PV plants with battery storage systems become more and more attractive for private households. These solutions allow a maximum of independence accordingly a significant reduction of electricity costs. In this seminar you learn how to plan and design future-proof solutions with flexible and integrated storage solutions from SMA.
Key aspects of the seminar are application scenarios for different systems, battery expertise and criteria for battery selection, tips on designing and integrating PV storage solutions into the SMA Smart Home, i.e. plant monitoring, visualization of energy flows and optimization of self-consumption via load shifting.
This seminar is part of training block on off-grid systems and storage solutions. This block consists of three seminars:

1. “Storage Systems in the SMA Smart Home”,
2. “Designing of Off-Grid Hybrid Energy Systems with Sunny Island Battery Inverters and the Multicluster Box“
3. „Commissioning of Off-Grid Hybrid Energy Systems with Sunny Island Battery Inverters and the Multicluster Box“.

All seminars can be visited as stand-alone trainings, but if you would like an even deeper and more encompassing understanding, we suggest you attend the entire block.

LANGUAGE: English

TARGET GROUP: Installer, solar technology specialist, technical system planner, electrically qualified person

REQUIREMENTS: Basic knowledge of solar power systems, PC skills, please bring an internet-enabled terminal with you for the workshop on system planning (participants require W-LAN access)

SE-5.2. DESIGNING OF OFF-GRID HYBRID ENERGY SYSTEMS WITH SUNNY ISLAND BATTERY INVERTERS AND THE MULTICLUSTER BOX

In sunny regions of the world, PV plants in combination with battery systems have already become the most reliable way to provide electrical energy to grid-isolated villages or consumers. The designing of PV plants and battery systems for isolated grids is complex because this hybrid energy system is composed of several critical components, whose correct sizing determines the technical success of the project. This advanced seminar qualifies you to understand the respective SMA solutions and to design modern off-grid power systems based on the successful SMA Sunny Island- and Multicluster technology. The main topics are the functions, protections and sizing of the Sunny Island inverters and the

Multicluster Box, including the designing of the hybrid energy systems using the latest version of the SMA software Sunny Design.

Please do not forget to bring your laptop and a pocket calculator. This seminar consists of three days and includes lessons, workshops with software and a visit to the SMA Hybrid Test Center.

This seminar is part of our training block on off-grid systems and storage solutions. This block consists of three seminars:

1. "Storage Systems in the SMA Smart Home",
2. "Designing of Off-Grid Hybrid Energy Systems with Sunny Island Battery Inverters and the Multicluster Box"
3. „Commissioning of Off-Grid Hybrid Energy Systems with Sunny Island Battery Inverters and the Multicluster Box".

All seminars can be visited as stand-alone trainings, but if you would like an even deeper and more encompassing understanding, we suggest you attend the entire block.

LANGUAGE: English

TARGET GROUP: Renewable energy professionals

REQUIREMENTS: We recommend previous knowledge of PV modules, PV inverters, battery inverters and lead-acid batteries for isolated grids (Off-grid)

SE-5.3. COMMISSIONING OF OFF-GRID HYBRID ENERGY SYSTEMS WITH SUNNY ISLAND BATTERY INVERTERS AND THE MULTICLUSTER BOX

In sunny regions of the world, PV plants in combination with battery systems have already become the most reliable way to provide electrical energy to grid-isolated villages or consumers. The professional installation and commissioning of SMA hybrid energy systems are essential to ensure a reliable power supply to the isolated loads. This advanced training qualifies you for the commissioning of hybrid energy systems according to the SMA commissioning process. The main topics are the required configurations of the Sunny Island battery inverters and SMA PV inverters.
Please do not forget to bring your laptop and a voltage measuring device (DC/AC). This training consists of one day and includes practical workshops at the SMA Hybrid Test Center.

This seminar is part of our training block on off-grid systems and storage solutions. This block consists of three seminars:

1. "Storage Systems in the SMA Smart Home",
2. "Designing of Off-Grid Hybrid Energy Systems with Sunny Island Battery Inverters and the Multicluster Box"
3. „Commissioning of Off-Grid Hybrid Energy Systems with Sunny Island Battery Inverters and the Multicluster Box".

LANGUAGE: English

TARGET GROUP: Renewable energy professionals

REQUIREMENTS: The successful participation in the seminar "Designing of Off-Grid Hybrid Energy Systems with Sunny Island battery inverters and the Multicluster Box"

SE-5.4. DESIGNING OF HYBRID ENERGY SYSTEMS WITH THE SMA FUEL SAVE CONTROLLER VERSION 2.0

In sunny regions of the world, PV plants in combination with diesel generators and/or the utility grid have already become the most economical way to generate electrical energy, even without subsidies.
The designing of PV-Diesel hybrid energy systems is complex, because a reliable control for the PV plant is needed to ensure the smooth operation of the grid. Designers need up-to-date information for using the latest SMA technology in their projects. This advanced seminar qualifies you to understand the functions of the SMA Fuel Save Controller and to design reliable hybrid energy systems using the latest version of the SMA software Sunny Design.
Please do not forget to bring your laptop and a pocket calculator. The seminar consists of two-and-a-half days and includes lessons, workshops with software and a visit to the SMA Hybrid Test Center.
This seminar is part of training block on Fuel Save solutions. This block consists of two seminars,

1. “Designing of Hybrid Energy Systems with the SMA Fuel Save Controller Version 2.0”
2. ”Commissioning of Hybrid Energy Systems with the SMA Fuel Save Controller Version 2.0”.

All seminars can be visited as stand-alone trainings, but if you would like an even deeper and more encompassing understanding, we suggest you attend the entire block.

LANGUAGE: English

TARGET GROUP: Renewable energy professionals

REQUIREMENTS: It is recommended previous knowledge of PV plants, diesel generators, active power, reactive power, and networks

SE-5.5. COMMISSIONING OF HYBRID ENERGY SYSTEMS WITH THE SMA FUEL SAVE CONTROLLER VERSION 2.0

In sunny regions of the world, PV plants in combination with diesel generators and/or the utility grid have already become the most economical way to generate electrical energy, even without subsidies.
The commissioning of the SMA Fuel Save Controller 2.0 is the most important part of such projects, because correct settings for the controller are essential for the stable operation of the system. The commissioning of the Fuel Save Controller can now be done by the plant designer him- or herself. Local commissioning significantly reduces the cost and the effort of the project. There are three steps that are subject of this course:

- Strict commissioning procedure (SMA),
- Controller configuration with graphical interface (Fuel Save Controller, Graphical User Interface),
- Configuration of PV plant with according software (Sunny Explorer),
- Practical training.

This advanced training qualifies you to commission the SMA Fuel Save Controller Version 2.0 according to the SMA commissioning process.

Please do not forget to bring your laptop and a pocket calculator. The seminar consists of one day and includes practical Workshops at the SMA Hybrid Test Center.

This seminar is part of our training block on Fuel Save solutions. This block consists of two seminars:

1. “Designing of Hybrid Energy Systems with the SMA Fuel Save Controller Version 2.0”
2. ”Commissioning of Hybrid Energy Systems with the SMA Fuel Save Controller Version 2.0”.

LANGUAGE: English

TARGET GROUP: Renewable energy professionals

REQUIREMENTS: Please note that this training is for qualified electricians only!

Participation in this training requires the successful completion of our seminar “Designing of Hybrid Energy Systems with the SMA Fuel Save Controller Version 2.0”
The SMA commissioning process described in this training must be observed for the commissioning of all SMA Fuel Save Controller plants.

Process of technical control which is subject of this course must be obeyed on all plants with Fuel Save Controller. For first commissioning is strictly recommended usage of SMA Remote Commissioning Support, with appropriate Internet connection with Fuel Save Controller as well as VPN approach to controller by SMA technical service.

SE-5.6. WEBINAR SUNNY TRIPOWER CORE1 - FUNCTIONS, DESIGN, INSTALLATION AND COMMISSIONING

In this webinar we present the new Sunny Tripower CORE1 and provide you in a compact fashion with all technical knowledge required for design, installation and commissioning.
The new Sunny Tripower generation „Sunny Tripower CORE1“ is already different from its predecessors due to its innovative design as a standing appliance. This inverter, designed specifically for commercial rooftop applications, offers a multitude of advantages in installation and commissioning.
Experience the individual steps of a successful design, installation and commissioning with the new Sunny Tripower CORE1 in practice.
In addition, as always, the Technical Trainers of the SMA Solar Academy provide you with useful tips and tricks and you have the option to ask questions via the integrated chat that will be answered directly during the webinar.
Use this opportunity for an encompassing product presentation and in-depth technical insights into the new Sunny Tripower CORE1. We are looking forward to welcoming you in the webinar.
You will receive the access data for the webinar room at latest one day before the webinar starts. The data will be sent via e-mail to the e-mail address you used for registration.

LANGUAGE: English

TARGET GROUP: Installer, Solar professional, technical plant designers, electrically qualified persons, distributors

REQUIREMENTS: Knowledge of photovoltaics

SE-5.7. WEBINAR OVERVIEW SMA UTILITY SOLUTIONS – PORTFOLIO AND OPPORTUNITIES

In this webinar we introduce you to the ecosystem of SMA utility solutions and provide you with a comprehensive overview of SMA’s versatile product range.

From decentralized solutions based on the Sunny Tripower inverters connected to the compact MV station up to centralized solutions based on the fully integrated Medium Voltage Power Station – SMA offers integrated solutions from DC to the medium voltage grid for your utility projects.

After attending this webinar you will have gained an in-depth insight into the utility market and see how SMA solutions can benefit your worldwide PV projects.

In addition, as always, the Technical Trainers of the SMA Solar Academy provide you with useful background information and you have the opportunity to ask questions via the integrated chat that will be answered directly during the webinar.

Use this opportunity to gain a solution-oriented overview, which will assist you in making a more sophisticated decision. We are looking forward to welcoming you in the webinar.

You will receive the access data for the webinar room at latest one day before the webinar starts. The data will be sent via e-mail to the e-mail address you used for registration.

LANGUAGE: English

TARGET GROUP: decision makers, investors, distribution network operators and (independent) power producers.

REQUIREMENTS: Basic understanding of utility projects.

Each of noted courses can be attended separately obeying recommendations for previous knowledge.

18. INTERNATIONAL STRATEGIC PARTNERSHIP IN THE FIELD OF PV SOLAR ENERGY

Transnational VET in the field of PV (both initial and continuing) as a goal has developing the partnerships, supporting the setting up and implementation of internationalization strategies, aimed at putting in place the necessary support mechanisms as well as contractual frameworks to promote quality mobility of VET staff and learners, including promoting the automatic mutual recognition of qualifications and learning outcomes. Developing partnerships aimed at promoting work-based learning in all its forms. These partnerships can also aim at developing new training content and joint VET qualifications that integrate periods of work-based learning, opportunities to apply knowledge in practical workplace situations, and embedding international mobility experience whenever possible. The general intention is enhancing access to training and qualifications for all members of clusters-partners and also students of educational institutions included in program, with a particular attention to the low-skilled workers.

The presented parts of curricula should serve to validation of non-formal and informal learning, promoting work-place learning, providing for efficient and integrated guidance services and flexible and permeable learning pathways with initial and/or continuing training to their staff.

This program is a part of strengthening key competences in initial and continuing VET, in particular PV technology and skills.

The goal of this program is also supporting the uptake of innovative approaches and digital technologies not only in technology and skills but also in teaching and learning.

The proposed programe includes systematic approaches to the initial and continuous professional development of VET teachers, trainers and mentors in both school and work-based settings.

In collaboration with international partners (Slovenia, Romania, Poland, and partners in earlier European projects) sustainable partnerships will be developed in order to establish

further national, regional and sectoral skills competitions organizations, as a form of raising the attractiveness and excellence in VET, in particular in the fields of Energy Efficiency and Renewable energy sources (in our case, PV).

REFERENCES

[10] Pavlović, T.M., Čabrić, B.D.: *Fizika i tehnika solarne energetike, Gradjevinska knjiga, Beograd, 2006.*

[11] Pavlović, T., Jevdjović, S., Kostić, Lj., Radosavljević, J., Pirls, D.*: Solar Energy and Education in Serbia, Proc. Intnl. Conf. Interculturality in the Education Process, Pedagogical Faculty "Goce Delčev", Štip, Macedonia, 2005, 454-457.*

[12] Pavlović, T., Kostić, Lj., Pavlović, Z., Pantić, L.: *Measurement of Electrical Characteristics of PV/Thermal Collector, Proc. 3rd Intnl. Workshop on Teaching in Photovoltaics, Prag, 2006, 81-86.*

[13] https://www.sma.de/en/partners/sma-solar-academy/seminars.html

[14] C. Cecati, C. Citro, P. Siano: *Combined Opertaions of Renewable Energy Systems and Rasponsive Demand in a Smart Grid, IEEE Trans Sustain Energy 2011, Vol. 24, pp 68-76.*

[15] Tomislav Pavlović, Đorđe Đorđević, Dragoslav Stojić, Biljana Avramović: P*rimena sistema dualnog obrazovanja u oblasti korišćenja solarne energije, Nauka + Praksa, 20/2017, pp. 34-41.*

5. BASIC CURRICULA AND MANUAL FOR TECHNICIAN OF PV[17] SOLAR ENERGY (TSE) TRAINING[18]

Ljubiša Stajić[19], Đorđe Đorđević[20], Snežana Tošić[21], Nenad Floranović[22]

Summary: *In the frame of* ***Smart4NZEB (COSME)*** *project line for partners from Romania, Poland, Slovenia, and Serbia, for realization of Work Package 3, Training & Coaching program, it is provided the training program, as one of the main pillars for the achievement of boosting competitiveness and supporting the scaling-up of SMEs, and the activities within this WP will target the actual execution, monitoring, and evaluation of the training and coaching programs supported by the project and conducted in the participating countries. These trainings and coaching programs will be executed according to a training plan including each country and will deliver results in terms of number of courses, sessions and trainees. It is expected to develop inovative curricula for education and training and intensive dissemination and exploitation activities. In addition, the provided VET oriented to SMEs aims at tackling skills gaps, by identifying sector specific labour market needs and demand for new skills with regard to one or more occupational profiles or by enhancing the responsiveness of initial and continuing VET system, at any level, to sector specific labour market needs. The need for additional education, not being part of system of formal education and prevailing of practical nature, is especially noticed in the field of energy efficiency, ecological building, renewable energy, and insulation. These four fields are recognized as very prosperitive and promissing in construction sector. It has to be realized by establishing close relations with educational and R/D institutions. It is expected that all partners offer inovative courses that would improve production processess and procedures using reserach results and improved competences of cluster management, SMEs, and skilled workers.*

Key words: *Solar energy*, *Photo Voltaic*, *Training*, *Dual Education*, *Energy Efficiency*, *VET*, *NZEB (Near Zero Energy Building)*, *Passive House*

Rezime: *U okviru projekta* ***Smart4NZEB (COSME)*** *za partnere iz Rumunije, Poljske, Slovenije i Srbije, za realizaciju Plana rada br. 3, predvidjeni su edukacija i obuka kao glavni stubovi za povecanje kompetitivnosti i rasta MSP (Mala i srednja preduzeća), kao i izvršavanje, kontrolu i procenu edukacije i obuka podržanih projektom i realizovanih u zemljama učesnicama. Ovi programi obuka biće realizovani u saglasnosti sa planom obuke koji uključuje sve zemlje, dok će rezultati biti izraženi u broju kurseva, sednica i treninga. Očekuje se da će biti razvijeni inovativni programi kurseva i obuka uz intenzivne akcije diseminacije i eksploatacije. Takodje, predvidjene stručne obuke orijentisane ka MSP imaju za cilj da se popune praznine, identifikacijom specifičnih potreba tržišta rada u datoj oblasti kao i zahteva za novim veštinama – zanatima, s obzirom na jedan ili više obrazovnih profila ili usavršavanje reprezentativnih inicijalnih ili unapredjenih stručnih edukacija i obuka, na svim nivoima za potrebe tržišta rada u datoj oblasti. Potreba za dodatnim obukama zaposlenih, koje nisu deo formalnog sistema obrazovanja, već su pretežno praktične obuke, uočena je naročito u oblasti energetske efikasnosti, ekološke gradnje, korišćenja solarne energije i izolacija. Ove četiri oblasti su prepoznate kao prosperitetne u gradjevinskom sektoru, gde se može izvršiti povezivanje privrede sa naučno-obrazovnim i razvojnim institucijama. Očekuje se da svi partneri ponude inovativne kurseve koji će unaprediti procese i procedure proizvodnje koristeći rezultate istraživanja i unapredjene kompetencije menadžmenta klastera, MSP i obučenih radnika. .*

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[17] Photo Voltaic - PV

[18] Research is approved by Office for Local Economic Development and Research (KLERP) of City of Niš; Initial vesion of this paper for purpose of dual education was printed in [6] (in Serbian);

[19] IRC Alfatec, Niš, Serbia;

[20] Construction Cluster "Dundjer", Niš, Serbia;

[21] IRC Alfatec, Niš, Serbia;

[22] IRC Alfatec, Niš, Serbia.

Ključne reči: *Solarna energije, Elektro-solarna energija, Obuka, Dualno obrazovanje, Energetska efikasnost, Stručno obrazovanje (VET), NZEB (izgradnja sa potrošnjom energije bliskom nuli), Pasivne kuće*

1. INTRODUCTION

In frame of this program the curricula is proposed for professions:

- Technician of Solar Energy (TSE),
- Bachelor of Solar Energy (BSE)
- Master of Solar Energy (MSE)

For given professions are proposed the following subjects:

SE-1. Introduction to Use of Solar Energy.
SE-2. Calculation of Solar Capacity of Micro-locations of Buildings/Locations Using Appropriate Software.
SE-3. Solar Cells and Panels – Surway of Technology.
SE-4. Connecting Panels in Bigger Solar Systems.
SE-5. Solar DC/AC Convertors – Methods of Connections in Systems (Solar Plants).
SE-6. Actual Legal Regulations, National and International Legislative and Contracts, New Demands in the Field of Production and Applying of Solar Energy.

The curricula of courses SE-1, SE-2, and SE-3 are taken from available sources and publications given in References. The important practical courses (SE-4 and SE-5) are generated in collaboration with known German firm SMA, based on courses delivered to members of Cluster Dundjer in Niš, Serbia and Sofia, Bulgaria, as well as in SMA Solar Academy (SMA Solar Academy, see [4]). The subject SE-6 deals with legislative in the solar energy sector, FIDIC oriented to solar energy, as well as new demands and challenges in the field and will be subject of special presentation.

2. CURRICULA AND MANUAL FOR INSTALATION OF SMALL PV SYSTEMS – THE CONTENT

- Introduction
- Construction Works, Infrastructure preparation
- Production of bearing mechanical construction
- Electrical Works
- Quality system and critical points in construction
- Security and health during contruction
- Case study

2.1 Introduction

- Mechanics of PV plants
- Functional demands
- Operational Demands
- Limitations
- Design of bearing construction
- PV Plants on the Roofs
- PV Plants on Ground

2.2 Construction Works, Infrastructure preparation

- Soil preparation and straightening
- Internal and road infrastructure
- Cable channels and rows

2.3 Production of bearing mechanical construction

2.4 Electrical Works

- Cable installation
- Instalation of roof plants
- Instalation of ground plants
- Instalation of switch boxes
- Grounding systems and potentials equalization
- Critical control points

2.5 Quality system and critical points in construction

2.6 Security and health during contruction

2.7 Case study

3 PREREQUISITES

The presented seminar can be visited as stand-alone trainings, but for an even deeper and more encompassing understanding, we suggested to attend the entire block.

LANGUAGE: English

TARGET GROUP: Installer, solar technology specialist, technical system planner, electrically qualified person

REQUIREMENTS: Knowledge of solar power systems and SMA components, PC skills, please bring a mobile device with a web browser (IE, Firefox, Safari) with you for the workshop on system communication

4 INTERNATIONAL STRATEGIC PARTNERSHIP IN THE FIELD OF PV SOLAR ENERGY

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REFERENCES

[16] Pavlović, T.M., Čabrić, B.D.: *Fizika i tehnika solarne energetike, Gradjevinska knjiga, Beograd, 2006.*

[17] Pavlović, T., Jevdjović, S., Kostić, Lj., Radosavljević, J., Pirls, D.*: Solar Energy and Education in Serbia, Proc. Intnl. Conf. Interculturality in the Education Process, Pedagogical Faculty "Goce Delčev", Štip, Macedonia, 2005, 454-457.*

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6. FOTONAPOSNKI SISTEMI U FUNKCIJI POVEĆANJA ENERGETSKE EFIKASNOSTI - LEGISLATIVA U REPUBLICI SRBIJI

Ljubiša Stajić[23],

Rezime

U fokusu ovog rada je solarna energija kao vid obnovljivog izvora energije. Posmatrano kroz istoriju, društvo je uvek imalo problem sa posledicama koje je neracionalna upotreba resursa ostavljala za sobom. Iz tog razloga, i na ovom stepenu razvoja civiliziacije, neophodno je da izvori obnovljive energije dobiju širu primenu, jer se rezerve neobnovljivih izvora masovno iscrpljuju, dok stepen zagađenja dostiže nesagledive razmere. Obnovljivi izvori nisu novost, zabeležena je njihova upotreba u najranijim fazama razvoja ljudskog društva i mahom se odnosila na upotrebu sunčeve energije. Današnja moderna tehnologija i razvoj omogućavaju višestruku upotrebu solarnih izvora. Podsticanje većeg korišćenja obnovljivih izvora energije je aktuelno pitanje u svim razvijenim zemljama, a razlozi su brojni - od ekonomskih do onih koji se tiču smanjenja efekta staklene bašte. Predstavljeno je stanje u Evropi sa posebnim akcentom na zakonsku regulativu, kada su fotonaponske elektrane u pitanju, u Republici Srbiji.

Ključne reči: obnovljivi izvori, fotonaposnke elektrane, energetska efikasnost, legislativa

Abstract

The focus of this paper is solar energy as a form of renewable energy. Viewed through history, society has always had a problem with the consequences that the irrational use of resources has left behind. For this reason, even at this stage of civilization development, it is necessary for renewable energy sources to become more widely used, since the reserves of non-renewable resources are massively depleted, while the level of pollution reaches unprecedented proportions. Renewables are not new, their use has been noted in the earliest stages of human society's development and has largely been related to the use of solar energy. Today's modern technology and development enables multiple uses of solar energy. Encouraging greater use of renewable energy is a pressing issue in all developed countries, and there are many reasons - from economic to those for reducing the greenhouse effect. The situation in Europe is presented, with special emphasis on the regulation of photovoltaic power plants in the Republic of Serbia.

Key words: renewable energy, photovoltaic power plants, energy efficiency, legislation

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Uvod

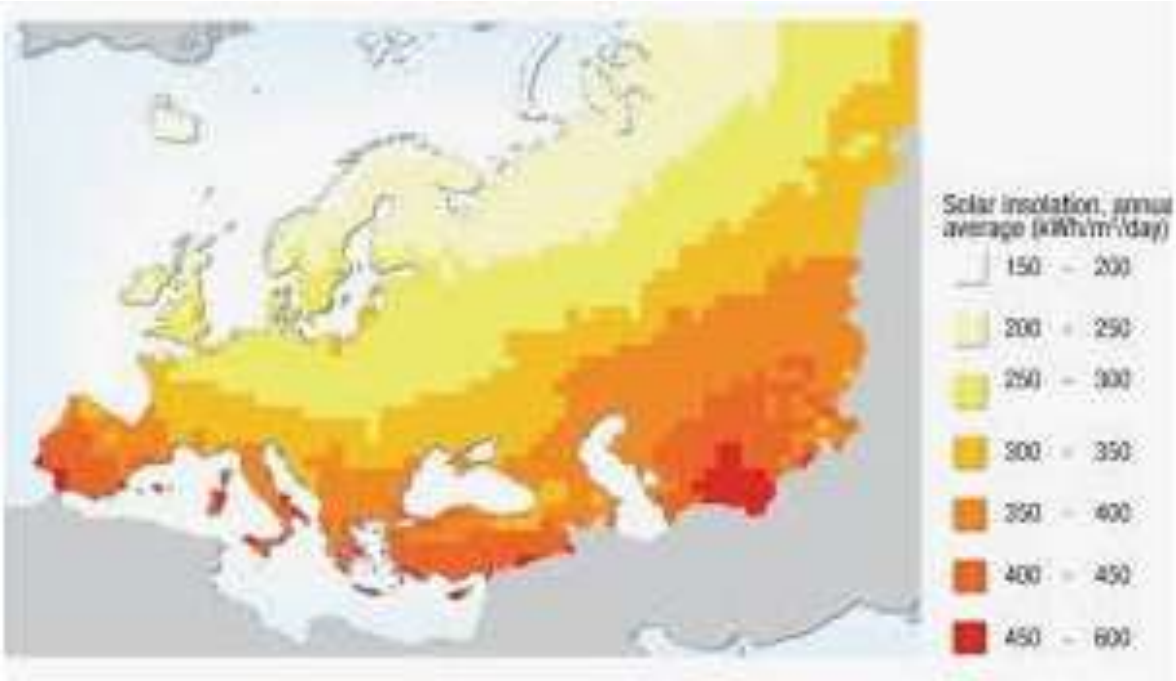
Poboljšanje energetske efikasnosti jedan je od najvažnijih stubova održive energetske politike i ključna komponenta strategija ublažavanja klimatskih promena. Obnovljivi izvori energije predstavljaju neiscrpne izvore energije iz prirode, koji se obnavljaju u određenom vremenskom intervalu, u celosti ili delimično. Oni se eksploatišu sa ciljem proizvodnje električne, toplotne i mehaničke energije, a njihova održiva karakteristika je neškodljivost po okolinu, sa smanjenom ili redukovanom emisijom CO_2. Razvoj obnovljivih izvora energije (energija sunca, vetra, hidro-energija, geotermalna energija, energija biomase) važan je iz više razloga:

povećanje udela obnovljivih izvora energije, pored redukcije emisije gasova koji pogoršavaju efekat staklene bašte, povećava energetsku održivost. Takođe pomaže u poboljšavanju sigurnosti kontinuiteta energije, na način da smanjuje zavisnost od uvoza energetskih sirovina i električne energije. Očekuje se da će obnovljivi izvori energije postati ekonomski konkurentni konvencionalnim izvorima energije u dugom vremenskom periodu. Neki od izvora, kao što su energija vetra, hidroenergija, energija iz biomase i solarna energija, već su ekonomski konkurentni. Ostale tehnologije su zavisne od potražnje na tržištu, a većina zahteva visoka početna ulaganja, što utiče na konkurentnost i brzinu uvođenja novih tehnologija. Proces prihvatanja novih tehnologija je spor, pri čemu je glavni problem za instalaciju novih postrojenja početna cena, što podiže cenu dobijene energije u prvih nekoliko godina do visine potpune neisplativosti u odnosu na ostale komercijalno dostupne izvore energije. Međutim, koristi od korišćenja obnovljivih izvora energije, dugoročno, premašuju troškove potrebne za instalaciju, pa se očekuje značajno povećanje učešća u energetskom bilansu, samim tim što se nameću kao prirodan odgovor na postojeće i nadolazeće klimatske probleme.

Cilj ovog rada je utvrđivanje značaja solarne energije u procesu realizovanja strategije održivog razvoja, smanjenju emisije gasova staklene bašte i redukovanju klimatskih promena, kao i da ukaže na put do realizacije koji je uređen pravno-administrativnom regulativom.

1. Stanje u EU i Republici Srbiji

Poslednjih 15 godina u svim sredinama širom Evrope sve je veća primena fotonaponskih (PV) sistema. Implementacija PV sistema u projektovanju i izgradnji objekata postaje deo standardnih aktivnosti u razvojnim procesima posebno u gradovima. Iako se ne može očekivati da primena ovih sistema bude na listi prioriteta urbanog razvoja, ipak, s druge strane može značajno doprineti rešavanju sistemskih energetskih problema u mnogim sredinama.



Slika 1. Solarna insolacija u Evropi – kWh/m^2/h

Međutim, postoje i značajne prepreke za implementaciju ovih sistema, koje su evropske države prevazišle, a tiču se pre svega legislativnog okvira koji reguliše ovakvu vrstu projekata, a zatim i načina njihovog finansiranja

Republika Srbija ima značajan potencijal u obnovljivim izvorima enrgije koji je, na žalost, još uvek nedovoljno iskorišćen. Jedan od razloga za takvu situaciju je nedovoljna investiciona aktivnost u ovom sektoru.Vladi Republike Srbije, u smislu prihvatanja odluke Ministarskog saveta Energetske zajednice o promociji obnovljive energije kroz transpoziciju Direktive 2009/28/EC o obnovljivim izvorima energije postavljen je ambiciozni cilj da poveća učešće obnovljive energije u ukupnoj potrošnji finalne energije na 27% u 2020. godini sa 21.2% u referentnoj, 2009. godini.

U 2018. godini dostignut je udeo energije iz obnovljivih izvora u bruto krajnjoj potrošnji energije od 18,0% u Evropskoj uniji (EU), u odnosu na 17,5% u 2017. godini i više nego udvostručen u odnosu na 2004. godinu (8,5%), prvoj godina za koju su podaci dostupni na Eurostat platformi. Povećanje udela obnovljivih izvora energije od suštinskog je značaja za postizanje klimatskih i energetskih ciljeva EU. Cilj EU je da do 2020. dostigne 20% svoje energije iz obnovljivih izvora. Među 28 država članica EU, 12 država članica već je postiglo udeo jednak ili veći od njihovog nacionalnog cilja za 2020. godinu: Bugarska, Češka, Danska, Estonija, Grčka, Hrvatska, Italija, Letonija, Litvanija, Kipar, Finska i Švedska. Četiri države članice su blizu ispunjavanja svojih ciljeva (tj. manje od jednog procentnog poena, a devet je između 1 i 4 procentna poena daleko, dok su tri udaljena 4 ili više procentnih poena od svojih ciljeva. Švedska je imala daleko najveći udeo, dok je najniži udeo u Holandiji

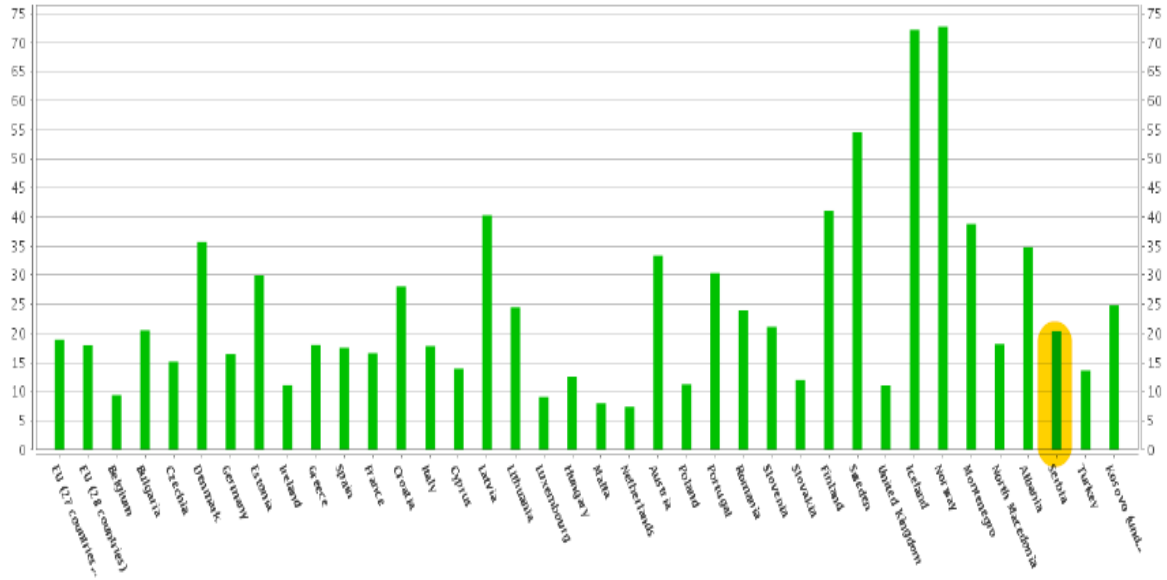
U 2018. godini udeo obnovljivih izvora u bruto potrošnji krajnje energije porastao je kod 21 od 28 članica u poređenju sa 2017. godinom, dok su ostale stabilne u jednoj državi članici i

smanjivale se u šest. Od 2004. godine značajno je porastao udeo OI u svim državama članicama.

Švedska je imala daleko najveći udeo u 2018. godini gde više od polovine (54,6%) energije dolazi iz obnovljivih izvora, ispred Finske (41,2%), Letonije (40,3%), Danske (36,1%) i Austrije (33,4%). Na suprotnom kraju skale, najmanji udeo obnovljivih izvora je registrovan u Holandiji (7,4%). Niske udele, manje od deset procenata, zabeležene su i na Malti (8,0%), Luksemburgu (9,1%) i Belgiji (9,4%), dok su Holandija i Francuska najdalje od svojih ciljeva.

Svaka država članica EU ima svoj cilj za 2020. godinu. Uzeta su u obzir različita polazišta, potencijal obnovljivih izvora energije i ekonomski učinak. Rumunija je 0,1 postotni poen (pp) daleko od svog nacionalnog cilja 2020. godine. Mađarska, Austrija i Portugal su udaljeni manje od jednog, a Nemačka, Luksemburg i Malta oko 2 postotna poena od svojih ciljeva za 2020. godinu. Na suprotnom kraju skale, Holandija (6,6 pp), Francuska (6,4 pp), Irska (4,9 pp), Velika Britanija (4,0 pp) i Slovenija (3,9 pp) su najudaljenije od svojih ciljeva.

Akcionim planom Republike Srbije za obnovljive izvore energije regulisano je poštovanje obaveze preuzetih ugovorom o osnivanju Energetske zajednice, utvrđene su putanje za dostizanje cilja od 27% obnovljivih izvora u bruto finalnoj potrošnji Srbije 2020. godine i defnisane su mere za njihovo veće korišćenje. Srbija je udaljena 7 postotnih poena od svog cilja za 2020. godinu. (Slika 2).



Slika 2. Udeo obnovljiih izvora energije u ukupnoj potrošnji energije u Evropi

Tabela 1. Učešće obnovljivih izvora energije u ukupnoj proizvodnji energije (ostvareno u odnosu na planirano)

	2004	2015	2016	2017	2018	2020 target
EU	8.5	16.7	17.0	17.5	**18.0**	20
Belgium	1.9	8.0	8.7	9.1	**9.4**	13
Bulgaria	9.2	18.3	18.8	18.7	**20.5**	16
Czechia	6.8	15.1	14.9	14.8	**15.1**	13
Denmark	14.8	30.9	32.0	35.0	**36.1**	30
Germany	6.2	14.9	14.9	15.5	**16.5**	18
Estonia	18.4	28.2	28.7	29.1	**30.0**	25
Ireland	2.4	9.1	9.3	10.6	**11.1**	16
Greece	7.2	15.7	15.4	17.0	**18.0***	18
Spain	8.3	16.2	17.4	17.6	**17.4**	20
France	9.5	15.0	15.7	16.0	**16.6**	23
Croatia	23.4	29.0	28.3	27.3	**28.0**	20
Italy	6.3	17.5	17.4	18.3	**17.8**	17
Cyprus	3.1	9.9	9.9	10.5	**13.9**	13
Latvia	32.8	37.5	37.1	39.0	**40.3**	40
Lithuania	17.2	25.8	25.6	26.0	**24.4**	23
Luxembourg	0.9	5.0	5.4	6.3	**9.1**	11
Hungary	4.4	14.5	14.3	13.5	**12.5**	13
Malta	0.1	5.1	6.2	7.3	**8.0**	10
Netherlands	2.0	5.7	5.8	6.5	**7.4**	14
Austria	22.6	33.5	33.4	33.1	**33.4**	34
Poland	6.9	11.7	11.3	11.0	**11.3**	15
Portugal	19.2	30.5	30.9	30.6	**30.3**	31
Romania	16.8	24.8	25.0	24.5	**23.9**	24
Slovenia	16.1	21.9	21.3	21.1	**21.1**	25
Slovakia	6.4	12.9	12.0	11.5	**11.9**	14
Finland	29.3	39.3	39.0	40.9	**41.2**	38
Sweden	38.7	53.0	53.4	54.2	**54.6**	49
United Kingdom	0.9	8.3	9.0	9.7	**11.0**	15
Norway	58.5	69.1	70.2	71.6	**72.8**	67.5
Montenegro	:	43.1	41.6	39.7	**38.8**	33
North Macedonia	15.7	19.5	18.0	19.6	**18.1**	23
Albania	29.6	34.4	35.5	34.5	**34.9**	38
Serbia	12.7	22.0	21.1	20.3	**20.3**	27
Turkey	16.2	13.6	13.7	12.8	**13.7**	-

1.1 Tehnički potencijal solarne energije u Srbiji.

Broj časova sunčevog zračenja na teritoriji Srbije iznosi između 1.500 i 2.200 časova godišnje. Prosečan intenzitet sunčevog zračenja je od 1,1 kWh/m2/dan na severu do 1,7 kWh/m2/dan na jugu – tokom januara, a od 5,9 do 6,6 kWh/m2/dan – tokom jula. Prosečna vrednost energije zračenja iznosi od 1.200 kWh/m2/godišnje u severozapadnoj Srbiji, do 1.550 kWh/m2/godišnje u jugoistočnoj Srbiji, dok u centralnom delu iznosi oko 1.400 kWh/m2/godišnje.

Srbija ima znatno veći broj časova Sunčevog zračenja nego većina evropskih zemalja, a najbolji uslovi su u jugoistočnom delu naše zemlje. Mobilne solarne jedinice su veoma pogodne za primenu u čistim energetskim tehnologijama pri čemu je u poslednjoj deceniji u svetskim okvirima, kao i u Srbiji, svoju primenu pre svega doživele u poljoprivredi, u njenim najznačajnijim granama, kao što su ratarstvo i stočarstvo. Poseban značaj ove napojne jedinice i agregati imaju na lokacijama na kojima nije dostupno mrežno napajanje, a postoji potreba za navodnjavanjem u slučajevima sušnih perioda, ili u slučajevima organske proizvodnje hrane, kada je potrebno obezbediti zadovoljavanje najstrožijih ekoloških standarda (Despotović i sar., 2016). Vlada Republike Srbije prvi put je omogućila putem subvencija priliku za izgradnju solarnih elektrana u Srbiji Uredbom o podsticajnim merama za proizvodnju električne energije iz obnovljivih izvora i iz visokoefkasne kombinovane proizvodnje električne i toplotne energije 2009. godine. Nakon toga, vlada je dodatno povećavala kapacitet a smanjivala subvencionisanu cenu kroz dve nove Uredbe iz 2013. i 2016. godine. Prepreke koje stoje na putu ekspanziji korišćenja solarne energije mogu se razvrstati na dve grupe. Kao prvo, rani tipovi fotonaponskih jedinica bili su osetljivi na lokalne klimatske faktore, kao što su npr. ekstremno visoke temperature, nivo vlage i pesak, a sve to moglo je da umanji količinu energije koju su proizvodile. Tehnički napredak u proizvodnji otpornijih solarnih panela znači da fotonaponske jedinice mogu ostati efikasne čak i u teškim uslovima.Kao drugo, tokom rane faze razvoja korišćenja solarne energije, troškovi proi-zvodnje električne energije iz solarnih panela bili su znatno viši u odnosu na druge izvore energije. Tehnička poboljšanja koja su ostvarena tokom protekle decenije, u znatnoj meri su smanjila te troškove. Ima primera gde je masovna proizvodnja fotonaponskih solarnih postrojenja za proizvodnju električne energije postala ekonomski održiva i široko se primenjuje. Na primeru SAD-a, predviđa se da će delimično rešenje problema isprekidanosti doneti završetak jedinstvene inteligentne mreže za celu zemlju, jer kada se ona bude proširila na široku geografsku oblast, promene isprekidanosti na jednoj lokaciji biće nadoknadive dostupnošću sunčeve svetlosti na nekom drugom mestu (*Gor, 2010*).

1.2. Procedure i zakonska regulativa u Republici Srbiji

Realizacija projekata koji koriste obnovljive izvore energije (OIE) je složen proces koji zahteva pribavljanje niza različitih dokumenata, dozvola, licenci, saglasnosti, mišljenja, koje izdaju nadležni državni organi, kao i pripremu projektne dokumentacije i druge radnje koje investitor treba da preduzme u cilju izgradnje postrojenja što je ilustrativno prikazano na slici 2.

Izgradnja elektrane i obavljanje delatnosti proizvodnje električne energije u ovakvim elektranama je regulisana brojnim propisima Republike Srbije.

Izvori prava Republike Srbije mogu se podeliti na dve osnovne grupe propisa:

Prvu grupu propisa čine propisi kojima se uređuje oblast izgradnje konkretnog energetskog objekta i način dobijanja građevinske dozvole za ovakav objekat, kao i način utvrđivanja podobnosti objekta za upotrebu i pribavljanje upotrebne dozvole samog objekta. Poseban značaj u ovoj grupi propisa imaju propisi kojima se uređuje zaštita životne sredine. U grupu propisa kojima je uređena oblast planiranja i izgradnje objekata spadaju: Zakon o planiranju i izgradnji, Zakon o Prostornom planu Republike Srbiji, podzakonska akta ovih zakona i drugi.

Prostorni planovi (regionalni prostorni planovi, prostorni planovi jedinice lokalne samouprave i prostorni planovi područja posebne namene) i urbanistički planovi (generalni urbanistički plan, plan generalne regulacije, plan detaljne regulacije) su planski dokumenti. Propisima kojima je uređena oblast izgradnje propisan je postupak dobijanja lokacijske dozvole, građevinske dozvole i upotrebne dozvole, a planskim dokumentima su definisani ciljevi prostornog planiranja i razvoja, odnosno prostornog uređenja, odnosno da li je planirano da se u određenom vremenskom periodu izgradi određeni objekat na određenom mestu u Republici Srbiji. Neophodan element za dobijanje navedenih dozvola je pribavljanje tehničkih uslova za priključenje na elektroenergetsku mrežu.

Drugu grupu propisa čine propisi koji se odnose na sticanja prava na obavljanje delatnosti proizvodnje električne energije. U grupu propisa kojima je uređena oblast energetike spadaju: Zakon o energetici, prateći propisi ovog zakona, Strategija razvoja energetike Republike Srbije i Program ostvarivanja Strategije razvoja energetike Republike Srbije i drugi gore navedeni propisi koji se odnose na energetske delatnosti, objekte i sl. Do donošenja Zakona o energetici (donetog 2011. godine) proizvodnja električne energije bila je energetska delatnost od opšteg interesa. Stupanjem na snagu ovog zakona, navedena delatnost nije više delatnost od opšteg interesa. Posledica ovoga je činjenica da je sticanje prava na obavljanje delatnosti postalo jednostavnije i da se svodi na sticanje prava na obavljanje energetske delatnosti – pribavljanje licence za obavljanje energetske delatnosti.

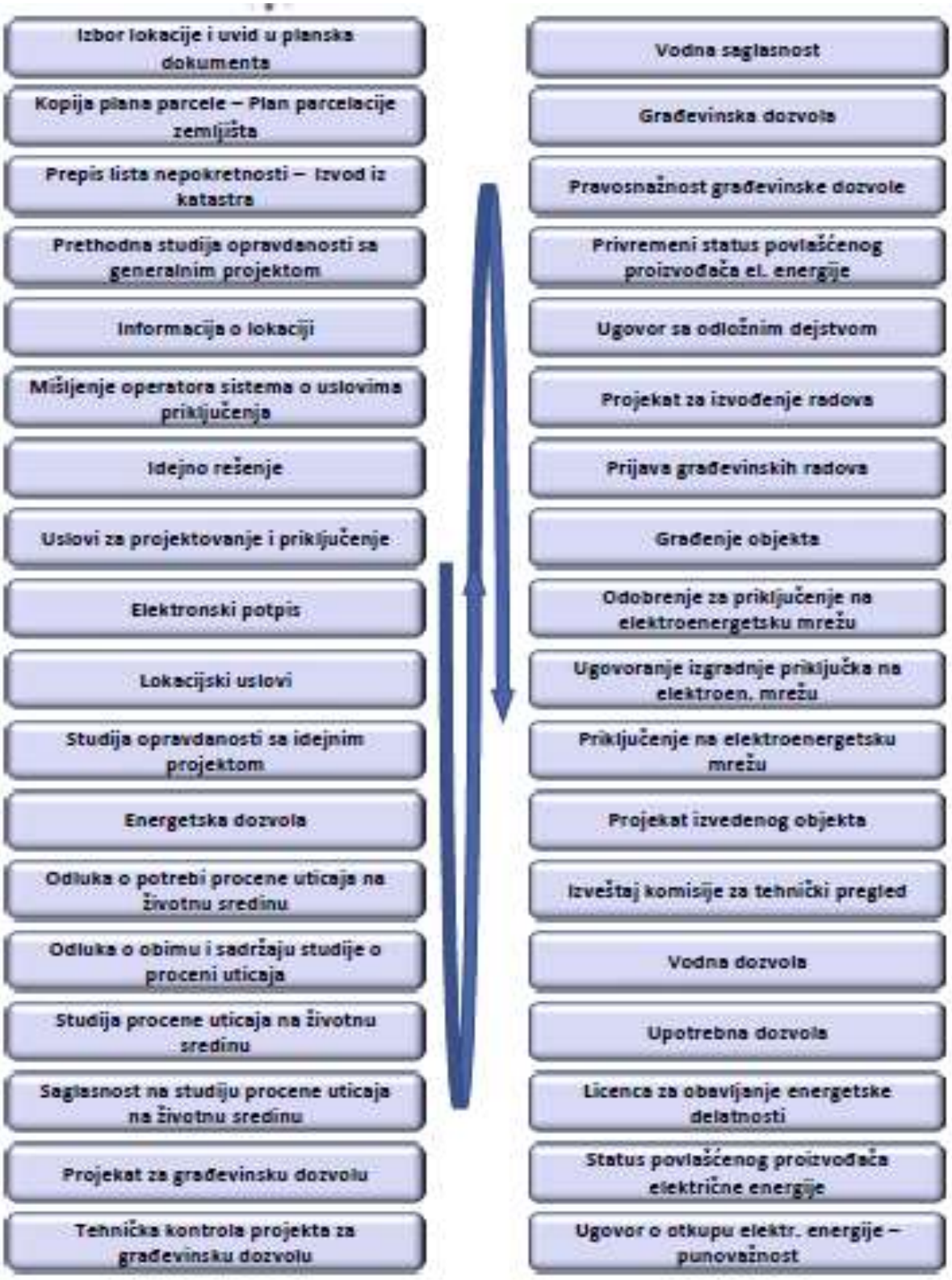
2. Zaključak

Da bi se obnovljiva energija prihvatila na širem planu potrebno je sprovoditi brojne akcije koje obuhvataju rad sa javnošću kroz programe permanentne edukacije. Cilj je da se na širokom planu prihvati ideja o prednostima primene obnovljivih goriva u Srbiji (ekonomske i ekološke prednosti). Za ove akcije potrebna je jaka vladina politika koja donosi propise o delimičnom oslobađanju poreza na proizvodnju i primenu proizvoda koji doprinose racionalnoj potrošnji energije.

Jačanje fokusa prema organizacijama koje koordiniraju ove poduhvate, zatim privatnih i javnih preduzeća, kao i akcije vlasti npr. grupa organizacija koje podržavaju razvoj, finansiranje i koordinaciju između stakeholder-a (razne vrste industrija, biznisa, vlade, univerziteta i istraživačkih instituta i korisnika usluga).

Kao potrebne preduslove za veću proizvodnju i efikasnije korišćenja OIE su jaka administrativna struktura i efikasna procedura, kao i politička volja da ovaj segment privrednog razvoja dobije povlašćen položaj (oslobađanje od PDV-a, razne subvencije itd.) u odnosu na fosilna goriva.

Pretpostavke ostvarenja prednosti obnovljivih goriva su stabilno političko i ekonomsko okruženje, jer se radi o dugoročnim ulaganjima. Neophodni su pre svega transparentnost i predvidivost načina određivanja cena, kao i institucionalni razvoj, s ciljem da se omogući da maloprodajna cena bude prihvatljiva za potrošače.



Slika 3. Potrebne radnje za realizaciju projekata iz oblasti OIE u Republici Srbiji

3. Literatura

Despotović, Ž., Jovanović, M., Stevanović, I. (2016). *Primena mobilnih solarnih jedinica u ratarstvu i stočarstvu,* Beograd, Institut Mihajlo Pupin, Univerzitet u Beogradu.

Vlada Republike Srbije (2013) „*Nacionalni akcioni plan za korišćenje obnovljivih izvora energije"* (NAPOIE), Službeni glasnik RS, broj 53/2013.

Vlada Republike Srbije (2013) „*Uredba o podsticajnim merama za proizvodnju električne energije iz obnovljivih izvora i iz visokoefikasne kombinovane proizvodnje električne i toplotne energije*", Beograd.

Vlada Republike Srbije (2013) „*Uredba o uslovima i postupku sticanja statusa povlašćenog proizvođača električne energije, privremenog povlašćenog proizvođača i proizvođača električne energije iz obnovljivih izvora energije*", Beograd.

Gor, A. (2010). *Naš izbor*, Beograd, Geopoetika.

Ministartvo rudarstva i energetijke RS (2015) „*Pravilnik o utvrđivanju slobodnog kapaciteta uvećanog za vrednost instalisane snage elektrana za koje je prestao privremeni status povlašćenog proizvođača*" Službeni glasnik RS, broj 24/2015.

Ministartvo rudarstva i energetijke RS (2015) „*Pravilnik o utvrđivanju modela ugovora o energetskim uslugama za primenu mera poboljšanja energetske efikasnosti kada su korisnici iz javnog sektora*", Službeni glasnik RS, broj 41/2015.

Narodna skupština Republike Srbije (2015) „*Strategija razvoja energetike Republike Srbije do 2025. godine sa projekcijama do 2030. godine*" Službeni glasnik RS, broj 101/2015.

Narodna skupština Republike Srbije (2014) „*Zakon o energetici*" Službeni glasnik RS, br. 145/2014.

Eurostat: https://ec.europa.eu/eurostat/documents/2995521/10335438/8-23012020-AP-EN.pdf/292cf2e5-8870-4525-7ad7-188864ba0c29

Eurostat: https://ec.europa.eu/eurostat/tgm/graph.do?pcode=sdg_07_40&language=en

7. BASIC CURRICULA AND MANUAL FOR TECHNICIAN OF PV SOLAR ENERGY (TSE) TRAINING

APPENDIX 1: INSTALATION OF SMALL PV SYSTEMS

Ljubiša Stajić

Montaza fotonaponskih elektrana

SADRŽAJ

MEHANIKA FOTONAPONSKIH ELEKTRANA

Zbog svoje primarne funkcije, generacije električne energije iz sunčeve, vrlo često se zapostavlja mehanički apsekti elektrana. S obzirom da projektovani životni vek elektrane veoma je važno da sni njeni elementi imaju dug životni vek.

Mehanički aspekti fotonaponske elektrane:

- Građevinsko inžinjerstvo
- Mašinsko inžinjerstvo
- Razmatranje materijala
- Arhitektura
- Aeronautičko inžinjerstvo

Delovi projekta koji se odnose na navedene discipline:

- Određivanje sila naprezanja u sistemu
- Izbor, dimenzionisanje i konfiguracija strukturnih komponenti koje mogu da izdrže određene sile naprezanja
- Izbor i konfiguracija materijala adekvatnih lokaciji izgradnje
- Projektovanje noseće konstrukcije da zadovolji funkcionalnost i estetiku

FUNKCIONALNI ZAHTEVI

Statička nosivost konstrukcije projektovana da izdrži određene sile narezanja uz određenu sigurnosnu marginu.
Funnkcionalni zahtevi u vezi sa statikom konstrukcije:

- Specifikacija faktora sigurnosti
- Maksimalno dozvoljena naprezanja
- Granice deformacije
- Životni vek strukturnih komponenti
- Fiksni sistemi lil suntracker sistemi potrebno kretanje sistema

U zavisnosti od gore navedenih stavki vrši se izbor adekvatnih materijala, geometrije konstukcije i veličine strukturnih komponenti.

Fotonaponski niz i njegova noseća konstrukcija moraju izdržati sva naprezanja kojima su izloženo tokom projektovanog životog veka od 20 do 30 godina.

OPERACIONI ZAHTEVI

Operacioni zahtevi se odnose na aspekte projektovanja koji utiču na osobe koje instaliraju, poseduju, upravljaju, održavaju, otklanjaju kvarove:.

- Specifikacija maksimalnog broja radnih sati koji si potrebni za montažu sistema
- Specifikacija koja se odnosi na pristupačnost individualnih panela i kritičnih komponenti za inspekciju, održavanje i popravku
- Specifikacija vezana za bezbednost – krađa, vandalizam, sprečavanje povređivanja...
- Periodično isptivanje i održavanje

OGRANIČENJA

- Tipično ograničenje pri projektovanju su troškovi. U visoko kompetitivnom okruženju bitno je što više smanjiti troškove
- Drugi ograničavajući faktor je vreme. Dobar projekat u svim svojim kreativnim delovima uzima u obzir vreme.
- Drugi ograničavajući faktori koji su specifični prema tipu projekta npr. Pojava senki, ograničeno prisustvo suncu

PROJEKTOVANJE NOSEĆE KONSTRUKCIJE

Pored zahteva za ispunjenje regulativnih, strukturnih i bezbednosnih uslova, dobar projekat mora imati i sledeće:

- Minimizirane instalacione troškove
- Poboljšane perfonmanse stringova
- Omogućen razuman pristup elementima sistema radi održavanja i otklanjanja kvarova
- Estetski aspekt projekta u skladu sa okruženjem elektrane

Minimizacija instalacionih troškova

- Dobar projekat i kvalitetno izvođenje radova smanju instalacione troškove
- Polovina invensticije fotonaponske elektrane čine paneli dok drugu polovinu činetroškovi ostale opreme i troškovi izgradnje
- Smanjenje troškova instalacije je moguće:

1. **Razvojem odgovarajućih prodajnih paketa** – panela, odgovarajućih elemenata noseće konstrukcije, komponente za pričvršćenje, baterije, invertore, komponente za povezivanje itd.
2. **Minimalizazijom broja delova sistema** – veću paneli manji broj
3. **Minimalizacijom različitih tipova delova sistema**
4. **Upotrebom multifunkcionalnih delova** – delovi sistema imaju različitu funkciju npr. Noseći profili koji pored uloge pričvršćenja panela imaju funkciju kablovskih kanalnica
5. **Upoteba delova koji mogu da se koriste u različite namene i sa različitom opremom**
6. **Primenom jednostavnih načina montaže**
7. **Izbegavanjem različitih načina pričvršćenja**
8. **Minimizovanjem načina na koji je moguće pričvrstiti određeni deo** – što znači da se određeni deo uklapa u druga na samo jedan način i nije g amoguće drugačije postaviti
9. **Maksimiziranje usklađenosti pri montaži** – delovi se uklapaju idealno bez tolerancije
10. **Minimizacija rukovanja pri sklapanju** – gde se nalaze otvori, rupe, kako se profili uklapaju

ELEKTRANE NA KROVU

- Može ih odlikovati brza izgradnja i mali broj pripremnih radova
- Uglavnom se građevinski radovi odnose na:
  - Pripremu i iskop trase napojnog kabla (ukoliko je potrebno položiti nov napojni kabl)
  - Pripremu i iskop kanala za postavljanje uzemljivača
  - Postav
  - Polaganje kablova DC i AC instalacije

ELEKTRANE NA ZEMLJI

- Građevinski radovi su veoma bitni
- Potrebno je veoma dobro planiranje
- Glavni radovi su:
  - Priprema i ravnjanje terena
  - Izgradnja pristupne u unutrašnje putne infrastrukture
  - Pripremu i iskop trase napojnog kabla (ukoliko je potrebno položiti nov napojni kabl)
  - Pripremu i iskop kanala za postavljanje uzemljivača
  - Polaganje kablova DC i AC instalacije

GRAĐEVINSKI RADOVI. PRIPREMA INFRASTRUKTURE

PRIPREMA I RAVNJANJE TERENA

- Uglavnom se svodi na najminimalnije radove zbog uticaja na životnu sredinu
- Samo ono što je neophodno:
  - Izbor ravnog terena može isključiti potrebu za poravnjanjem
  - Izborom načina pričvršćivanja po principu ankera umesto betonskih temelja
  - Izborom padine odgvarajućeg nagiba može se smanjiti rastojanje među redovima
  - Od slučaju da teren ima veliki pad potrebno je ispitati geomorfologiju terena da bi se sprečilo oštećenje opreme usled erozije zemljišta. Ukoliko je teren nestabilan savetuje se promena lokacije

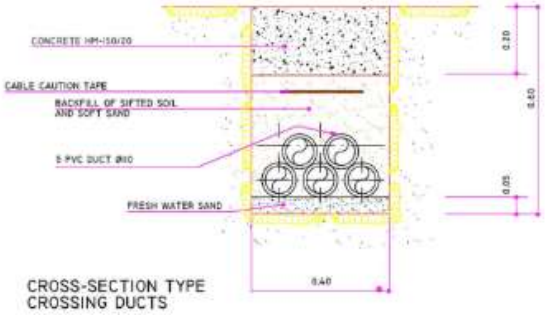
UNUTRAŠNJA I PUTNA INFRASTRUKTURA

- Preporučena je upotreba već postojeće pristupne infrastrukture odnosno pri izboru lokacije teži se ka tome da je lokacija u blizini posojeće putne infrastrukture
- Potrebno je uzeti u obzir da će infrastrukturu koristiti kamioni tako da je potrebno predvideti radijus da bi omogućio okretanje i paralelno kretanje

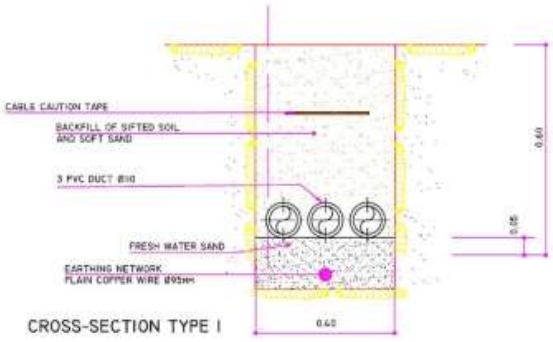
- Protivpožarni putevi u samoj elektrani – treba predvideti prostor za kretanje vatrogasnih kola u slučaju nastanka požara
- Nakon završetka radova unutrašnje putanje neće biti mnogo korišćene tako da ih potrebno nasuti mešavinom 75% rizle, 25% peska da bi se sprečilo osipanje i rast korova

KABLOVSKI KANALI I ROVOVI

- Svi kablovi se polažu podzemno
- Svakih 40 m u svakom pravcu se prave revizione šahte da bi se olakšalo polaganje i pristup kablovima
- Trasa kablova mora biti optimizovana
- Kablovi jednosmernog i naizmeničnog sistema moraju biti odvojeni
- Pri paralelnom polaganju kablova moraju se uzeti redukcioni koeficijenti u obzir da bi se odredila tačna strujna opteretljivost kablova



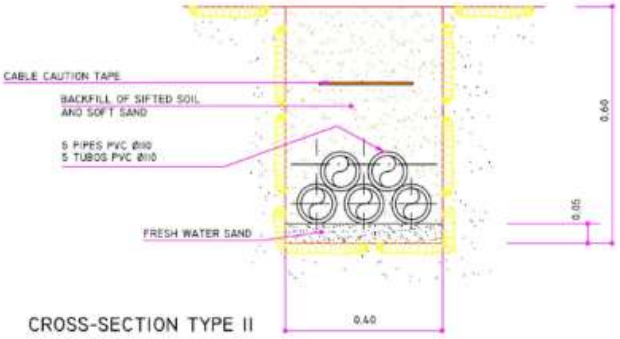
CROSS-SECTION TYPE CROSSING DUCTS



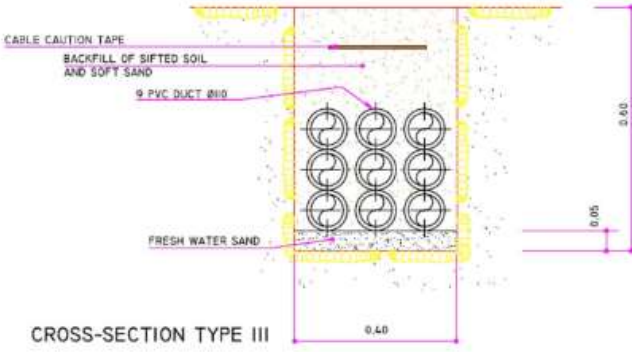
CROSS-SECTION TYPE I

Svi kanali moraju imati:

- Peščanu osnovu
- Razmak između kablovske kanalizacije odnosno PVC cevi
- Ispuna od mešavine prosejane zemlje i rečnog peska
- Traka upozorenja
- Ukoliko preko kanala prolaze vozila potrebo je preko kanala postaviti sloj betona



CROSS-SECTION TYPE II



CROSS-SECTION TYPE III

IZRADA MEHANIČKE NOSEĆE KONSTRUKCIJE

IZRADA NOSEĆE KONTRUKCIJE

- Konstrukcije za elektrane na objektu – krovu:
  - U ravni krova – jednostavnije i lakše rešenje
  - Pod optimalnim nagibom – dodatni konstruktivni elementi
  - Suntracker sistemi

Tip konstrukcije	Težina	Trajanje antikorozivne zaštite	Mehaničke krakteristike
Galvanizovan čelik	Otporan i težak krovni pokrivač	8 godina (za neslane atmosfere)	Odlične
Vruće galvanizovan čelik	Otporan i težak krovni pokrivač	Preko 25 godina	Odlične
Obrađen aluminijum	Lak krovni pokrivač	Preko 25 godina	Srednje
Bez konstrukcije	Lak krovni pokrivač		

Za fiksne sisteme konstrukcija se montira paralelno površini ili pod optimalnom inklinacijom i azimutom.

Paralelno površini	Pod nagibom
Bez proračuna usled udara vetra	Važno uzeti udare vetra pri proračunu
Lošije hlađenje panela	Najbolje prirodno hlađenje
Niži troškovi izgradnje (i konstrukcije i montiranja)	Veći troškovi investicije

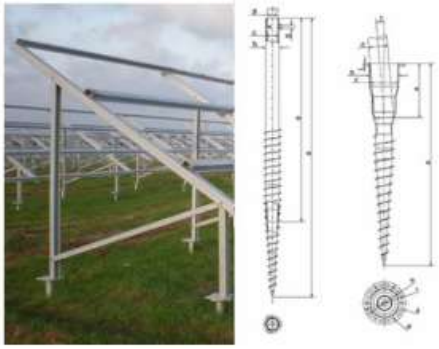
Kada su u pitanju elektrane na objektu potrebno je proceniti sledeće:

- Bezbednost – u zavisnosti od tipa krova koriste se različiti tipovi sistema za sprečavanje padova
- Pristupačnost – na koj način se vrši prostup krovu i da li je potrebno izgraditi skelu koristiti dizalicu
- Tip krova – U zavisnosti od ptimenjenog tipa pokrivača biraju se elementi kostrukcije. U nekim slučajevima je potrebo izvšiti zamenu krovnog pokrivača kao na primer kad je u pitanju salonit

- Hidroizolovanost – Vrlo je bitno pri postavljanju konstrukcije voditi računa da se ne ošteti vodonepropusna zaštita odnosno da se ne naruši funkcija krova u smislu odbrane od atmosferskih uticaja
- Opterećenje krova – odnosno proveriti da li je u skladu sa statičkim prpačunim konstrukcija krova dovoljno jaka da izdrži dodatno opterećenje
- Uticaj vetra na postavljene panele – da bi se sprečio efekat jedra i oštećenje opreme
- Dodatna opterećenja tokom izgradnje – alat, ljudstvo, maksimalan broj ljudi na krovu tokom instalacije

Kada su u pitanju elektrane na zemlji kod njih imamo problem fundiranja noseće konstrujkcije. U tom smislu proilikom projektovanja koriste se sledeće tehnike fundiranja:

- Sistem ankera
  - Ankeri sa spiralnim navojem dužine između 1 i 1,6 m
  - Moguće ih je lako skinuti odnsno izvući iz zemlje
  - Lako se prilagođeveju reljefu terena



  - Mogu se upotrebiti i kod kamenih i šljunkovitih podloga
  - Metalni šipovi koji se pobijaju u zemlju

- Betonski temelji
  - Prave se kao ukopani i površinski
  - Zahtevaju ravnu površinu
  - Ako su površinski moguće ih je lako premestiti

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  - Metalni šipovi koji se pobijaju u zemlju

- Betonski temelji
  - Prave se kao ukopani i površinski
  - Zahtevaju ravnu površinu
  - Ako su površinski moguće ih je lako premestiti

POLAGANJE KABLOVA

U zavisnosti od tipa elektrane potrebno je položiti potrebnu kablovsku infrastrukturu:

- Instalaciju DC sistema
- Instalaciju AC sistema
- Uzemljivački sistem
- Sistem za izjednačavanje potencijala
- Komunikacionu infrastrukturu
- Napojni kabl elektrane (400V ili srednjenaponski kabl 10kV)
- Sistem bezbedbosti i video nadzora

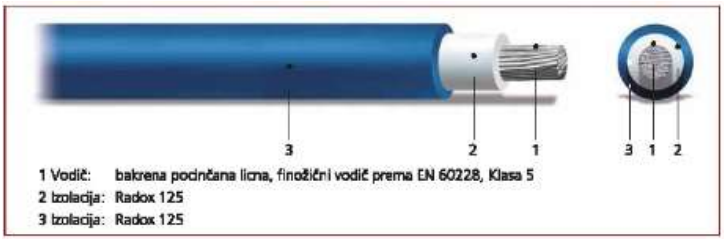
Svaki od navedenih sistema koristi provodnike i kablova različitog tipa izabranih i dimenzionih prema svim navedenim faktorima prilikom projektovanja.

Potrebno je obezbediti galvansku odvojenost jednosmernog i naizmeničnog sistema provlačeći kablove kroz kablovsku kanalizaciju. Takođe potrebno je osirurati i primeniti odgovarajuće tehnike sprečavanje uticaja elektromagnetnog zračenja na komunikacionu infrastrukturu (uzemljavanje, šildovanje, asihroni prenos, wireless tehnologije...)

Prilkom povezivanja sistema postavljaju se odgovarajući konettori na krajeve provodnika u skladu sa namenom.

Karakteristike PV kabla:

-Jednožilni finožični-licnasti kabl, sa provodnikom od pocinkovanog bakra i dvostrukom izolacijom od radox-a 125
-Savitljiv, mehanički izuzetno izdržljiv
-Otporan na visoke i niske temperature, UV zračenje
-Otporan na vodu, ulja i hemikalije
-Postojan na ozon i hidrolizu
-Najčešće se izrađuje u tri boje (izolacija): crna, plava i crvena, preseka 4 mm^2 i 6 mm^2



MC4 konektori

Priključni sklop specijalno dizajniran za fotonaponske sisteme, čiji su kontakti izrađeni od pocinkovanog bakra, geometrijskog oblika koji omogućava precizan i stalan pritisak i pouzdan spoj sa minimalnim prelaznim otporom.

Tipovi MC4 konektora:
- Muški i ženski
- Muški i ženski ugradni
- Muški i ženski razdelni

Ostala oprema:
- poklopac za muški i ženski kontakt
- klešta za spajanje-presovanje MC4 kontakata sa PV kablom

PVA19000
Kliješta za stezanje MC4 kontakata, specijalno za primjenu za vodiče presjeka 2,5 - 4 - 6 mm²

AC instalacija

Izvodi se kablovima PP00 ili PP00-A, koji se u zavisnosti od uslova na terenu polažu u kanalice ili PNK regale, a većim delom u zemlju. Presek kabla se određuje proračunom koji je sastavni deo projektne dokumentacije.

Kabl treba da bude u skladu sa SRPS N.C5.220, sa izolacijom i plaštom od PVC mase, sa provodnikom od bakra ili aluminijuma, za nazivni napon 0,6/1 kV, za opseg temperatura, radne: -40°C do +70°C, a pri polaganju: +5°C do +70°C.

INSTALACIJE KROVNIH ELEKTRANA

Postavljaju se plastične cevi, metalni poncinkovani pnk regali, rebrasta creva itd.

Upotreba kanalnica pojednostavljuje polaganje kablova

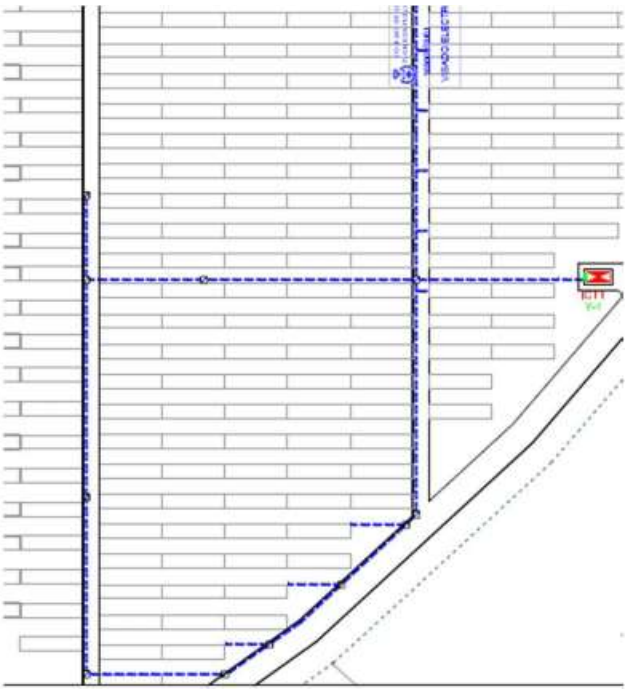
INSTALACIJE ELEKTRANA NA ZEMLJI

Kablovi se polažu u kablovske kanale. Upotrebljavaju se kablovi sa plaštom položeni u odgoarajuću kablovsku kanalizaciju.

Kablovski kanali mogu biti veoma dugčki, tako da izgled kanala, broj kablova u kanalicama, revizioni otvori itd. mogu biti od velikog značaja pri izvođenju elektro radova

Kablovi moraju biti jasno označeni odakle potiču i gde se priključuju.

Važno je izbegavati oštre uglove radi sprečavanja oštećenja kablova



RAZVODNI ORMANI

U zavisosti od mesta postavljanja različitog su stepea zaštite. Za spoljnu montažu upotrebljavaju se ormani IP65. Za unutrašnju montažu minimalan stepen zaštite je IP 21 sem u specijalnim slučajevima sa vlažnom i slanom atmosferom.

Od izuzetnog je značaja posvetiti posebnu pažnju kripmlovanju kablova kao i svim električnim kontaktima. Takođe nepohodno je da si elementi budu jasno označeni da bi se jasnoi lako raspoznala njihova funkcija u skladu sa projektnom dokumentacijom.

SISTEM UZEMLJENJA I IZJEDNAČAVANJA POTENCIJALA

Sledeće elemente je neophodno uzemljiti:

- Okvire PV panela
- Noseću konstrukciju
- Metalne plaštove kablova
- Metalne mase u razvodnim ormanima
- Kućišta invertora

KRITIČNE KONTROLNE TAČKE SU:

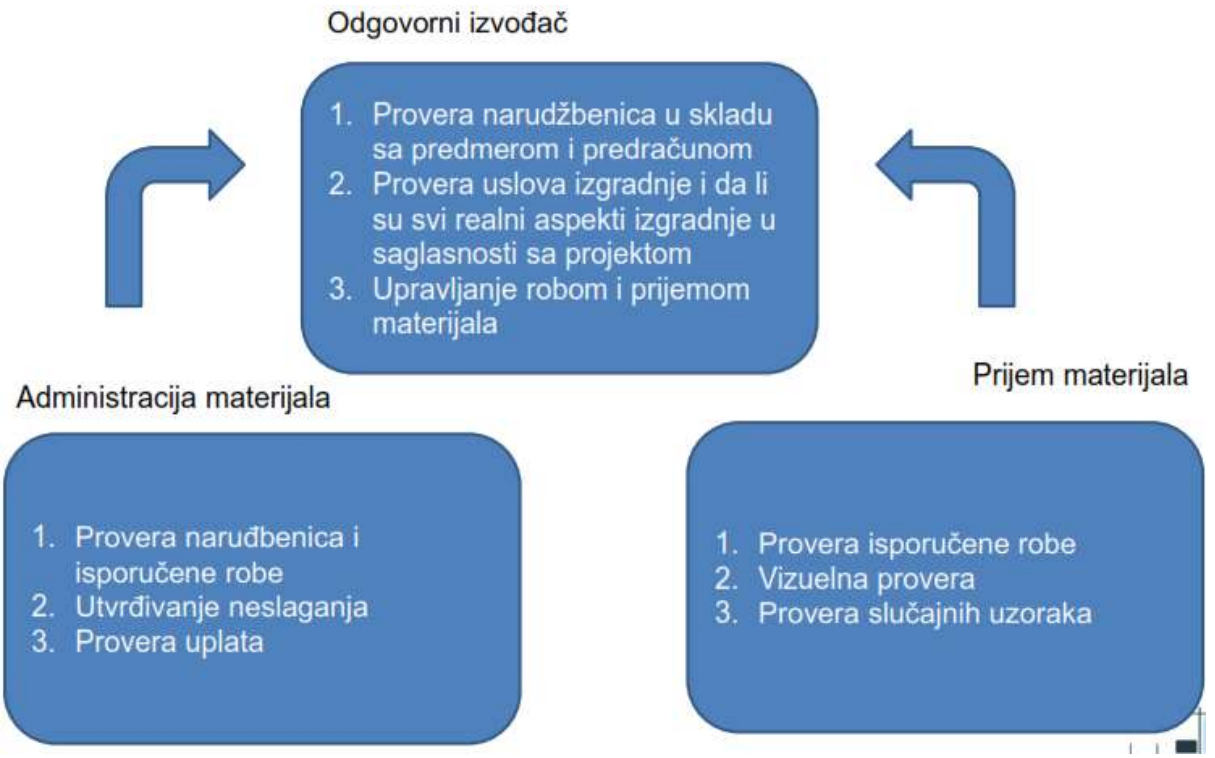
Materijali

- Provera dospeća sve potrebne opreme i materijala
- Inspekcija dospele robe odnosno ulazna kontrola kvaliteta
- Ispistivanje slučajnih uzoraka radi utvrđivanja karakteristika u skladu sa katalоškim podacima opreme
- Provera električnih i mehaničkih karakteristika opreme

Izvođenje radova

- Izrada dinamičkog plana izgradnje i usaglašavanje svih akcija i izvršioca
- Provera tačnosti dokumentacije

KVALITET I KRITIČNE TAČKE GRADNJE

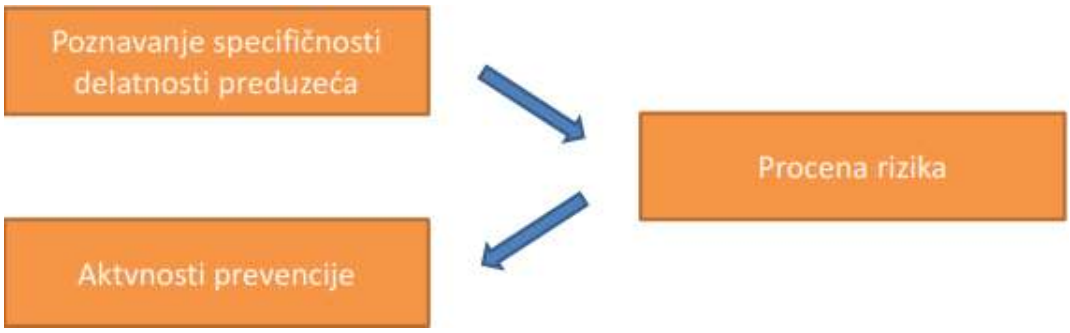

Odgovorni izvođač
1. Provera narudžbenica u skladu sa predmerom i predračunom
2. Provera uslova izgradnje i da li su svi realni aspekti izgradnje u saglasnosti sa projektom
3. Upravljanje robom i prijemom materijala
Administracija materijala
1. Provera naruđbenica i isporučene robe
2. Utvrđivanje neslaganja
3. Provera uplata
Prijem materijala
1. Provera isporučene robe
2. Vizuelna provera
3. Provera slučajnih uzoraka


Odgovorni izvođač
1. Poštovanje zadatih rokova
2. Korigovanje plana izgradnje u slučaju odstupanja
3. Provera dokumentacije
4. Vođenje građevinskog dnevnika
5. Provera kvaliteta izvršenih rodova u različitim fazama izgradnje
6. Upravljanje viškovima materijala i opreme
7. Finalna provera izvedenih radova
RADNIK
1. Izvršava radne zadatke u skladu sa plaom
2. Prijavljuje uočene nedostatke
3. Izveštava o stepenu izvršenja

BEZBEDNOST I ZDRAVLJE NA RADU

NAJVAŽNIJI ZAHTEV PRI PROJEKTOVANJU I IZVOĐENJU FOTONAPONSKE ELEKTRANE JE BEZBEDNOST I ZDRALVJE POJEDINACA, OBJEKATA I SREDINE!!!

Svaka firma mora da ima akt o proceni rizika pri obavljanju određenih aktivnosti iradnih zadataka. U skladu sa aktom se definišu procedure i neophodna zaštitna oprema neophodne za uzvršenje radnih zadataka.



Elektrana na krovu	Elektrana na zemlji (fiksna)	Elektrana na zemlji (suntracker)
Male elektrane 2-3 kW do 100 kW	**Velika postrojenja > 100 kW**	**Velika postrojenja > 100 kW**
RAD NA VISINI	RAD NA ZEMLJI	RAD NA ZEMLJI
RAZLIČITI TIPOVI KROVOVA	POMERANJE ZEMLJE	POMERANJE ZEMLJE
RAZLIČITI NAGIBI KROVOVA	ISKOP ROVOVA	ISKOP ROVOVA
RAD PRI NEOMATANJU AKTIVNOSTI LOKACIJE	VELIKI BROJ RADNIKA	VELIKI BROJ RADNIKA
ELEKTRIČNA INSTALACIJA I PRIKLJUČENJE INVERTORA	MOGUĆS UPOTREBA DIZALICA I KRANOVA	UPOTREBA DIZALICA I KRANOVA
	ELEKTRIČNA INSTALACIJA I PRIKLJUČENJE INVERTORA	ELEKTRIČNA INSTALACIJA I PRIKLJUČENJE INVERTORA

Elektrana na krovu	Elektrana na zemlji (fiksna)	Elektrana na zemlji (suntracker)
PAD SA VISINE	PAD U OTVORE U KANALE	PAD U OTVORE U KANALE
NESREĆE USLED PADA MATERIJALA	RIZIK OD GAŽENJA VOZILOM	RIZIK OD GAŽENJA VOZILOM
RIZICI OD STRANE AKTIVNOSTI INDUSTRIJE LOKACIJE	RIZIK OD STRUJNOG UDARA	RIZIK OD STRUJNOG UDARA
RIZIK OD STRUJNOG UDARA	NESREĆE USLED PADA MATERIJALA	NESREĆE USLED PADA MATERIJALA
		NESREĆE USLED SUDARA SA SUNTRACKEROM

8. NUMERICAL METHODS IN COMPUTATIONAL ENGINEERING[24]

Gradimir Milovanović[25], Đorđe Đorđević[26],

Summary: *The need for additional education, not being part of system of formal education and prevailing of practical nature is especially noticed in the field of energy efficiency, ecological building, and solar energy. These three fields are recognized as very prosperitive and promissing in construction sector. It has to be realized by establishing close relations with educational and R/D institutions, and by forming transnational dual education system. It is expected that all partners offer inovative courses that would improve production processess and procedures using reserach results and improved competences of workers.*

International industrial cooperation of clusters of South-East Europe, in addition to strict industrial outcomes, has important influence on educational cooperation of all partners, in our case, City of Nis, i.e. University of Niš and corresponding partners – clusters from Romania, Poland, and Slovebia. The main objective of projects KLERP No. 4939/2019-01 (Internationa Industrial Cooperation of Clusters of South-East Europe as Tool for Development of Educational-Business Tourism of City of Niš) and SMART4NZEB (EASME COSME COS-CLUSTER-2018-3-02 SMART4NZEB No. 874425) is to create a sustainable collaboration, co-learning and capacity building between the involved partners - cluster managers, cluster members and relevant stakeholders representative for the nZEB market in the selected Central and East-European countries, with a view to develop the involved clusters management excellence and to support interregional partnerships to facilitate the development of competitive products and technological solutions intended for new and existing buildings, which will lead to market penetration of nearly zero energy buildings, related to their production, use and reuse. The objective is to drive clusters towards innovative and modern clusters being able to address cross-sectoral and cross border collaboration and tackling main environmental, economic, and social challenges of their members. In order to realise this goal, the improved theoretical and practical background of all partners is necessary. In addition to proposed trainings, some additional courses, both theoretical and practical, are proposed. The course entitled „Numerical Methods in Computational Engineering" is presented in this paper. The curricila presented here could cover almost all needs not only in research, development and engineering practice, but also management and control in building construction.

Key words: *Numerical Mathematics*, *Applied Mathematics*, *Numerical Methods*, *Programming Numerical Methods*, *Computational Engineering*, *Computational Engineering Design*, *Numerical Algorithms*

Rezime*: Potreba za dodatnim obrazovanjem, koje nije deo sistema formalnog obrazovanja i sa naglaskom na praktičnu primenu je specijalno izražena u oblastima energetske efikasnosti, ekološke gradnje i solarne energije. Ove tri oblasti su označene kao vrlo perspektivne i obećavajuće u gradjevinskom sektoru. To se može ostvariti uspostavljanjem bližih veza sa obrazovnim i razvojno-istraživačkim institucijama, i uspostavljanjem transnacionalnog sistema dualnog obrazovanja. Očekoje se da svi partneri ponude inovativne kurseve koji će poboljšati procese proizvodnje i procedure korišćenjem rezultata istraživanja i unapredjenih veština radnika. Medjunarodna saradnja industrijskih klastera Jugoistočne Evrope, pored strogo industrijskih rezultata, ima značajan uticaj na obrazovnu saradnju svih partnera, u našem slučaju Grada Niša, tj. Univerziteta u Nišu i odgovarajućih partnera, klastera iz Rumunije, Poljske i Slovenije. Glavni cilj projekata KLERP No. 4939/2019-01 (Međunarodna privredna saradnja klastera jugoistočne Evrope kao pravac razvoja poslovno-obrazovnog turizma grada Niša) i Smart4NZEB (EASME COSME COS-CLUSTER-2018-3-02 SMART4NZEB No. 874425) je da kreiraju održivu saradnju, uzajamnu obuku i izgradnju kapaciteta izmedju uključenih partnera – menadžera klastera, članova klastera i predstavnika uticajnih institucija za tržište od uticaja na gradnju sa ciljem utroška energije bliskog nuli u izabranim zemljma Centralne i Jugoistočne Evrope, sa intencijom da se razvije usavršeni menadžment klastera i medjuregionalno partnerstvo koje bi omogućilo razvoj konkurentnih proizvoda i tehnoloških rešenja za nove i postojeće zgrade, što bi omogućilo prodor nZEB zgrada na tržište, u smislu proizvodnje, korišćenja i ponovnog korišćenja. Opšti cilj je da se pomogne klasterima na putu ka inovativnim i modernim klasterima, sposobnim za medjunarodnu i medjusektorsku saradnju, baveći se ekološkim, ekonomskim i socijalnim izazovima svojih članova. Da bi*

[24] Research is approved by Office for Local Economic Development and Research (KLERP) of City of Niš;

[25] Mathematical Institute of Serbian Academy of Sciences and Arts, Belgrade, Serbia;

[26] Construction Cluster "Dundjer", Niš, Serbia;

se postigao taj cilj, neophodni su su dobra teoretska osnova, kao i praktična znanja.Pored predvidjenih obuka, planirani su i teoretski i praktični kursevi. Kurs pod naslovom „Numerical Methods in Computational Engineering" je predstavljen u ovom radu. Predvidjeni program nastave (direktne ili on-line) treba da podrži ne samo istraživanje, razvoj i inženjersku praksu, već i menadžment i regulacije u gradjevinskim konstrukcijama.

Ključne reči: *Numerička matematika, Primenjena matematika, Numeričke metode, Programiranje numeričkih metoda, Računarsko inženjerstvo, Računarsko inženjersko projektovanje, Numerički algoritmi.*

0. INTRODUCTION

A course in Numerical Methods in Computational Engineering, oriented to engineering education, originates at first from the course in Numerical Analysis for graduate students at Faculty of Civil Engineering and Architecture of Niš (GAF), and then from course Numerical Methods held in English language at Faculty of Civil Engineering in Belgrade in the frame of project DYNET (Dynamical Network) in common of Faculty of Civil Engineering of University of Bochum, Faculty of Civil Engineering and Architecture of University of Niš, Faculty of Civil Engineering of University Belgrade, and IZIIS (Institute for Earthquake Engineering and Seismology) of University Skopje, Northern Macedonia. The subject Numerical Analysis was held in the first semester of postgraduate studies at GAF by Prof. G.V. Milovanović for years. In continuation, following Bologna process, the new structured subject entitled Numerical Analysis was introduced to PhD students at GAF. In addition, having in mind that course in Numerical Analysis become accepted as an important ingredient in the undergraduate education in engineering and technology, it was with its main topics involved in undergraduate subject Informatics II at GAF Niš (As a collateral case, in Appendix A.4.– in electronic form – are given numerical methods in Informatics, what could be interesting for students of this orientation). The backbone of this course are famous books of G.V. Milovanović, Numerical Analysis, Part I, II, and III, Naučna knjiga, Beograd, 1988 (Serbian). The course tutorial is taken, with small changes from the book

Milovanović, G.V., Djordjević, Dj.R.*: Numerical Methods in Computational Engineering, University of Niš, Faculty of Civil Engineering and Architecture, Niš, 2008.*

In addition, the book *Programming Numerical Methods in Fortran*, by G.V. Milovanović and Dj. R. Djordjević, University of Niš, 1981 (Serbian), with its engineering-oriented text and codes, was rather used.

As previously noted, this course is supporting undergraduate studies, master and doctoral study at GAF, and international master study in the frame of DYNET project. Presentation on Cluster DUNDJER site (www.dundjer.co.rs) would enable distance learning technique and on-line consultations with lecturer. By up-to-day engineering oriented applications the supporting of lifelong education of civil engineers is enabled. Each lesson in this curricula concludes with a basic bibliography and suggested further reading, what is given for potential students. Tutorial exercises in form of selected assignments are also presented on the site of Cluster Dundjer. Some hints for solutions are given in the same files. Devoted primarily to students of Civil Engineering (undergraduate and graduate - master & PhD), this textbook is dedicated also to industry and research purposes.

1. Mathematics and Computer Science

1.1. Calculus
1.2. Number representation
1.3. Error, accuracy, and stability
1.4. Programming
1.5. Numerical software
1.6. Case study: errors, round-off, and stability

Bibliography (Cited references and further reading)

[1] Milovanović, G.V., Numerical Analysis I, Naučna knjiga, Beograd, 1988 (Serbian).

[2] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu "Edvard Kardelj", Niš, 1981 (Serbian).

[3] Hoffman, J.D., Numerical Methods for Engineers and Scientists. Taylor & Francis, Boca Raton-London-New York-Singapore, 2001.

[4] Press, W.H., Flannery, B.P., Teukolsky, S.A., and Vetterling, W.T., Numerical Recepies - The Art of Scientific Computing. Cambridge University Press,1989.

[5] Rice, J.R., Numerical Methods, Software, and Analysis. McGraw-Hill, New York, 1983.

[6] Abramowitz, M., and Stegun, I.A., Handbook of Mathematical Functions. National Bureau of Standards, Applied Mathematics Series, Washington, 1964 (reprinted 1968 by Dover Publications, New York).

[7] Hildebrand, F.B., Introduction to Numerical Analysis. Mc.Graw-Hill, New York, 1974.

[8] Stoer, J., and Bulirsch, R., Introduction to Numerical Analysis. Springer-Verlag, New York, 1980.

[9] Kahaner, D., Moler, C., and Nash, S., Numerical Methods and Software., Prentice Hall, Englewood Cliffs, 1989.

[10] Johnson, L.W., and Riess, R.D., Numerical Analysis. 2nd ed., Addison- Wesley, Reading, 1982.

[11] Wilkinson, J.H., Rounding Errors in Algebraic Processes. Prentice-Hall, Englewood Cliffs, 1964.

[12] Milovanović, G.V. and Kovačević, M.A., Zbirka rešenih zadataka iz numeričke analize. Naučna knjiga, Beograd, 1985. (Serbian).

[13] Forsythe, G.E., Malcolm, M.A., and Moler, C.B., Computer Methods for Mathematical Computations. Englewood Cliffs, Prentice-Hall, NJ, 1977.

[14] IMSL Math/Library Users Manual , IMSL Inc., 2500 City West Boulevard, Houston TX 77042.

[15] NAG Fortran Library, Numerical Algorithms Group, 256 Banbury Road, Oxford OX27DE, U.K.

Assignment-I :

http://www.dundjer.co.rs/Assignment-I.pdf

2. Linear Systems of Algebraic Equations: Direct Methods

2.1. Elements of matrix calculus
2.1.1. *LR* factorization of quadratic matrix
2.1.2. Matrix eigenvectors and eigenvalues
2.2. Direct methods in linear algebra
2.2.1. Introduction
2.2.2. Gauss elimination with pivoting
2.2.3. Matrix inversion using Gauss method
2.2.4. Factorization methods
2.2.5. Program realization

Bibliography

[1] Milovanović, G.V., Numerical Analysis I, Naučna knjiga, Beograd, 1988 (Serbian).
[2] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu "Edvard Kardelj", Niš, 1981 (Serbian).

(The full list of references and further reading is given on the end of Chapter 3.)

3. Linear Systems of Algebraic Equations: Iterative Methods

3.1. Introduction
3.2. Simple iteration method
3.3. Gauss-Seidel method
3.4. Program realization
3.5. Packages for systems of linear algebraic equations

Bibliography (Cited references and further reading)

[1] Milovanović, G.V., Numerical Analysis I, Naučna knjiga, Beograd, 1988 (Serbian).
[2] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu "Edvard Kardelj", Niš, 1981 (Serbian).
[3] Hoffman, J.D., Numerical Methods for Engineers and Scientists. Taylor & Francis, Boca Raton-London-New York-Singapore, 2001.
[4] Press, W.H., Flannery, B.P., Teukolsky, S.A., and Vetterling, W.T., Numerical Recepies - The Art of Scientific Computing. Cambridge University Press,1989.
[5] Albrecht, J., Fehlerabschätzungen bei Relaxationsverfahren zur numerischen Auflösung linearer Gleichungsysteme. Numer. Math. 3(1961), 188-201.
[6] Apostolatos, N. und Kulisch, Über die Konvergenz des Relaxionsverfahrens bei nicht-negativen und diagonaldominanten Matrizen. Computing 2(1967), 17-24.
[7] Golub, G.H. & Varga, R.S., Chebyshev semi-iterative methods, successive overrelaxation iterative methods and second order Richardson iterative methods. Numer. Math. 3(1961), 147-168.
[8] Soutwell, R.V., Relaxation Methods in Theoretical Physics. 2 vols. Oxford Univ. Press. Fair Lawn., New Jersey, 1956.

[9] Varga, R.S., Matrix Iterative Analysis. Prentice Hall, Englewood Cliffs, New Jersey, 1962.
[10] Young, D.M., Iterative Solution of Large Systems. Academic Press, New York, 1971.
[11] Ralston,A., A First Course in Numerical Analysis. McGraw-Hill, New York, 1965.
[12] Hildebrand, F.B., Introduction to Numerical Analysis. Mc.Graw-Hill, New York, 1974.
[13] Acton, F.S., Numerical Methods That Work (corrected edition). Mathematical Association of America, Washington, D.C., 1990.
[14] Abramowitz, M., and Stegun, I.A., Handbook of Mathematical Functions. National Bureau of Standards, Applied Mathematics Series, Washington, 1964 (reprinted 1968 by Dover Publications, New York).
[15] Rice, J.R., Numerical Methods, Software, and Analysis. McGraw-Hill, New York, 1983.
[16] Forsythe, G.E., Malcolm, M.A., and Moler, C.B., Computer Methods for Mathematical Computations. Englewood Cliffs, Prentice-Hall, NJ, 1977.
[17] Forsythe, G.E., Solving linear algebraic equations can be interesting. Bull. Amer. Math. Soc. 59(1953), 299-329.
[18] Forsythe & Moler, C.B., Computer Solution of Linear Algebraic Systems. Prentice-Hall, Englewood Cliffs, NJ, 1967.
[19] Kahaner, D., Moler, C., and Nash, S., 1989, Numerical Methods and Software. Englewood Cliffs, Prentice Hall, NJ, 1989.
[20] Hamming, R.W., Numerical Methods for Engineers and Scientists. Dover, New York, 1962 (reprinted 1986).
[21] Ferziger, J.H., Numerical Methods for Engineering Applications. Stanford University, John Willey & Sons, Inc., New York, 1998.
[22] Pearson, C.E., Numerical Methods in Engineering and Science. University of Washington, Van Nostrand Reinhold Company, New York, 1986.
[23] Stephenson, G. and Radmore, P.M., Advanced Mathematical Methods for Engineering and Science Students. Imperial College London, University College, London Cambridge Univ. Press, 1999
[24] Milovanović, G.V. and Kovačević, M.A., Zbirka rešenih zadataka iz numeričke analize. Naučna knjiga, Beograd, 1985. (Serbian).
[25] IMSL Math/Library Users Manual , IMSL Inc., 2500 City West Boulevard, Houston TX 77042
[26] NAG Fortran Library, Numerical Algorithms Group, 256 Banbury Road, Oxford OX27DE, U.K.
[27] Dongarra, J.J., et al., LINPACK Users Guide. S.I.A.M., Philadelphia, 1979.
[28] Golub, G.H., and Van Loan,C.F., Matrix Computations, 2nd ed. (Baltimore: Johns Hopkins University Press), 1989.
[29] Gill, P.E., Murray, W., and Wright, M.H., Numerical Linear Algebra and Optimization, vol. 1. Addison-Wesley, Redwood City, CA, 1991.
[30] Stoer, J., and Bulirsch, R., Introduction to Numerical Analysis. Springer-Verlag, New York, 1980.
[31] Coleman, T.F.,and Van Loan,C., Handbook for Matrix Computations. S.I.A.M., Philadelphia, 1988.

[32] Wilkinson, J.H., and Reinsch, C. , Linear Algebra, vol. II of Handbook for Automatic Computation. Springer-Verlag, New York, 1971.
[33] Westlake, J.R. A Handbook of Numerical Matrix Inversion and Solution of Linear Equations. Wiley, New York, 1968.
[34] Johnson, L.W., and Riess, R.D., Numerical Analysis, 2nd ed. Addison-Wesley, Reading, MA, 1982.
[35] Ralston, A., and Rabinowitz, P., A First Course in Numerical Analysis, 2nd ed. McGraw-Hill, New York, 1978.
[36] Isaacson, E., and Keller, H.B., Analysis of Numerical Methods. Wiley, New York, 1966.
[37] Horn,R.A., and Johnson, C.R., Matrix Analysis. Cambridge University Press, Cambridge, 1985.

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4. Eigenvalue Problems

4.1. Introduction
4.2. Localization of eigenvalues
4.3. Methods for dominant eigenvalues
4.4. Methods for subdominant eigenvalues
4.5. Eigenvalue problem for symmetric tridiagonal matrices
4.6. LR and QR algorithms
4.7. Software eigenpackages
4.8. Generalized and nonlinear eigenvalue problems

Bibliography (Cited references and further reading)

[1] Milovanović , G.V., Numerical Analysis I, Naučna knjiga, Beograd, 1988 (Serbian).
[2] Press, W.H., Flannery, B.P., Teukolsky, S.A., and Vetterling, W.T., Numerical Recepies - The Art of Scientific Computing. Cambridge University Press, 1989.
[3] Smith, B.T., et al., Matrix Eigensystem Routines - EISPACK Guide, 2nd ed., vol 6 of Lecture Notes in Computer Science, Springer, New York, 1976.
[4] IMSL Math/Library Users Manual , IMSL Inc., 2500 City West Boulevard, Houston TX 77042
[5] NAG Fortran Library, Numerical Algorithms Group, 256 Banbury Road, Oxford OX27DE, U.K., Chapter F02.
[6] Golub, G.H., and Van Loan, C.F., Matrix Computation, Johns Hopkins University Press, Baltimore 1989.
[7] Wilkinson, The Algebraic Eigenvalue Problem, Oxford University Press, New York, 1965.
[8] Acton, F.S., Numerical Methods that Work, corrected edition, Mathematical Association of America, Chapter 13, Washington, 1970.
[9] Horn, R.A., and Johnson, C.R., Matrix Analysis, Cambridge University Press, Cambridge, 1985.
[10] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu ”Edvard Kardelj”, Niš, 1981 (Serbian).
[11] Parlett, B.N. and Poole, W.G., A geometric theory for the QR, LU, and power iterations. SIAM J. Numer. Anal. 10(1973), 389-412.

[12] Bart, W., Martin, R.S., Wilkonson, J.H. Calculation of the eigenvalues of a symmetric tridiagonal matrix by the bisection method. Numer Math. 9(1967), 386-393.
[13] Wilkinson, J.H. & Reisch, C., Handbook for Automatic Computation. Vol. II Linear Algebra. Springer Verlag, Berlin-Heidelberg-New York, 1971.
[14] Rutishauser, H., Solution of eigenvalue problem with the LR-transformation. Appl. Math. Ser. Nat. Bur. Stand. 49(1958), 47-81.
[15] Francis, J.G.F., The QR transformation - a unitary analogue to the LR transformation. Comput. J. 4(1961/62), 265-271, 332-345.
[16] Kublanovskaya, V.N., O nekotoryh algorifmah dlja rešenija polnoˇi problemy sobstvennyh značeniˇi. ˇZ. Vyčisl. Mat. i Mat. Fiz. 1(1961), 555-570.
[17] Golub, G.H. & Welsch, J.H., Calculation of Gauss quadrature rules. Math. Comp. 23(1969), 221-230.
[18] Bowdler, H., Martin, R.S., Reinsch, C. Wilkinson, J.H., The QR and QL algorithms for symmetric matrices. Numer. Math. 11(1968), 293-306.
[19] Dubrulle, A., Martin, R.S., Wilkinson, J.H., The implicit QR algorithm. Numer. Math. 12(1968), 377-383.
[20] Stoer, J., and Bulirsch, R., Introduction to Numerical Analysis, Springer, New York, 1980.
[21] Mitrinović, D.S. and Djoković, D.ˇZ., Polinomi i matrice. ICS, Beograd, 1975 (Serbian).
[22] Hoffman, J.D., Numerical Methods for Engineers and Scientists. Taylor & Francis, Boca Raton-London-New York-Singapore, 2001.

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5. Nonlinear Equations and Systems of Equations

5.1. Nonlinear equations
5.1.0. Introduction
5.1.1. Newton's method
5.1.2. Bisection method
5.1.3. Program realization
5.2. System of nonlinear equations
5.2.1. Newton-Kantorowitch (Raphson) method
5.2.2. Gradient method
5.2.3. Globally convergent methods

Bibliography (Cited references and further reading)

[1] Milovanović, G.V., Numerical Analysis I, Naučna knjiga, Beograd, 1988 (Serbian).
[2] Hoffman, J.D., Numerical Methods for Engineers and Scientists. Taylor & Francis, Boca Raton-London-New York-Singapore, 2001.
[3] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu "Edvard Kardelj", Niš, 1981 (Serbian).
[4] Stoer, J., and Bulirsch, R., Introduction to Numerical Analysis, Springer, New York, 1980.
[5] Press, W.H., Flannery, B.P., Teukolsky, S.A., and Vetterling, W.T., Numerical Recepies - The Art of Scientific Computing. Cambridge University Press, 1989.
[6] Milovanović, G.V., Stanimirović, P.S., Symbolic Implementation of Nonlinear Optimization. University of Niš, Faculty of Electronic Engineering, Niš, 2002(Serbian).

[7] Djordjević, L.N., An iterative solution of algebraic equations with a parameter to accelerate convergence. Univ. Beograd. Publ. Elektrotehn. Fak.Ser. Mat.Fiz. No. 412- No. 460(1973), 179-182.
[8] Tihonov, O.N., O bystrom vychyslniˇi najbolshih korneˇi mnogočlena. Zap.Leningrad. gorn. in-ta 48, 3(1968), 36-41.
[9] Ostrowski, A., Solution of Equations and System of Equations. Academic Press, New Yurk, 1966.
[10] Wegstein, J.H., Accelerating convergence of iterative processes. Comm. ACM 1 (1958), 9-13.
[11] Ralston, A., A First Course in Numerical Analysis. McGraw-Hill, New York, 1965.
[12] Milovanović, G.V. & Petković, M.S., On some modifications of a third order method for solving equations. Univ. Beograd. Publ. Elektroteh. Fak. Ser. Mat. Fiz. No. 678 - No. 715 (1980), pp. 63-67.
[13] Milovanović, Kovačević, M.A., Two iterative processes of third order without derivatives. IV Znanstveni skup PPPR, Stubičke Toplice, 1982, Proceedings, pp. 63-67 (Serbian).
[14] Varjuhin, V.A. and Kasjanjuk, S.A., Ob iteracionnyh metodah utočnenija korneˇi uravneniˇi. ˇZ. Vychysl. Mat. i Mat. Fiz. 9(1969), 684-687.
[15] Lika, D.K., Ob iteracionnyh metodah viššego porjadka. Dokl. 2-ˇi Nauč.-tehn. respubl. konf. Moldaviˇi. Kishinev, 1965, pp.13-16.
[16] Djordjević, L.N. & Milovanović, G.V., A combined iterative formula for solving equations. Informatika 78, Bled 1978, 3(207).
[17] Petković, M.S., Some iterative interval methods for solving equations.Ph.D. thesis, University Niš, 1980.
[18] Petković, M.S. & Petković, D. Lj., On a method for two-sided approaching for solving equations. Freiburger Intervall-Berichte 10(1980), pp. 1-10.
[19] IMSL Math/Library Users Manual , IMSL Inc., 2500 City West Boulevard, Houston TX 77042
[20] NAG Fortran Library, Numerical Algorithms Group, 256 Banbury Road, Oxford OX27DE, U.K., Chapter F02.
[21] Broyden, C.G., Quasi-Newton methods and their application to function minimization, Math. Comp. 29(1967), 368-381.
[22] Kantorowich, L.V., Funkcional'nyi analiz i prikladnaja matematika., Uspehi Mat. Nauk 3(1948), 89-185.
[23] Ortega, J.M. & Rheinboldt, W.C., Iterative solution of nonlinear equations in several variables, Academic Press, New York, 1970.
[24] Rall, L., Computational solution of nonlinear operator equations, New York, 1969.
[25] Kul'čickiˇi, O.Ju. & šimelevič, L.I., O nahoˇzdeniˇi načal'nogo pribiˇzenija., ˇZ. Vyčisl. Mat. i Mat. Fiz. 14(1974), pp. 1016-1018.
[26] Dennis, J.E. and Schnabel, R.B., Numerical Methods for Unconstrained Optimization and Nonlinear Equations, Englewood Cliffs, NJ: Prentice Hall, 1983.

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Meedterm Test (Exam)

6. Approximation and Interpolation

6.1. Introduction
6.2. Chebyshev systems
6.3. Lagrange's interpolation
6.4. Newton's interpolation with divided differences
6.5. Newton's interpolation formulas

6.6. Spline functions and interpolation by splines
6.7. Prony's interpolation
6.8. Packages for interpolation of functions

Bibliography (Cited references and further reading)

[1] Milovanović, G.V., Numerical Analysis II, Naučna knjiga, Beograd, 1988 (Serbian).
[2] Hoffman, J.D., Numerical Methods for Engineers and Scientists. Taylor & Francis, Boca Raton-London-New York-Singapore, 2001.
[3] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu "Edvard Kardelj", Niš, 1981 (Serbian).
[4] Stoer, J., and Bulirsch, R., Introduction to Numerical Analysis, Springer, New York, 1980.
[5] Press, W.H., Flannery, B.P., Teukolsky, S.A., and Vetterling, W.T., Numerical Recepies - The Art of Scientific Computing. Cambridge University Press, 1989.
[6] Karlin, S. and Studden, W.J., Tchebyshev Systems With Applications in Analysis and Statistics. Interscience Publishers, New York, 1966.
[7] Milovanović, G.V. and Kovačević, M.A., Zbirka rešenih zadataka iz numeričke analize. Naučna knjiga, Beograd, 1985. (Serbian).
[8] Goertzel, G., An algorithm for the evaluation of finite trigonometric series. Amer. Math. Monthly 65(1958).
[9] Cooley, J.W., Lewis, P.A.W,Welch, P.D., Historical notes on the fast Fourier transform. Proc. IEEE 55(1967), 1675-1677.
[10] Cooley, J.W., Tukey, J.W., An algorithm for the machine calculation of complex Fourier series. Math. Comp. 19(1965), 297-301.
[11] Quade,W. and Collatz, L., Zur Interpolationstheorie der reellen periodischen Funktionen. S. - B. Preus. Akad. Wiss. Phys.-Math. Kl. 30(1938), 383-429.
[12] Courant, R., Variational methods for the solution of problem of equilibrium and vibrations. Bull. Amer. Math. Soc. 49(1943), 1-23.
[13] Schoenberg,I.J., Contributions to the problem of approximation of equidistant data by analytic functions. Quart. Appl. Math. 4(1946), 45-99; 112-141.
[14] Prony, R. De, Essai exp´erimentale et analytique... J. Ec. Polytech. Paris 1(2) (1795), 24-76.
[15] Ralston,A., A First Course in Numerical Analysis. McGraw-Hill, New York, 1965.
[16] IMSL Math/Library Users Manual , IMSL Inc., 2500 City West Boulevard, Houston TX 77042
[17] NAG Fortran Library, Numerical Algorithms Group, 256 Banbury Road, Oxford OX27DE, U.K., Chapter F02.

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7. Best Approximation of Functions

7.1. Introduction
7.2. Best L2 approximation
7.3. Best l2 approximation
7.4. Packages for approximation of functions

Bibliography (Cited references and further reading)

[1] Milovanović, G.V., Numerical Analysis II, Naučna knjiga, Beograd, 1988 (Serbian).

[2] Hoffman, J.D., Numerical Methods for Engineers and Scientists. Taylor & Francis, Boca Raton-London-New York-Singapore, 2001.
[3] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu "Edvard Kardelj", Niš, 1981 (Serbian).
[4] Milovanović, G.V., Numerical Analysis I, Naučna knjiga, Beograd, 1988 (Serbian).
[5] Stoer, J., and Bulirsch, R., Introduction to Numerical Analysis, Springer, New York, 1980.
[6] Press, W.H., Flannery, B.P., Teukolsky, S.A., and Vetterling, W.T., Numerical Recepies - The Art of Scientific Computing. Cambridge University Press, 1989.
[7] Milovanović, G.V. and Wrigge, S., Least squares approximation with constraints. Math. Comp. 46(1986), 551-565.
[8] Milovanović, G.V. and Kovačević, M.A., Zbirka rešenih zadataka iz numeričke analize. Naučna knjiga, Beograd, 1985. (Serbian).
[9] D¯ ord¯ević, D¯ .R., Ilić, Z.A., Realization of Stieltjes procedure and Gauss-Christoffel quadrature formulas in system Mathematica. Zb. rad. Gradj.fak. Niš 17(1996), pp. 29-40.
[10] Todd, J., Introduction to the Constructive Theory of Functions. New York, 1963.
[11] Schoenberg,I.J., Contributions to the problem of approximation of equidistant data by analytic functions. Quart. Appl. Math. 4(1946), 45-99; 112- 141.
[12] Ralston,A., A First Course in Numerical Analysis. McGraw-Hill, New York, 1965.
[13] Brass, H., Approximation durch Teilsummen von Orthogonalpolynomreihen. In: Numerical Methods of Approximation Theory (L. Collatz, G. Meinarus, H. Werner, eds.), 69-83, ISNM 52, Birkhäuser, Basel, 1980.
[14] Brass, H., Error estimates for least squares approximation by polynomials. J. Approx. Theory 41(1984), 345-349.
[15] Collatz, L. and Krabs, W., Approximationstheorie. Tschebyscheffsche Ap-
proximation with Anwendungen. B.G. Teubner, Stutgart, 1973.
[16] Davis, P.J., Interpolation and Approximation. Blaisdell Publ. Comp., New York, 1963.
[17] Feinerman, R.P. & Newman, D.J., Polynomial Approximation. Williams &
Wilkins, Baltimore, 1974.
[18] Fox, L. & Parker, I.B., Chebyshev Polynomials in Numerical Analysis.
Oxford Univ. Press, 1972.
[19] Hildebrand, F.B., Introduction to Numerical Analysis.Mc.Graw-Hill, New York, 1974.
[20] Rivlin, T.J., An Introduction to the Approximation od Functions. Dover
Publications, Inc., New York, 1981.
[21] IMSL Math/Library Users Manual , IMSL Inc., 2500 City West Boulevard, Houston TX 77042
[22] NAG Fortran Library, Numerical Algorithms Group, 256 Banbury Road, Oxford OX27DE, U.K., Chapter F02.

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8. Numerical Differentiation and Integration

8.1. Numerical differentiation
8.1.1. Introduction
8.1.2. Formulas for numerical differentiation
8.2. Numerical integration - Quadrature formulas
8.2.1. Introduction
8.2.2. Newton-Cotes formulas
8.2.3. Generalized quadrature formulas
8.2.4. Romberg integration

8.2.5. Program realization
8.2.6. On numerical evaluation of a class of double integrals
8.2.7. Packages for numerical integration

Bibliography (Cited references and further reading)

[1] Milovanović, G.V., Numerical Analysis II, Naučna knjiga, Beograd, 1988 (Serbian).
[2] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu "Edvard Kardelj", Niš, 1981 (Serbian).
[3] Hoffman, J.D., Numerical Methods for Engineers and Scientists. Taylor & Francis, Boca Raton-London-New York-Singapore, 2001.
[4] Press, W.H., Flannery, B.P., Teukolsky, S.A., and Vetterling, W.T., Numerical Recepies - The Art of Scientific Computing. Cambridge University Press, 1989.
[5] Kronrod, A. S., Nodes and Weights of Quadrature Formulas. Consultants Bureau, New York, 1965.
[6] Clenshaw, C.W. and Curtis, A.R., A method for numerical integration on an automatic computer Num. Math. 2(1960), pp. 197–205.
[7] Engels, H., Numerical Quadrature and Cubature. Academic Press, London, 1980.
[8] Abramowitz, M., On the practical evaluation of integrals. SIAM J. Appl. Math. 2(1954)20-35.
[9] Davis, P.J., and P. Rabinowitz, P., Methods of Numerical Integration. Academic Press, New York, 1975.
[10] Krylov, V.I., Approximate Calculation of Integrals. MacMillan, New York, 1962 (Russian, transl. A.H. Stroud).
[11] Stroud, A.H., Approximative Calculation of Multiple Integrals. Prentice-Hall, Englewood Cliffs, N.J. 1971.
[12] Mysovskih, I.P., Interpolyacionnye Kubaturnye Formuly. Nauka, Moskva, 1981.
[13] Stroud, A.H., Gaussian Quadrature Formulas. Prentice Hall, Englewood Cliffs, N.J., 1966.
[14] Ralston,A., A First Course in Numerical Analysis. McGraw-Hill, New York, 1965.
[15] Hildebrand, F.B., Introduction to Numerical Analysis.Mc.Graw-Hill, New York, 1974.
[16] Acton, F.S., Numerical Methods That Work (corrected edition). Mathematical Association of America, Washington, D.C., 1990.
[17] Abramowitz, M., and Stegun, I.A., Handbook of Mathematical Functions.National Bureau of Standards, Applied Mathematics Series, Washington, 1964 (reprinted 1968 by Dover Publications, New York).
[18] Rice, J.R., Numerical Methods, Software, and Analysis. McGraw-Hill, New York, 1983.
[19] Forsythe, G.E., Malcolm, M.A., and Moler, C.B., Computer Methods for Mathematical Computations. Englewood Cliffs, Prentice-Hall, NJ, 1977.
[20] Kahaner, D., Moler, C., and Nash, S., 1989, Numerical Methods and Software. Englewood Cliffs, Prentice Hall, NJ, 1989.
[21] Hamming, R.W., Numerical Methods for Engineers and Scientists. Dover, New York, 1962 (reprinted 1986).
[22] Ferziger, J.H., Numerical Methods for Engineering Applications. Stanford University, John Willey & Sons, Inc., New York, 1998.
[23] Pearson, C.E., Numerical Methods in Engineering and Science. University of Washington, Van Nostrand Reinhold Company, New York, 1986.
[24] Stephenson, G. and Radmore, P.M., Advanced Mathematical Methods for Engineering and Science Students. Imperial College London, University College, London Cambridge Univ. Press, 1999.
[25] Milovanović, G.V. and Kovačević, M.A., Zbirka rešenih zadataka iz numeričke analize. Naučna knjiga, Beograd, 1985. (Serbian).
[26] IMSL Math/Library Users Manual , IMSL Inc., 2500 City West Boulevard, Houston TX 77042.

[27] NAG Fortran Library, Numerical Algorithms Group, 256 Banbury Road, Oxford OX27DE, U.K.
[28] Piessens, R., de Doncker-Kapenga, E., überhuber, C.W., Kahaner, D.K., QUAD-PACK, A Subroutine Package for Automatic Integration. Springer-Verlag, Berlin, 1983.
[29] Laurie, D. P., Algorithm 584 CUBTRI: Automatic cubature over a triangle. ACM Trans. Math. Software 8(1982), 210.–218.
[30] Stoer, J., and Bulirsch, R., Introduction to Numerical Analysis. Springer-Verlag, New York, 1980.
[31] Johnson, L.W., and Riess, R.D., Numerical Analysis, 2nd ed. Addison-Wesley, Reading, MA, 1982.
[32] Ralston, A., and Rabinowitz, P., A First Course in Numerical Analysis, 2nd ed. McGraw-Hill, New York, 1978.
[33] Isaacson, E., and Keller, H.B., Analysis of Numerical Methods. Wiley, New York, 1966.

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9. Ordinary Differential Equations - ODE

Bibliography (Cited references and further reading)

[1] Milovanović, G.V., Numerical Analysis III, Naučna knjiga, Beograd, 1988 (Serbian).
[2] Milovanović, G.V., Numerical Analysis I, Naučna knjiga, Beograd, 1988 (Serbian).
[3] Hoffman, J.D., Numerical Methods for Engineers and Scientists. Taylor & Francis, Boca Raton-London-New York-Singapore, 2001.
[4] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu "Edvard Kardelj", Niš, 1981 (Serbian).
[5] Milovanović, G.V., Numerical Analysis II, Naučna knjiga, Beograd, 1988 (Serbian).
[6] Bertolino, M., Numerička analiza, Beograd, 1977.
[7] Runge, C., ¨ Uber die numerische Auflösung von Differentialgleichungen, Math. Ann. 46(1985), 167-178.
[8] Kutta, W., Beitrag zur Näherungsweisen Integration totaler Differentialgleichungen, Z. Math. Phys. 46(1901), 435-453.
[9] Neun, K., Neue Methode zur approximativen Integration der Differentialgleichungen einer unabhängigen Veränderlichen, Z. Math. Phys.
45(1900), 23-38.
[10] Gill, S., A Process for the step-by-step integration of differential equations in an automatic computing machine, Proc. Cambridge Phil. Soc. 47(1951), 96-108.
[11] Stoer, J., and Bulirsch, R., Introduction to Numerical Analysis, Springer,New York, 1980.

[12] Press, W.H., Flannery, B.P., Teukolsky, S.A., and Vetterling, W.T., Numerical Recepies - The Art of Scientific Computing. Cambridge University Press, 1989.
[13] Milovanović, G.V. and Kovačević, M.A., Zbirka rešenih zadataka iz numeričke analize. Naučna knjiga, Beograd, 1985. (Serbian).
[14] Ralston,A., A First Course in Numerical Analysis. McGraw-Hill, New York, 1965.
[15] Hildebrand, F.B., Introduction to Numerical Analysis. Mc.Graw-Hill, New York, 1974.
[16] Gear, C.W., Numerical Initial Value Problems in Ordinary Differential Equations. Englewood Cliffs, NJ: Prentice-Hall, 1971.
[17] Acton, F.S., Numerical Methods That Work (corrected edition). Mathematcal Association of America, Washington, D.C., 1990.
[18] Lambert, J., Computational Methods in Ordinary Differential Equations, Wiley, New York, 1973.
[19] Lapidus, L., and Seinfeld, J., Numerical Solution of Ordinary Differential Equations, Academic Press, New York, 1971.
[20] Abramowitz, M., and Stegun, I.A., Handbook of Mathematical Functions.National Bureau of Standards, Applied Mathematics Series, Washington, 1964(reprinted 1968 by Dover Publications, New York).
[21] Rice, J.R., Numerical Methods, Software, and Analysis. McGraw-Hill, New York, 1983.
[22] Forsythe, G.E., Malcolm, M.A., and Moler, C.B., Computer Methods for Mathematical Computations. Englewood Cliffs, Prentice-Hall, NJ, 1977.
[23] Kahaner, D., Moler, C., and Nash, S., 1989, Numerical Methods and Software. Englewood Cliffs, Prentice Hall, NJ, 1989.
[24] Hamming, R.W., Numerical Methods for Engineers and Scientists. Dover, New York, 1962 (reprinted 1986).
[25] IMSL Math/Library Users Manual , IMSL Inc., 2500 City West Boulevard, Houston TX 77042
[26] NAG Fortran Library, Numerical Algorithms Group, 256 Banbury Road, Oxford OX27DE, U.K., Chapter F02.

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10. Partial Differential Equations – PDE

10.1. Introduction
10.2. Grid method
10.3. Laplace equation
10.4. Wave equation
10.5. Packages for PDEs

Bibliography (Cited references and further reading)

[1] Milovanović, G.V., Numerical Analysis III, Naučna knjiga, Beograd, 1988 (Serbian).
[2] Milovanović, G.V., Numerical Analysis I, Naučna knjiga, Beograd, 1988 (Serbian).
[3] Hoffman, J.D., Numerical Methods for Engineers and Scientists. Taylor & Francis, Boca Raton-London-New York-Singapore, 2001.
[4] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu ”Edvard Kardelj”, Niš, 1981 (Serbian).
[5] Milovanović, G.V., Numerical Analysis II, Naučna knjiga, Beograd, 1988 (Serbian).
[6] Stoer, J., and Bulirsch, R., Introduction to Numerical Analysis, Springer, New York, 1980.
[7] Press, W.H., Flannery, B.P., Teukolsky, S.A., and Vetterling, W.T., Numerical Recepies - The Art of Scientific Computing. Cambridge University Press,1989.
[8] Milovanović, G.V. and Kovačević, M.A., Zbirka rešenih zadataka iz numeričke analize. Naučna knjiga, Beograd, 1985. (Serbian).
[9] Ralston,A., A First Course in Numerical Analysis. McGraw-Hill, New York, 1965.

[10] Hildebrand, F.B., Introduction to Numerical Analysis.Mc.Graw-Hill, New York, 1974.
[11] Acton, F.S., Numerical Methods That Work (corrected edition). Mathematical Association of America, Washington, D.C., 1990.
[12] Abramowitz, M., and Stegun, I.A., Handbook of Mathematical Functions.
National Bureau of Standards, Applied Mathematics Series, Washington, 1964
(reprinted 1968 by Dover Publications, New York).
[13] Rice, J.R., Numerical Methods, Software, and Analysis. McGraw-Hill, New York, 1983.
[14] Forsythe, G.E., Malcolm, M.A., and Moler, C.B., Computer Methods for Mathematical Computations. Englewood Cliffs, Prentice-Hall, NJ, 1977.
[15] Kahaner, D., Moler, C., and Nash, S., 1989, Numerical Methods and Software. Englewood Cliffs, Prentice Hall, NJ, 1989.
[16] Hamming, R.W., Numerical Methods for Engineers and Scientists. Dover, New York, 1962 (reprinted 1986).
[17] Ferziger, J.H., Numerical Methods for Engineering Applications. Stanford University, John Willey & Sons, Inc., New York, 1998
[18] Pearson, C.E., Numerical Methods in Engineering and Science. University of Washington, Van Nostrand Reinhold Company, New York, 1986.
[19] Stephenson, G. and Radmore, P.M., Advanced Mathematical Methods for
Engineering and Science Students. Imperial College London, University College, London Cambridge Univ. Press, 1999
[20] Ames, W.F., Numerical Methods for Partial Differential Equations. 2nd ed. Academic Press, New York, 1977.
[21] Richtmyer, R.D. and Morton, K.W., Difference Methods for Initial Value Problems. 2nd ed., Wiley-Interscience, New York, 1967.
[22] Mitchell, A.R., and Griffiths, D.F. , The Finite Difference Method in Partial Differential Equations., Wiley, New York, 1980.
[23] IMSL Math/Library Users Manual , IMSL Inc., 2500 City West Boulevard, Houston TX 77042
[24] NAG Fortran Library, Numerical Algorithms Group, 256 Banbury Road, Oxford OX27DE, U.K., Chapter F02.

Assignment-X: http://www.dundjer.co.rs/Assignment-X.pdf

11. Integral Equations

11.1. Introduction
11.2. Method of successive approximations
11.3. Application of quadrature formulas
11.4. Program realization

Bibliography (Cited references and further reading)

[1] Milovanović, G.V., Numerical Analysis III, Naučna knjiga, Beograd, 1988 (Serbian).
[2] Milovanović, G.V., Numerical Analysis I, Naučna knjiga, Beograd, 1988 (Serbian).
[3] Milovanović, G.V. and Djordjević, Dj.R., Programiranje numeričkih metoda na FORTRAN jeziku. Institut za dokumentaciju zaštite na radu ”Edvard Kardelj”, Niš, 1981 (Serbian).
[4] Milovanović, G.V., Numerical Analysis II, Naučna knjiga, Beograd, 1988 (Serbian).
[5] Press, W.H., Flannery, B.P., Teukolsky, S.A., and Vetterling, W.T., Numerical Recepies - The Art of Scientific Computing. Cambridge University Press, 1989.
[6] Delves, L.M., and Mohamed,J.L.,Computational Methods for Integral Equations. Cambridge University Press, Cambridge, 1985.

[7] Linz, P., Analytical and Numerical Methods for Volterra Equations. S.I.A.M., Philadelphia:, 1985.
[8] Atkinson, K.E., A Survey of Numerical Methods for the Solution of Fredholm Integral Equations of the Second Kind. S.I.A.M., Philadelphia, 1976.
[9] Smithies, F., Integral Equations. Cambridge University Press, Cambridge,1958.
[10] Kanwal, R.P., Linear Integral Equations. Academic Press, New York, 1971.
[11] Green, C.D., Integral Equation Methods , Barnes & Noble, New York, 1969,
[12] Stoer, J., and Bulirsch, R., Introduction to Numerical Analysis, Springer, New York, 1980.
[13] Ralston,A., A First Course in Numerical Analysis. McGraw-Hill, New York, 1965.
[14] Hildebrand, F.B., Introduction to Numerical Analysis. Mc.Graw-Hill, New York, 1974.
[15] Acton, F.S., Numerical Methods That Work (corrected edition). Mathematical Association of America, Washington, D.C., 1990.
[16] Kahaner, D., Moler, C., and Nash, S., 1989, Numerical Methods and Software. Englewood Cliffs, Prentice Hall, NJ, 1989.
[17] IMSL Math/Library Users Manual , IMSL Inc., 2500 City West Boulevard, Houston TX 77042
[18] NAG Fortran Library, Numerical Algorithms Group, 256 Banbury Road, Oxford OX27DE, U.K., Chapter F02.

Assignment-XI: http://www.dundjer.co.rs/Assignment-XI.pdf

Appendices

A.1. Equations of Technical Physics http://www.dundjer.co.rs/ETPH.pdf

A.2. Special Functions http://www.dundjer.co.rs/SPEC.pdf

A.3. Numerical Methods in FEM . . http://www.dundjer.co.rs/NMFEM.pdf

A.4. Numerical Methods in Informatics
http://www.dundjer.co.rs/NMINF.pdf

Final Test (Exam)

9. INTRODUCTION TO MATLAB IN COMPUTATIONAL ENGINEERING

Đorđe Đorđević[27], Dragoslav Stojić[28], Miomir Stanković[29]

Summary: *Two projects, first approved by EU (SMART4NZEB - EASME COSME COS-CLUSTER-2018-3-02 SMART4NZEB No. 874425) and second by City of Nis (KLERP No. 4939/2019-01 - Internationa Industrial Cooperation of Clusters of South-East Europe as Tool for Development of Educational-Business Tourism of City of Niš), initiated establishing new system for non-formal education, mainly oriented to energy efficiency, ecological building, and solar energy. These three fields are recognized as very prosperitive and promissing in construction sector. In addition to basic mathematical education and basic sotware for design in building construction, R/D activities suggested need for software for supporing engineering mathematics. This paper is giving support and description of MATLAB language, that prevailed nowadays among this kind of software. International industrial cooperation of clusters of South-East Europe, in addition to strict industrial outcomes, has important influence on educational cooperation of all partners, – clusters from Romania, Poland, and Slovebia. The main objective of this cooperation is to create a sustainable collaboration, co-learning and capacity building between the involved partners - cluster managers, cluster members and relevant stakeholders representative for the nZEB market in the selected Central and East-European countries. In order to realise this goal, the improved theoretical and practical background of all partners is necessary. This paper has to enhance course entitled „Numerical Methods in Computational Engineering" by programming the given algorithms in MATLAB. The curricila presented here could cover almost all needs not only in research, development and engineering practice, but also management and control in building construction.*

Key words: *MATLAB, Numerical Methods in Matlab, Numerical Mathematics, Aplied Mathematics, Computational Engineering with Matlab, Numerical Algorithms*

Rezime*: Dva projekta, prvi odobren od EU (SMART4NZEB - EASME COSME COS-CLUSTER-2018-3-02 SMART4NZEB No. 874425) i drugi, odobren od Grada Niša (KLERP No. 4939/2019-01 - Internationa Industrial Cooperation of Clusters of South-East Europe as Tool for Development of Educational-Business Tourism of City of Niš), inicirali su formiranje novog sistema neformalnog obrazovanja, sa orijentacijom na energetsku efikasnost, ekološku gradnju i solarnu energiju. Ove tri oblasti su označene kao vrlo perspektivne i obećavajuće u gradjevinskom sektoru. Uz osnovno matematičko obrazovanje i osnovnog sofvera za projektovanje gradjevinskih konstrukcija, aktivnosti u oblasti istraživanja i razvoja izražavaju potrebu za upotrebu softvera za inženjersku matematiku. Ovaj prilog opisuje jezik MATLAB, koji je dominantan u toj oblasti. Medjunarodna industrijska saradnja klastera Jugoistočne Evrope, pored direktnih industrijskih rezultata, ima značajan uticaj na saradnju u oblasti obrazovanja svih partnera – klastera iz Rumunije, Poljske i Slovenije. Glavni cilj ove saradnje je ispostavljanje održivog partnerstva, uzajamne obuke i izgradnje kapaciteta izmedju uključenih partnera – menadžera klastera, članova klastera i značajnih činilaca na tržištu koje pokriva potrebe gradnje sa zahtevima minimalne potrošnje energije u zemljama Jugoistočne Evrope. Za realizovanje tog cilja neophodna su napredna teoretska i praktična znanja svih partnera. Ovaj kurs treba da dopuni kurs pod nazivom „Numerical Methods in Computational Engineering" programiranjem datih algoritama u MATLAB jeziku. Program kursa prezentiran ovde trebalo bi da pokrije sve potrebe ne samo istraživanja, razvoja i inženjerske prakse, već i menadžmenta i kontrole u gradjevinskim objektima.*

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[28] Faculty of Civil Engineering and Architecture, University Niš, Serbia;

[29] Mathematical Institute of Serbian Academy of Science, Belgrade, Serbia.

***Ključne reči**: MATLAB**,** Numeričke metode u Matlabu, Numerička matematika, Primenjena matematika, Računarsko projektovanje, Numerički algoritmi*

0. INTRODUCTION

MATLAB is high performance programming language devoted to engineering computations. It integrates computation, visualization and programming into the simple unit that is easy used with results given in known mathematical notation. Typical uses of program are:

- Mathematical performing and computations;
- Algorithms development;
- Modelling, simulation, and prototipe design;
- Data analysis, surway and visualisation;
- Scientific and engineering graphics;
- Development of different aplications, including graphic interface design.

MATLAB is interactive system with basic data element array without dimensioning. This enabled the solution of many engineering computing problems, especialy those with matrix and vector formulation, much faster than using programming by scalar non-interactive languages like C or Fortran.
The name MATLAB originates from shortage for *matrix laboratory*. MATLAB is designed in order to enable easy access to matrix software developed by projects LINPACK and EISPACK. Later on, MATLAB used sofware developed by projects LAPACK and ARPACK, which in common are extraordinary software for matrix calculations.
MATLAB itself developed from many sources. In the academy environment it is standard program for basic and advanced subjects in mathematics. In industry, MATLAB is tool for high productivity research, development and several analyses.
MATLAB contains groups of specific software solutions named *Toolboxes*. For majority of MATLAB they enable training in specialized technology. *Toolboxes* are sophisticated collections of MATLAB functions (m-files) which enlarged MATLAB environment in order to solve some classess of problems. These areas include signal processing, control systems, neural networks, fuzzy logic, waves, simulations and many others.

MATLAB system contains 5 main elements:

1. **Development environment.** That is collection of tools and means which enables use of MATLAB functions and files. Many of those tools are graphical interfaces. It includes MATLAB desktop and command windows, command history as well as browser for help in work, working space, files, and search path.

2. **MATLAB library of mathematical functions.** It is big collection of computational algorithms from elementary functions as Sum, Sin, Cos, until sophisticated functions as matrix inversion, eigenvalues, Bessel finction, Fast Furie Transformation (FFT).

3. **MATLAB language.** It is high level language for matrix/arrays with commands for execution control, functions, data structures, I/O, as well as abilities for object oriented programming. It enables design of small programes – applications and complex programming tools for design of big and complex appication programs.

4. **Hadle Graphics.** This is MATLAB graphical system. It includes high level commands for 2D and 3D data visualization, image processing, animation and graphics for presentation. It includes low level commands that enables full functional adaptation of graphical modules and design of complete graphical interface for MATLAB applications.

5. **MATLAB Aplication Program Interface (API).** This is library which enables programming in C and Fortran languages in accordance with MATLAB. It enables routine calls from MATLAB (dynamic linking), where MATLAB is called as computationa engine, and readind and writing MAT-files.

LANGUAGE of course: English/Serbian

TARGET GROUP: Mathematicians, Engineers, Scientists, Designers, R/D teams.

REQUIREMENTS: Basic mathematical knowledge, engineering knowledge, basic programing knowledge.

1. LESSON 1: An Overview of MATLAB

a. 1.1 MATLAB Interactive Sessions

Conventions; Starting MATLAB; Entering Commands and Expressions; Order of Precedence; The Assignment Operator; Variable Names; Managing the Work Session; Tab and Arrow Keys; Deleting and Clearing; Predefined Constants; Complex Number Operations; Formatting Commands.

b. Menus and the Toolbar

The Desktop Menus; The File Menu in MATLAB; The Edit Menu in MATLAB.

c. Arrays, Files, and Plots

Arrays; Polynomial Roots; Working with Files; Saving and Retrieving Your Workspace Variables (Directories and Path, Working with Removable Disks); Plotting with MATLAB.

d. Script Files and the Editor/Debugger

Creating and Using a Script File; Effective Use of Script Files; Debugging Script Files; Programming Style; Controlling Input and Output; Steps for Obtaining a Computer Solution.

e. The MATLAB Help System

The Help Browser; Viewing Documentation; Using the Contents Tab; Using the Index Tab; Using the Search Tab; Help Functions.

f. Summary

- Starting and exiting MATLAB,
- Computing simple mathematical expressions,
- Managing variables.
- Using arrays and polynomials,
- Creating plots,
- Creating script files

g. Problems

2. LESSON 2: Numeric, Cell, and Structure Arrays

2.1 One- and Two-Dimensional Numeric Arrays

Creating Vectors in MATLAB; Two-Dimensional Arrays; Creating Matrices; Matrices and the Transpose Operation; Array Addressing; Using clear to Avoid Errors; Some Useful Array Functions; The Array Editor.

2.2 Multidimensional Numeric Arrays

2.3 Element-by-Element Operations

Array Addition and Subtraction; Element-by-Element Multiplication; Vectored Functions; Element-by-Element Division; Element-by-Element Exponentiation.

2.4 Matrix Operations

Multiplication of Vectors; Vector-Matrix Multiplication; Matrix-Matrix Multiplication; Evaluating Multivariable Functions; The General Matrix Multiplication Case; Special Matrices; Matrix Division and Linear Algebraic Equations; Matrix Exponentiation; Special Products.

2.5 Matrix Methods for Linear Equations

Matrix Inverse; Existence and Uniqueness of Solutions; The Left Division Method; Underdetermined Systems; The pinv Function and the Euclidean Norm; The Reduced Row Echelon Form; Supplementing Underdetermined Systems; Overdetermined Systems.

2.6 Polynomial Operations Using Arrays

Polynomial Addition and Subtraction; Polynomial Multiplication and Division; Plotting Polynomials.

2.7 Cell Arrays

Creating Cell Arrays; Accessing Cell Arrays.

2.8 Structure Arrays

Creating Structures; Accessing Structure Arrays; Modifying Structures; Using Operators and Functions with Structures.

2.9 Summary

■ Create, address, and edit arrays.
■ Perform array operations including addition, subtraction, multiplication, division, and exponentiation.
■ Perform matrix operations including addition, subtraction, multiplication, division, and exponentiation.
■ Solve linear algebraic equations.
■ Perform polynomial algebra.
■ Create databases using cell and structure arrays.

2.10 Problems

3. LESSON 3: Functions and Files

3.1 Elementary Mathematical Functions

Exponential and Logarithmic Functions; Complex Number Functions; Numeric Functions; Function Arguments; Function Arguments; Hyperbolic Functions.

3.2 User-Defined Functions

Some Simple Function Examples; Variations in the Function Line; Variations in Function Calls; Local Variables; Global Variables; Function Handles; Function Functions; Finding the Zeros of a Function; Minimizing a Function of One Variable; Minimizing a Function of Several Variables.

3.3 Additional Function Topics

Methods for Calling Functions; Types of Functions; Anonymous Functions; Multiple-Input Arguments; Calling One Function within Another; Variables and Anonymous Functions; Subfunctions; Nested Functions; Private Functions.

3.4 Working with Data Files

Importing Spreadsheet Files; The Import Wizard; Exporting ASCII Data Files.

3.5 Summary

3.6 Problems

4. LESSON 4: Decision-Making Programs

4.1 Relational Operators and Logical Variables

The logical Class; The logical Function; Accessing Arrays Using Logical Arrays.

4.2 Logical Operators and Functions

Short-Circuit Operators; Logical Operators and the find Function.

4.3 Conditional Statements

The else Statement; The elseif Statement; Checking the Number of Input and Output Arguments; Strings and Conditional Statements; Solving Sets of Equations.

4.4 Loops

for Loops; The break and continue Statements; Using an Array as a Loop Index; Use of Logical Arrays as Masks; while Loops.

4.5 The switch Structure

4.6 Debugging MATLAB Programs

Cell Mode; The Debug Menu; Using Breakpoints.

4.7 Summary

4.8 Problems

Midterm Test (Exam)

5. LESSON 5: Advanced Plotting and Model Building

5.1 xy Plotting Functions

grid and axis Commands; Plots of Complex Numbers; The Function Plot Command fplot; Plotting Polynomials; Saving Figures; Exporting Figures.

5.2 Additional Commands and Plot Types

Subplots; Overlay Plots; Data Markers and Line Types; Labeling Curves and Data; The hold Command; Annotating Plots; Logarithmic Plots; Stem, Stairs, and Bar Plots; Separate y-Axes; Polar Plots; Publishing Reports Containing Graphics.

5.3 Interactive Plotting in MATLAB

The Figure Window; The File Menu; The Edit Menu; The View Menu; The Insert Menu; The Tools Menu; Other Menus; The Figure Toolbar; The Plot Edit Toolbar; The Plot Tools; The Figure Palette; The Plot Browser; The Property Editor; Recreating Graphs from M-Files.

5.4 Function Discovery

- The linear function;
- The power function;
- The exponential function;
- Solution.

5.5 Regression

The Least Squares Method; Fitting Other Functions; The Quality of a Curve Fit; Scaling the Data; Using Residuals; Multiple Linear Regression; Linear-in-the-Parameters Regression.

5.6 The Basic Fitting Interface

- Fit data using a cubic spline or a polynomial up to degree 10.
- Plot multiple fits simultaneously for a given data set.
- Plot the residuals.
- Examine the numerical results of a fit.
- Interpolate or extrapolate a fit.
- Annotate the plot with the numerical fit results and the norm of residuals.
- Save the fit and evaluated results to the MATLAB workspace.

5.7 Three-Dimensional Plots

Three-Dimensional Line Plots; Surface Mesh Plots; Contour Plots.

5.8 Summary

- Label each axis with the name of the quantity being plotted and its units!
- Use regularly spaced tick marks at convenient intervals along each axis.
- If you are plotting more than one curve or data set, label each on its plot or use a legend to distinguish them.

■ If you are preparing multiple plots of a similar type or if the axes' labels cannot convey enough information, use a title.
■ If you are plotting measured data, plot each data point in a given set with the same symbol, such as a circle, square, or cross.
■ If you are plotting points generated by evaluating a function (as opposed to measured data), do not use a symbol to plot the points. Instead, connect the points with solid lines.

5.9 Problems

6. LESSON 6: Statistics, Probability, and Interpolation

6.1 Statistics and Histograms

6.2 The Normal Distribution

Scaled Frequency Histogram; Continuous Approximation to the Scaled Histogram; Sums and Differences of Random Variables.

6.3 Random Number Generation

Uniformly Distributed Numbers; Normally Distributed Random Numbers; Functions of Random Variables.

6.4 Interpolation

One-Dimensional Interpolation; Two-Dimensional Interpolation; Cubic-Spline Interpolation; Interpolation with Hermite Polynomials;

6.5 Summary

■ Solve basic problems in statistics and probability.
■ Create simulations incorporating random processes.
■ Apply interpolation to data.

6.6 Problems

7. LESSON 7: Numerical Methods for Calculus and Differential Equations

8.1 Numerical Integration

Trapezoidal Integration; Quadrature Functions; Polynomial Integration; Triple Integrals.

8.2 Numerical Differentiation

The diff Function; Polynomial Derivatives; Gradients'

8.3 First-Order Differential Equations

ordinary differential equation (ODE); The Euler Method; The Predictor-Corrector Method; Runge-Kutta Methods; MATLAB ODE Solvers.

8.4 Higher-Order Differential Equations

8.5 Special Methods for Linear

8.6 Equations

Matrix Methods; Characteristic Roots from the eig Function; ODE Solvers in the Control System Toolbox; Linear ODE Solvers; The initial Function; The impulse Function; The step Function; The lsim Function.

8.7 Summary

■ Numerically evaluate single, double, and triple integrals whose integrands are given functions.
■ Numerically evaluate single integrals whose integrands are given as numerical values.
■ Numerically estimate the derivative of a set of data.
■ Compute the gradient and Laplacian of a given function.
■ Obtain in closed form the integral and derivative of a polynomial function.
■ Use the MATLAB ODE solvers to solve single first-order ordinary differential equations whose initial conditions are specified.
■ Convert higher-order ordinary differential equations into a set of first-order equations.
■ Use the MATLAB ODE solvers to solve sets of higher-order ordinary differential equations whose initial conditions are specified.
■ Use MATLAB to convert a model from transfer function form to state-variable form, and vice versa.
■ Use the MATLAB linear solvers to solve linear differential equations to obtain the free response and the step response for arbitrary forcing functions.

8.8 Problems

8. LESSON 8: Symbolic Processing

8.1 Symbolic Expressions and Algebra

Symbolic Expressions; Manipulating Expressions; Evaluating Expressions; Order of Precedence.

8.2 Algebraic and Transcendental Equations

8.3 Calculus

The diff function; Integration; Taylor Series. Limits.

8.4 Differential Equations

Solving a Single Differential Equation; Solving Sets of Equations; Specifying Initial and Boundary Conditions; Solving Nonlinear Equations.

8.5 Laplace Transforms

Laplace(function); The inverse Laplace transform; Application to Differential Equations; Input Derivatives; Direct Method.

8.6 Symbolic Linear Algebra 380

Characteristic Polynomial and Roots; Solving Linear Algebraic Equations.

8.7 Summary

■ Create symbolic expressions and manipulate them algebraically.

■ Obtain symbolic solutions to algebraic and transcendental equations.
■ Perform symbolic differentiation and integration.
■ Evaluate limits and series symbolically.
■ Obtain symbolic solutions to ordinary differential equations.
■ Obtain Laplace transforms.
■ Perform symbolic linear algebra operations, including obtaining expressions for determinants, matrix inverses, and eigenvalues.

8.8 Problems

Final Test (Exam)

REFERENCES

[1] William J. Palm III: *A Concise Introduction to MATLAB,McGraw-Hill, New York, 2008.*
[2] Milovanović, G.V., Djordjević, Dj.R.: Numerical Methods in Computational Engineering, University of Niš, Faculty of Civil Engineering and Architecture, Niš, 2008.

DODATAK

PLANOVI I PROGRAMI OBUKA

10. APPLICATION OF INFRARED THERMOGRAPHY IN ENERGY EFFICIENCY

Dragan Mančić

Title of the training programme	Application of infrared thermography in energy efficiency
Organization (training provider)	University of Nis, Faculty of Electronic Engineering
Type of training event	• Seminar with a workshop • Workshop • Lecture • Webinar • Long-term distance learning program (from few months to a year) • 1-2 days training
Objectives of the module (2-3 short paragraphs)	Acquiring the fundamental knowledge about: Thermovision; Practical application of a thermal imaging camera.
What will the participants know after completing the training?	After completing this course, they will know to process thermal images using software, and use thermal imaging camera for: Thermal imaging inspection of energy efficiency of buildings. Thermal imaging inspection of the power grid. Thermal imaging inspection of a thermal pipeline system. Optional: Thermal imaging inspection of electronic devices. Thermal imaging inspection of patients in medicine.
What new competencies will they acquire?	Theoretical knowledge on the fundamentals of thermovision. Mastering the technique of recording and interpretation of the results of thermal imaging inspections.
Who is the main target group for the training programme?	Participants involved in energy efficiency in various areas.
Who else could attend the training programme?	Researchers in the field of medicine and veterinary medicine.
Module content (describe the main content of the module in 8-12 indents)	Introduction to thermal imaging. Theory of infrared radiation. Detection of infrared radiation and temperature measurement. Devices for temperature measurement. Operation principle and types of thermal imaging cameras. Practical aspects of thermal imaging cameras. Application of thermal imaging in preventive maintenance and testing in various areas. Processing and analysis of thermal images.
Type of work (lecture, individual work, case study, pair and team work, etc.)	*Lectures and practical exercises.*
Equipment needed (projector, internet, whiteboard, ...)	*Projector*
Duration of the training program	1 day
Activities following the	

training program implemented (if any)	
Additional options (such as event extension if needed)	
Later options	
Lecturer or. facilitator of the training programme *(add a new row if there are more lecturers)*	Dragan Mančić. Received the B.S., M.S., and Ph.D. degrees in electrical engineering from the University of Niš, Niš, Serbia, in 1991, 1995 and 2002, respectively. He is a Full Professor with the Department of Electronics, Faculty of Electronic Engineering, University of Niš, where he lectures in thermovision, power electronics, alternative sources of energy, and ultrasonic techniques. His current research interests include thermography, power converters, and modeling and design of power ultrasonics and solar systems. https://www.npao.ni.ac.rs/elektronski-fakultet/682-dragan-mancic.
Lecturer or. facilitator of the training programme *(add a new row if there are more lecturers)*	Igor Jovanović. Received the B.S. and Ph.D. degrees in electrical engineering from the University of Niš, Niš, Serbia, in 2008 and 2018, respectively. At the moment, he is a teaching associate at the Department of Electronics, Faculty of Electronic Engineering, University of Niš. His current research interests include thermography, the characterization of piezoelectric materials, modeling and design of power ultrasonic transducers, and alternative sources of energy. https://www.npao.ni.ac.rs/elektronski-fakultet/628-igor-jovanovic.

11. BUSINESS MODEL DESIGN AND INNOVATION FOR CLUSTER ORGANIZATION

Andro Goblon

Title of the training programme	**Business Model design and innovation for cluster organization**
training provider	Slovenski gradbeni grozd (Construction Cluster of Slovenia)
Type of training event	• Seminar with a workshop
Objectives of the module (2-3 short paragraphs)	Evaluation of existing business models in organization (cluster, SME, other organizations). Business Model Innovation. Understanding of business model, ability for adapting on unpredicted impacts, ability for understanding different possible scenarios of which the company, cluster or other type of organization should follow in the future, seing the new possible streams of revenue, etc., are foundations for the longevity of the company, cluster, organization and personal business or career. As a external consultants we can see the situation different as compared to owners or employees of the company, cluster or other type of organization. Seeing from different perspective almost always lead to unlocking the new opportunities, which were not seen before, due to day by day routine and sometimes also due to believes of what is possible and what not. See what the previous clients said about the help of business modeling, on the reccomendation section on the Linkedin profile https://www.linkedin.com/in/androgoblon/
What will the participants know after completing the training?	This practical oriented and intensive two days workshop is aiming to lead attendees to create and build strong business models that will be able to competein todays daily changing business, societal, political and technological environment. Attendees will learn how to easily visualize your present business models and what measures or changes could be done to improve them. The goal in this step is better understanding of their customers and why they are willing to buy products or services they offer. They will also learn techniques of how to to develope or prototype of business ideas and how to in short period of time and with low costs evaluate them.
What new competencies will they acquire?	Participants will understand, what their present and potential customers really need and want and how to serve them better solving their real problems. They will be able to develop and evaluate a range of business models to fit their existing and future situation using the modern business model visualization tools.

	They will prepare one or more business models for their organization and co create the common cluster business model with competitive differentiation based on your interests and market needs
Who is the main target group for the training programme?	The workshop is aimed at • Clusters (cluster offices) Attendees should include persons who have responsibility for sales, product development, marketing, business strategy, research and similar positions and all other interested in the topic.
Who else could attend the training programme?	• Companies developing their business model(s) and looking to maximise market impact, profitability and scale up; • Companies which already have business models (a good opportunity to evaluate them and explore opportunities to enter new markets, establish new revenue streams and or prototype possible new innovative business models). • Other type of organizations Individuals who want better understand of their work and to make positive changes in their careers. Local public authorities (Municipalities, public services, schools, etc.).
Module content (describe the main content of the module in 8-12 indents)	Day 1: 9:00 – 17:30 The aim of the first day is to revise the current business model of each company attending. Attendees will be guided and consulted to design and present their current business models. They will assess the value proposition of their current offer and jobs to be done f or their customers. Following the new findings and insights, based on redefined value proposition, they will redesign the current business models, taking into account also possible new key resurces, activities, partners, revenue streams and distribution and communication channels for implementing the new solutions. They will also rethink the customer relationships in order to design more atractive value proposition. The day will be highly interactive, with each company developing one or more business model prototypes. Day 2: 9:00 – 15:00 The day will start with exercise of how to implement the chosen business model through organisational structures, processes and systems in the organization. In the next part of the workshop attendees will be guided to overview of business model environment with • economic, • environmental, • social and

	• technological forces which influence on the market. After this step they will once again work on their business models taking into account business model environment and prototyping improved business models. In case of web based delivery of the training the modules could be divided in parts and delivered in different days.
Lecturer or. facilitator of the training programme	The workshop will be lead by Andro Goblon, business model design specialist and project manager from Construction Cluster of Slovenia. He helps to create better business, based on solving real problems of todays and future customers and using insights from emerging technologies, new trends and cross industry innovation. https://www.linkedin.com/in/androgoblon/

12. International training on mini PV plants on the roofs of NZEB
Prof dr Djordje Djordjevic, PhD

TRAINING PROVIDER	**CONSTRUCTION CLUSTER DUNDJER**
Title of the training programme	International training on mini PV plants on the roofs of NZEB
Organization (training provider)	DUNDJER
Type of training event	Workshop or Webinar
Objectives of the module (2-3 short paragraphs)	Calculation of available roofs for installation of mini PV plants
What will the participants know after completing the training?	Participants will be trained to calculate the possibilities of usage of the roofs to constuct mini PV plants, how to constuct mini PV plants, and to calculate the benefits of savings of electricity
What new competencies will they acquire?	participants will understand, know how to do after the workshop, etc. …)
Who is the main target group for the training programme?	Civil engineers, architects, urban planners, design offices
Who else could attend the training programme?	Technicians, local authorities, member of the academic community
Module content (describe the main content of the module in 8-12 indents)	The training will be implemented in 2 modules
Type of work (lecture, individual work, case study, pair and team work, etc.)	Type of work will be combined lecture and case study
Equipment needed (projector, internet, whiteboard, ...)	Needed equipment is: internet, projector, laptop, whiteboard
Duration of the training program	One day
Activities following the training program implemented (if any)	
Later options	
Lecturer or. facilitator of the training programme *(add a new row if there are more lecturers)*	Prof dr Djordje Djordjevic, PhD – full professor at Faculty of Civil Engineering and Architecture, University of Nis, Serbia https://www.linkedin.com/in/djordje-djordjevic-776b251a3/ Prof dr Zoran Stajic, PhD, – full professor at Faculty of Electronic engineering, University of Nis, Serbia Biljana Avramovic – general manager at Construction Cluster Dundjer Nis, Serbia https://www.linkedin.com/in/biljanaavramovic/?senderId=biljanaavramovic

13. International training on Open House Methodology
Biljana Avramovic

TRAINING PROVIDER	CONSTRUCTION CLUSTER DUNDJER
Title of the training programme	International training on Open House Methodology
Organization (training provider)	DUNDJER
Type of training event	Workshop or Webinar
Objectives of the module (2-3 short paragraphs)	Criteria for building quality assessment and life cycle accordind to new EU methodology Open House
What will the participants know after completing the training?	Participants will be trained for Open House evaluator
What new competencies will they acquire?	participants will understand, know how to do after the workshop, etc. …)
Who is the main target group for the training programme?	Civil engineers, architects, urban planners, design offices
Who else could attend the training programme?	Technicians, local authorities, member of the academic community
Module content (describe the main content of the module in 8-12 indents)	The training will be implemented in 6 modules
Type of work (lecture, individual work, case study, pair and team work, etc.)	Type of work will be combined lecture and case study
Equipment needed (projector, internet, whiteboard, ...)	Needed equipment is: internet, projector, laptop, whiteboard
Duration of the training program	One day
Activities following the training program implemented (if any)	
Later options	
Lecturer or. facilitator of the training programme *(add a new row if there are more lecturers)*	Prof dr Djordje Djordjevic, PhD – full professor at Faculty of Civil Engineering and Architecture, University of Nis, Serbia https://www.linkedin.com/in/djordje-djordjevic-776b251a3/ Prof dr Zoran Stajic, PhD, – full professor at Faculty of Electronic engineering, University of Nis, Serbia Biljana Avramovic – general manager at Construction Cluster Dundjer Nis, Serbia https://www.linkedin.com/in/biljanaavramovic/?senderId=biljanaavramovic

14. Industry 4.0
Bialystok University of Technology Poland

TRAINING PROVIDER	*PSDiK*
Title of the training programme	*Industry 4.0; different options, e.g.:* *(A) Elements and foundations of Industry 4.0* *(B) Competences and Digital Transformation Plan* *(C) Artificial Intelligence - Introduction. Technology, business, law* *(D) Factory of the Future - Cloud Technologies as a key element of Industry 4.0* *(E) Internet of Things - Sensors in the industry and on the construction site* *(F) Factory of the Future - Process Automation*
Organization (training provider)	*PSDiK in parnerschip with Bialystok University of Technology and other partners*
Type of training event	• *Seminar with a workshop* • *Workshop* • *Lecture*
Objectives of the module (2-3 short paragraphs)	*Understanding the benefits of using Industry 4.0 solutions is directly proportional to the awareness of the issue itself. Thanks to the indicated trainings, its participants will be able to effectively analyze the maturity of the enterprise for implementing several solutions. The digital maturity model in Industry 4.0 consists of three basic key modules for the development of Industry 4.0 in manufacturing companies: Technologies, Processes and Organization.*
What will the participants know after completing the training?	*(A) (B)* *- Strengthening knowledge about Industry 4.0 from an economic and technological perspective* *- Substantive preparation for talks on Industry 4.0 initiatives in the company* *- Initiating and conducting analyzes and audits in the field of digital transformation* *(C)* *- Knowledge of basic issues and possibilities of Artificial Intelligence* *- Knowledge about the possibilities of using Artificial Intelligence in projects to modernize the factory* *- Commencing works on building a road map for Industry 4.0 initiatives worth implementing in the company* *(D)* *- Knowledge of basic issues and capabilities of Cloud Technology.* *- Knowledge about the possibilities and advantages of Cloud Computing and the areas of use of the above. solutions in business and operational management.* *- Commencing works on building a road map for Industry 4.0 initiatives worth implementing in the company where the participant works* *(E)* *- Knowledge of basic issues and the importance of collecting and*

	processing data in an enterprise. *- Knowledge about the possibilities of collecting and storing data in projects for modernizing the factory in which the participant works. Knowledge about the possibilities of extending existing infrastructure with the possibility of collecting data.* *- Commencing works on building a road map for Industry 4.0 initiatives worth implementing in the company* *(F)* *- Knowledge of the basic capabilities of business process automation systems.* *- Knowledge of selected applications of business process automation systems, Robotic Process Automation and the possibilities of using it in an enterprise, not only in the Factory of the Future of Industry 4.0*
What new competencies will they acquire?	
Who is the main target group for the training programme?	*Representatives of business environment institutions, entrepreneurs.*
Who else could attend the training programme?	
Module content (describe the main content of the module in 8-12 indents)	*(A)* *1. Definition and introduction to Industry 4.0* *2. 4 archetypes of Factories of the Future* *3. Industry 4.0 from an economic perspective* *4. Industry 4.0 from a technological perspective* *5. Digital factory - its possibilities and requirements* *6. What should the Factory of the Future look like?* *(B)* *1. Stages of digital transformation to Industry 4.0* *2. Reliance between stages and benefits of implementing.* *3. Start of construction of a road map for Industry 4.0* *4. Engineer's competences 4.0* *(C)* *1. Artificial intelligence as the key technology in the future* *2. Introduction to AI technology* *3. Digital transformation and the role of AI* *4. Tools and trends. Possibilities of modern AI tools (machine learning, nauron networks, deep learning, machine vision)* *5. Using AI in business - a review of areas and solutions* *6. Introduction to legal aspects of AI* *7. Current trends and development strategies of AI in Poland and in the world* *(D)* *1. Cloud technologies. Advantages and disadvantages. When your own server room is not enough.* *2. How is Big Data, the Internet of Things and Data Analysis in the context of the Cloud and the Factory of the Future - Dependencies, scope of use and implementation technologies.*

	3. Why cloud technologies can be crucial for Industry 4.0? *4. Implementation of Artificial Intelligence (AI), Big Data, Internet of Things and Cloud Data Analysis services* *5. AI services in the cloud (MLaaS - Machine Learning as a Service). Examples of Cognitive Services* *6. Ways to use Cognitive Services in data collection, pre-processing and further analysis.* *7. Cloud services as an ideal tool for building corporate knowledge bases, as well as tools for Help Desk, Technical Assistance and service.* *8. Sample scenarios for using cloud services in creating data warehouses or Big Data solutions based on cloud computing.* *(E)* *1. Internet of Things - Sensors in industry and on the construction site. Why are they key. Where to save the collected data?* *2. Data collection (IoT), data storage (storage) and pre-processing (data transformation) services* *3. Collecting more data and better quality from all levels of the organization. Data Warehousing - data storage for further processing.* *4. Information sources for the Internet of Things: meters, sensors monitoring environmental parameters, work of people and devices, and even industrial cameras. Data can also come from OT (Operational Technology) systems, such as industrial automation, PLC controllers, or dispatch systems (SCADA).* *5. IT systems as a supplement to business data - IT systems, such as the Manufacturing Execution System (MES) or Enterprise Resource Planning (ERP).* *6. Examples of using data analysis (IoT / big data) in business.* *7. How to collect data in the enterprise? What actions must be taken to collect data? Can existing solutions be expanded with data collection mechanisms?* *(F)* *1. Introduction to Process Automation. Types of systems and their capabilities. Disadvantages, advantages and pitfalls of process automation.* *2. South Africa is not just a production line or just Chatbots. What is Robotic Process Automation (RPA) and how it can be used in industry.* *3. Intelligent automation covers a wide spectrum of technologies, ranging from business process automation (RPA) through machine learning, cognitive automation to artificial intelligence.* *4. The use of software that mimics human behavior by performing routine, repetitive tasks.* *5. How automation can increase productivity while limiting the complexity of processes. Reducing costs, improving the efficiency and quality of implementation of many back office and front office processes, which enterprises have entrusted to implement so far.* *6. How can intelligent automation be a source of competitive advantage?*

	7. How can you build a Digital Workforce team and transform back-office operations?
Type of work (lecture, individual work, case study, pair and team work, etc.)	*lecture, indyvidual work, case study, team work*
Equipment needed (projector, internet, whiteboard, ...)	*classroom infrastructure (tables, chairs), projector, whiteboards, wi-fi*
Duration of the training program	*(A), (B), (D), (E), (F) - 8 hours, 1 day* *(C) - 16 hours, 2 days* *Each segmetn represents one of the elements of a complex idea of Industry 4.0 .*
Activities following the training program implemented (if any)	*Advisory, auditing and consulting services, the purpose of which is to indicate the possibility of introducing optimization or innovation in the existing way of producing products or rendering services, or possibly producing new products or rendering by the given entrepreneur new services based on the latest digital technologies. Advisory activities may be completed by preparing a document for the given entrepreneur* *his company's digital transformation plan.*
Additional options (such as event extension if needed)	
Later options	
Lecturer or. facilitator of the training programme	*Cluster members: employees of the Bialystok University of Technology , entrepreneurs.*

15. Export development strategy for ASIAN and NEAR EAST markets
Sebastian Sadowski-Romanov, Dawid Goleniowski

TRAINING PROVIDER	*PSDiK*
Title of the training programme	*ASIAN markets,NEAR EAST markets* *Export development strategy / Promotion on foreign markets / Export financial security* *Currency exchange / The course of the international transaction*
Organization (training provider)	*PSDiK in partnerschip with INTRO Sp. z o.o. (Asian markets) or EmpolB2B Sp. z o.o. (Near East markets)*
Type of training event	• *Seminar with a workshop* • *Lecture*
Objectives of the module (2-3 short paragraphs)	*The purpose of the training is to familiarize participants with the specifics of Asian markets, in particular in terms of entry methods, export strategies, promotions and financial transaction hedging methods. In addition to becoming familiar with the rules of functioning of entities entering a given market, the training will include rules of functioning depending on a cultural circle.* *1. Export development strategy* *2. Promotion on foreign markets* *3. Export financial security* *4. Currency exchange* *5. The course of the international transaction* *NEAR EAST markets: Saudi Arabia, Bahrain, Iran, Yemen, Quatar, Kuwait, Oman, United Arab Emirates* *ASIAN markets: Russia, Japan, China, Kazakhstan*
What will the participants know after completing the training?	
What new competencies will they acquire?	*After the meeting, participants will be able to identify the method of entering a given market, indicate threats and the scope of preparation necessary to undertake.*
Who is the main target group for the training programme?	*Representatives of SMEs planning foreign expansion on a given market, representatives of associations, Clusters.*
Who else could attend the training programme?	*Representatives of professions related to foreign trade and promotion, legal and customs specificity in the indicated markets.*
Module content (describe the main content of the module in 8-12 indents)	*Knowing the client's product or service and the target market to which it will be directed, you can build a strategy of entering a given market: examine distribution channels, segment clients, select the most effective communication and client acquisition channels, develop marketing and commercial materials in the language of a given country, define service conditions and warranty and optimal solutions that will ensure success in expansion in a given market.*

	Promotion, as an element of a marketing campaign, is a set of activities and means by which an enterprise transmits information characterizing the product and / or company to the market, shapes the needs of buyers and stimulates, directs and reduces the elasticity of demand. *The export or import of goods is not the end of the process. For many exporters and importers, the real problem begins when payment comes. However, this is not a matter of spending money - the bottom line is the uncertainty that accompanies distance transactions.* *To provide exporters and importers with a sense of security in making international fees, it is worth familiarizing yourself with the methods of securing transactions, but also the strategy of securing exchange rate risk in the event of a decrease or increase in the exchange rate in which the fee will be made.*
Type of work (lecture, individual work, case study, pair and team work, etc.)	*lecture, seminar, case study*
Equipment needed (projector, internet, whiteboard, ...)	*classroom infrastructure (tables, chairs), projector, whiteboards, wi-fi*
Duration of the training program	*4-8 hours for a single market (country)*
Activities following the training program implemented (if any)	*Help in developing individual export strategies deepening the description of the specificity of a given market.*
Additional options (such as event extension if needed)	
Lecturer or. facilitator of the training programme (add a new row if there are more lecturers)	*ASIAN markets: Sebastian Sadowski-Romanov* https://itro.pl/ https://www.linkedin.com/in/sadowskiromanov/ *NEAR EAST markets: Dawid Goleniowski*

16. Low-carbon & resource-efficient solutions
Dr. Ewa Kochańska, Katarzyna Korczak, M.Sc.

TRAINING PROVIDER	Pro-Akademia Poland
Title of the training programme	Low-carbon & resource-efficient solutions, circular economy, nZEB
Organization (training provider)	Research and Innovation Centre Pro-Akademia
Type of training event	• Seminar with a workshop
Objectives of the module (2-3 short paragraphs)	Understanding what low-carbon economy is and what business opportunities it brings. Understanding of nearly-zero energy buildings concept and its implementation in selected central european countires. Learning how circular economy concept might be implemented in an on-going business activities.
What will the participants know after completing the training?	• What are low carbon and efficient solutions. • What is circular economy. • What is nZEB. • New business opportunities related to above mentioned concepts.
What new competencies will they acquire?	(what the participants will understand, know how to do after the workshop, etc. …) After the workshop, participants will be able to analyse their business activities in terms of possibility of implmenting selected concepts of circular economy and nZEB, by e.g. development of new products and services, using new materials, entering new markets .
Who is the main target group for the training programme?	SMEs
Who else could attend the training programme?	Local authorities
Module content (describe the main content of the module in 8-12 indents)	1. Introduction to the workshop topic i. Definitions ii. Legal framework iii. EU Policy iv. Examples of implementation in selected EU countries 2. Workshop i. Work in groups – implementation of circular economy / low-carbon / nZEB concepts into existing SMEs. ii. Presentation of results iii. Discussion
Type of work (lecture, individual work, case study, pair and team work, etc.)	Lecture + work in subgroups (case study, problem solving)
Equipment needed (projector, internet, whiteboard, ...)	Conference room equipped with projector, laptop, tables and chairs.
Duration of the training program	8h
Later options	-

Lecturer or. facilitator of the training programme *(add a new row if there are more lecturers)*	Dr. Ewa Kochańska Pioneering project manager, sustainable energy research executive and innovation leader, Dr. Ewa Kochanska was named RIC Pro-Akademia's first president in April 1996. Dr. Kochanska and her colleagues pioneer innovation projects in sustainable energy and circular economy research in Poland. Her contributions have been recognized by numerous prizes and honors, including her election as a member of Horizon 2020 Advisory Board for Societal Challenge 5: Climate Action, Environment, Resource Efficiency and Raw Materials (European Commission) and Civil Society Forum for Eastern Partnership (European Commission). In 2011, Dr. Kochanska was recruited to Trimen Chemicals Ltd., a leading chemical R&D company in Central Poland, where she became a member of supervisory board. Dr. Kochanska has also been an active and visible leader in growing the Central Poland sustainable energy community, partnering with other local research institutions and enterprises (for instance, to help establish the RES Technology Transfer Centre, which serves over 80 institutions), and working with regional government and the private sector to stimulate development of the region's still nascent sustainable energy sector. Dr. Kochanska serves on several scientific advisory, non-profit, and corporate boards, including the Lodz Regional Academic Council, responsible for updating the regional development strategy in terms of research and innovation priorities. Dr. Kochanska also assists European Commission (Horizon 2020, Research Fund for Coal and Steel), Polish National Centre for Research and Development as well as German Federal Aerospace Agency (DLR) in evaluation of national and international projects involving research and innovation actions. https://www.linkedin.com/in/ewakochanska/?originalSubdomain=pl Katarzyna Korczak, M.Sc. Katarzyna is a graduate of power engineering from Warsaw University of Technology (with distinction – summa cum laude) and a Ph.D. candidate at the same university. She specialises in energy efficiency of buildings, transport and industrial sectors as well as sustainable energy planning in local, regional and national dimensions. Katarzyna is a certified auditor of buildings' energy characteristics (Polish Ministry of Infrastructure). She is also a consultant for National Innovation Network, accredited by the Polish Agency for Enterprise Development. Katarzyna is experienced in implementing and managing national and international R&I projects funded by both public and private institutions. Katarzyna is the head of Laboratory of Energy Efficiency at RIC Pro-Akademia's RES Technology Transfer Centre. https://www.linkedin.com/in/katarzyna-korczak-a27a1066/

17. Coaching for writing project proposals
Maksymilian Kochański, M.Sc., Iwona Adamkiewicz, M.A.

TRAINING PROVIDER	Research and Innovation Centre Pro-Akademia Poland
Title of the training programme	Coaching for writing project proposals
Organization (training provider)	Research and Innovation Centre Pro-Akademia
Type of training event	• Seminar with a workshop
Objectives of the module (2-3 short paragraphs)	Understanding how to develop a project concept and write a successful project proposal.
What will the participants know after completing the training?	• How a process of a project development looks like. • How a process of a proposal drafting looks like. • How to find suitable project partners. • Funding programmes available for innovative projects. • What mistakes to avoid.
What new competencies will they acquire?	After the workshop, participants will be able to develop a project proposal supporting their ideas. They will know what crucial steps of the process are, what mistakes they should avoid, and what benefits R&D projects bring.
Who is the main target group for the training programme?	SMEs
Who else could attend the training programme?	Local authorities, research institution
Module content (describe the main content of the module in 8-12 indents)	3. Introduction to the workshop topic a. What R&D project is b. Funding programmes c. Typical project structure d. Process of the proposal development 4. Workshop a. Work in groups – development of a project proposal (key elements) b. Presentation of results c. Discussion
Type of work (lecture, individual work, case study, pair and team work, etc.)	Lecture + work in subgroups (case study, problem solving)
Equipment needed (projector, internet, whiteboard, ...)	Conference room equipped with projector, laptop, tables and chairs.
Duration of the training program	8h
Activities following the training program implemented (if any)	-

Later options	-
Lecturer or. facilitator of the training programme *(add a new row if there are more lecturers)*	Iwona Adamkiewicz, M.A. Iwona Adamkiewicz is a graduate of Lodz University (economics). She also earned Diploma of Joseph Conrad Scholarship (Master of Business Administration) at Brighton University (UK). She began her career at the Foundation for Entrepreneurship Promotion in Lodz in 1991. She has been teaching post-graduate courses in innovation, entrepreneurship and business strategy as well as a large course in marketing for small and medium sized-entrepreneurs in textile industry. Then she served as a Foreign Stock Market Expert of Wolczanka, a Polish public-listed textile production company where she was responsible for all actions and measures aimed at company's internationalisation. Since 2003, she is a Vice President of RIC Pro-Akademia, responsible for project portfolio management. Her research has focused on the open innovation strategies in SMEs in Poland and Spain. Her work has contributed to a detailed understanding of factors involved in innovation processes in hundreds of enterprises in several EU countries. Nationally, she has served as an accredited consultant of National Services System for Small and Medium-sized Companies, as well as National Innovation Network, and advisor providing innovation support services for companies within Smart Growth Operational Programme. https://www.linkedin.com/in/iwona-adamkiewicz-14a60bbb/ Maksymilian Kochański, M.Sc. Maksymilian Kochański received undergraduate degrees in economics from Warsaw School of Economics (WSE) and in power engineering from Warsaw University of Technology (WUT). He also received graduate degrees in finance from WSE and in sustainable energy engineering from WUT (summa cum laude). He is currently earning his doctorate in sustainable energy engineering from WUT, where he is also engaged in several national and international research projects. He is also a consultant for National Innovation Network, accredited by the Polish Agency for Enterprise Development. As a permanent member of RIC Pro-Akademia's team since 2012, Maksymilian has served as project manager in over 20 national and international R&I projects. Since 2017, he has served as the Vice President of RIC Pro-Akademia, where he is leading RIC's pioneering efforts to help shape the future of eco-innovations in Poland. A champion for both applied science and RIC Pro-Akademia's signature style of interdisciplinary, problem-centered research, he is also pursuing an aggressive agenda to encourage innovation and entrepreneurship. Maksymilian's scientific interests concern ICT applications in energy efficiency, impact studies, smart grids, sustainable energy, energy economics, and behavioral determinants of energy efficiency. At the national level, Polish National Centre for Research and Development asked Maksymilian to chair several evaluation committees of the Smart Growth Operational Growth Programme, which spurred the creation of innovation in numerous Polish SMEs. https://www.linkedin.com/in/MaxKochanski/?originalSubdomain=pl

18. Deep Energy Retrofit: Retrofitting to nZEB Levels
Horia Petran, PhD

TRAINING PROVIDER	Cluster Pro-nZEB Romania
Title of the training programme	Deep Energy Retrofit: Retrofitting to nZEB Levels
Organization (training provider)	Cluster Pro-nZEB
Type of training event	• Lecture • Workshop
Objectives of the module (2-3 short paragraphs)	The subject Deep Energy Retrofit: Retrofitting to nZEB Levels is conceived as an additional module. The programme is divided into 60 hours (24 hours of theoretical lectures and 36 hours of practical lessons) in which 21 topics will be taught. The described deep energy retrofit course is based on the notion that the participants already have some knowledge and basic understanding and practical experience of the building design and construction process and building physics and materials. The design process is structured using the basic principles of the Passive House concept applied to the renovation of existing buildings, resulting in the achievement of different levels of energy efficiency. The course is divided in four major parts / Modules. Module 1 is focused on the general knowledge of building physics, requirements in terms of health, comfort and safety in buildings and general retrofit approach including notions about ecology and sustainability. Module 2 examines the deep energy retrofit (DER) in connection to the building envelope with particular attention being paid to the design and construction of the distinct building components, underlining the role of the comprehensive design to the DER and examining its key renovation principles. The basic renovation design principles are being introduced, emphasising on what makes a retrofit 'a deep energy retrofit' and what are the most common faults in the standard building renovation practices. The students get to grasp not only the theoretical knowledge behind the DER practices, but the insight on why it is advantageous and preferred to the standard energy renovation. Special and particular attention is paid to the step-by-step renovation. Module 3 covers the building services and deals with the ventilation, heating and cooling, DHW and RES in retrofitting. Module 4 is dedicated to the project management and planning and design instruments as well as to the assurance of high quality building design and construction. The basics of the economic efficiency and cost-effectiveness of the renovation of existing buildings is covered. The main sustainability indicators, the involvement of stakeholders, and energy management at community level are also briefly mentioned.
What will the participants know after completing	The participants will have a better overall understanding about Deep Energy Retrofit (DER) and how to achieve nZEB Levels in the process of Buildings Retrofitting, in connection to the building envelope and HVAC systems in the context of the comprehensive design to the DER and examining key renovation

the training?	principles.
What new competencies will they acquire?	Knowledge on: (a) Deep energy retrofit process (b) Principles and practices of deep energy retrofits (c) Key mechanical systems which impact significantly on building energy efficiency (d) Performance characteristics of insulation products that are typically used to insulated ducts, pipes and vessels (e) Availability of specialist insulating pieces which can be used to insulate joints, sharp bends and connections of hot water distribution pipes (f) Performance characteristics of adhesive tapes that are typically used to seal and secure the attachment of insulation to ducts and pipes with a view to ensuring high performance for the life of the building (g) Principles of heating and domestic hot water generation and distribution and potential for drain waste water heat recovery (h) Principles of mechanical ventilation with heat recovery and its contribution towards indoor air quality and comfort (i) Integrated technologies which offer multiple mechanical services to high performance retrofits (so-called 'Compact' units) (j) Principles of solar renewable energy generation (both electric and thermal) and storage Cognitive and practical skills on: (a) Overall organisation of the building renovation process (b) Implementing tasks relating to installation of high-efficient heating and domestic hot water systems including full and complete insulation of all vessels and pipework which store and / or distribute heated water (c) Implementing tasks relating to installation of mechanical ventilation with heat recovery (MVHR), including placement of supply and extract ducts and registers and thorough sealing and insulation cold air ducts and envelope penetrations (d) Implementing tasks relating to installation of solar renewable energy generation and storage systems including ensuring that (a) all fixings and penetrations do not comprise the building in terms of moisture ingress as well as wind-tightness and airtightness and (b) that any pipes transporting hot water are fully insulated (e) Implementing tasks relating to installation of drain waste water heat recovery systems Responsibility for: (a) Interpreting the deep retrofit drawings and schematics and understanding the planning of the main stages of the design and construction (b) Adaptation of own behaviour to circumstances in solving problems (c) Taking responsibility to ensure continuity of the insulated and airtight thermal envelope (where assessible) (d) Taking responsibility to ensure that all products used in deep energy retrofits are fit for purpose with respect to ensuring insulation and air-sealing of the thermal envelope for the life of the building (c) Taking responsibility to ensure that all ducts, pipes and vessels which transport or store heated water or air are fully and completely insulated and without any gaps whatsoever even at awkward junctions, bends or connections (d) Taking responsibility to ensure that all products used in insulating mechanical

	services are fit for purpose, most especially adhesive tapes used to secure insulation in-place (which typically fail on domestic retrofit projects)
Who is the main target group for the training programme?	Civil engineers, architects, urban planners, design offices, building services engineers, energy auditors for buildings, various tradespersons in Constructions and Heating, Ventilation and Air-Conditioning (HVAC) and Renewable Energy Systems (RES), producers and distributors of construction materials, systems and technologies a.o. specialists in construction sector.
Who else could attend the training programme?	Representatives of construction companies, decision makers (with minimal technical background in constructions/buildings)
Module content (describe the main content of the module in 8-12 indents)	Module 1 – Basic knowledge and criteria for DER at nZEB levels - *Basis of building physics, Passive house principles* • Heat and Heating Energy (Heat Flux/Thermal Conduction) • Thermal environments • The 5 Passive House Pillars - *Comfort, health and safety requirements in buildings, incl. indoor air quality* • indoor air quality (contaminants and performance levels), • thermal comfort, daylight and lighting, noise, influence of nearby landscape, • safety requirements in buildings and the compliance ensured during the renovation process: Fire Safety and legal responsibilities in Buildings, Environmental regulations. - *Ecology and Sustainability* • Efficient use of resources: • Energy; • Water; • Waste; • Materials; • Building and Environment: • Transport connections; • Bicycle places; • E-Mobility; • Heat island (Green surfaces; green roof); • Climate change. Module 2 – Building envelope - *Optimal solar gains, Solar Energy – Introduction and basic concepts* • Climate data and climate zones • Solar radiation and window orientation • Windows installation • Glazing • special aspects in curtain wall facades • Shading - *Thermal insulation* • insulating materials and their properties (thermal conductivity, water vapor diffusion resistance factor, reaction to fire, etc.) • properties of elements comprising building envelope (U-values, water vapor resistance, fire behaviour on different kind of building envelopes)

	• correct installation of thermal insulation • risks and construction damage resulted from poor workmanship • quality control of thermal insulation • cross-crafting - *Thermal bridges* • thermal bridges • moisture related building damage due to thermal bridges • prevention and minimisation of thermal bridges • thermal bridge optimised window installation • cross-crafting - *High performance building components, highly efficient windows: products and installation* • general requirements for windows (airtight, thermally insulating (U-value), transparent, possibility of opening and providing shade when necessary) • role of windows regarding energy efficiency and comfort (view towards the outside, thermal protection, solar gains, ventilation during day and during night) • window installation in a thermal bridge minimised/free manner, • airtight window installation - *Airtightness, vapour and moisture movement, windtightness* • Key psychometric concepts relating to (1) temperature (dry-bulb, wet-bulb and dew-point) and (2) vapour (relative humidity, humidity ratio and absolute humidity) and ability to interpret a simplified psychometric chart; • Sources of vapour in dwellings (generated internally and externally); • Vapour pressure and vapour drive in different climates and the optimal location for positioning the vapour control layer (internal, central or external); • Conditions that favour mould growth and condensation; • Understanding the term 'breathable' construction as it related to vapour diffusion; • Sd (or Perm) rating for different materials and best practice use according to different site conditions (vapour closed, vapour permeable / semi-permeable, vapour open and vapour variable); • Metrics used in airtightness testing including air changes per hour (h-1) as well as air permeability (m3/hr.m2) and targets for deep retrofitting, including 1.0 h-1 for EnerPHit; • Hands-on airtightness installation at key junctions, penetrations and connections for different construction types and using different materials (membranes, plaster, wooden boards (plywood), tapes, caulks and so forth); • Airtightness testing methods for local code compliance as well as Passive House / EnerPHit (considering pressure differences, testing direction (negative and / or positive), exterior weather conditions (temperature and wind speed)); • Airtightness demonstration test, including volume calculation, identification and fixing of leaks and re-testing; • Wind-tightness and its influence on interior comfort and performance of the insulation layer; • Materials used for achieving wind-tightness; and • Cross-crafting and quality assurance issues, including risks of failure. - *"Step-by-step" retrofit plans*

	• potential for energy savings assessment • renovation standards; certification of the energy performance • details, products and materials • RES • economic efficiency of the different steps - *Workshop* in the practical training facility / Site visit – renovation of existing building Module 3 – Building services - *Mechanical Ventilation with Heat Recovery* • Overview of key building services including ventilation, heating, cooling and domestic hot water; • Key air quality indicators including relative humidity and CO2; • Mechanical ventilation strategies (centralised, de-centralised or hybrid) and methods (extract only or balanced, with heat recovery); • Calculation of supply and extract ventilation rates to ensure high indoor air quality; • Principles of air-to-air heat exchange and mechanical ventilation with heat recovery (MVHR); • Identification of key components in an MVHR unit (heat exchanger, fans, filters, condensate drain) • Optimal placement of an MVHR unit considering minimisation of thermal bridging from cold air ducts; • Vapour-proof insulation and air-sealing of cold air ducts to MVHR unit and penetration through the thermal envelope; • Duct sizing, materials, routing, air-sealing and consideration of pressure losses; • Supply and extract registers – types, placement, adjustment; • Balancing the MVHR system. - *Heating and cooling* • Heating generation strategies (boiler, heat-pump, direct-electric, CHP, district heating and others); • Heating distribution strategies (using the ventilation air, hydronic (radiators, underfloor, wall or ceiling panels) or refrigerant); • Cooling (latent and sensible) generation strategies (heat-pump); • Cooling (latent and sensible) distribution strategies (using the ventilation air, hydronic (radiators, underfloor, wall or ceiling panels) or refrigerant). - *Summer comfort / passive cooling strategies* • solar loads, • air exchange / ventilation, • indoor heat sources, • impact of external colours, of thermal insulation and of thermal masses, • shading in summer; • passive cooling technologies to avoid overheating / to reduce the cooling demand during summer. - *DHW & Lightning* • Domestic hot water generation and distribution; • Insulation materials and thicknesses suitable for vessels, ducts and pipes conveying hot and cold water / refrigerant;

	• Application of insulation materials to pipework, including paying particular attention to awkward connections and junctions (which are typically poorly insulated); and • Drain water heat recovery systems. - *RES in building retrofit, Long and short-term energy storage* Module 4 – Project management and planning and optimization instruments - *Conservation of historic building fabric, Renovation of buildings, monuments of culture* • retrofit for non-residential historical buildings with high IHG • Internal Insulation as a solution in historical buildings • Improving thermal protection towards the ground when modernising historical buildings • Solutions for ventilation in retrofits of historical buildings • Thermal comfort in summer • The house-in-a-house principle • Built examples • Step-by-step Refurbishment Examples - *NZEB neighbourhoods, Energy cooperatives* • Nearly Zero Energy Neighbourhood - concept; • Impact and benefits of the distributed electrical energy generation grid integration; • Legal framework for energy management, tariffs and inter-connection and inter-operability of energy systems; • Cooperatives energy management systems and correlation with new business opportunities. - *Planning and design instruments* • PHPP: verified performance • PHPP: the tool • Design PH: plugin for 3D modeling - *Project management, Quality assurance* • Introduction – basic principles; • Necessary legislation; • Executing, monitoring and controlling; • Basic investment efficiency; • Energy efficiency principles; • Energy efficiency documents (EPC, Energy Audit). - *Economic efficiency of existing buildings energy renovation up to the level "passive house" and "nZEB"* • EED and EPBD II • What is Life Cycle Assessment – LCA, LCC • Economic Calculations of Return on Investment • Prices of construction materials, bill of quantities • Energy savings and operational costs - Energy efficiency measures – construction - *Engaging stakeholders* • benefits of DER • stakeholders groups: demands, needs and requirements

	• national and EU policies to support DER • financial instruments • sources of information
Type of work (lecture, individual work, case study, pair and team work, etc.)	Type of work will be combined lecture and case study.
Equipment needed (projector, internet, whiteboard, ...)	• White board; • Multimedia facility; • Demonstration models; • Practical training models; • Samples of components and materials, suitable for deep renovation; • Demonstration videos
Duration of the training program	The total duration of the training program is 60 hours (of which 36 h theory and 24 h practical training). The course modules could be implemented separately and specific competences could be acquired per module. Module 1 – 8 hours (1 day) Module 2 – 26 hours (5 days) Module 3 – 12 hours (2 days) Module 4 – 14 hours (2 days)
Additional options (such as event extension if needed)	- Visits to nZEB or Passive House sites could be organised,
Later options	-
Lecturer or. facilitator of the training programme *(add a new row if there are more lecturers)*	Horia Petran, PhD https://www.linkedin.com/in/horia-petran-60a16024/ Cluster Pro-nZEB www.pro-nzeb.ro INCD URBAN-INCERC www.incd.ro The Building Knowledge Hub Romania https://www.facebook.com/BKHTrain2nZEBRomania/

19. Circular economy in construction – a mayor contribution to decarbonisation of buildings and infrastructure

Vladimir Gumilar

TRAINING PROVIDER	Construction cluster of Slovenia
Title of the training programme	Circular economy in construction – a mayor contribution to decarbonisation of buildings and infrastructure
Organization (training provider)	Construction cluster of Slovenia
Type of training event	• Webinar
Objectives of the module (2-3 short paragraphs)	- Outline the circular economy (CE) as a regenerative and restorative economy replacing linear economy - Present circular business models and solutions in construction - Describe the potential impact of circular construction on climate mitigation
What will the participants know after completing the training?	- The scope of natural resources exploited to build, use and manage built environment, and the environmental impacts related - The difference between linear and circular economy and the main concepts and business models of circular economy - The application of CE in building and construction value chain with main business models - Insights in potential for climate mitigation within the circular design/build and end-of-life phase of building
What new competencies will they acquire?	(what the participants will understand, know how to do after the workshop, etc. …) - Basic communication skills in the domain of circular economy in comparison to linear approach, and overall, in domain of sustainability and sustainable construction - Basic analytical competences in evaluating the linearity and circularity in different domains, from household management to solutions in buildings and construction - Identification for opportunities for transition to circular economy by applying appropriate concepts and business model in their domain (businesses/companies/organisations) - Competence to identify and describe main circularity impacts/results of CE implementation
Who is the main target group for the training programme?	SMEs, managers, developers within Large organisations – managers, developers, responsible for environment/systems Design/engineering specialists, other middle management in technical and non-techical positions
Who else could attend the training?	R&D representatives Policy makers, representative of public sector/semi-public organisations
Module content (describe the	a) Outline the circular economy (CE) as a regenerative and restorative economy replacing linear economy

main content of the module in 8-12 indents)	- Overview of current economy – linear approach, economic, social and environmental challenges of current economies - Circular economy and related concepts/approached - Models/systemic approach to circular economy - Circular economy principles and business models - Circular solutions / case studies / examples - Questions & answers, discussion b) Present circular business models and solutions in construction - Overview of construction / built environment development from the perspective of use of resources, key challenges and opportunities - Circular construction -overview - Models/systemic approach in circular construction - Application and circular economy principles and business models in construction value chain - Circular solutions / case studies / examples in sector/construction value chains - Questions & answers, discussion c) Describe the potential impact of circular construction on climate mitigation - Overview of construction / built environment key resources exploited to build, use and manage built environment, and the environmental impacts caused - Sufficiency of low carbon (energy efficiency in use) approach to reach goals of low carbon energy by 2050 - Circular economy strategies to make better use of material and product to reduce GHG emission - Circular solutions / case studies / examples in sector/construction value chains - Questions & answers, discussion
Type of work (lecture, individual work, case study, pair and team work)	Lecture (webinar), with interactions (Q&A) with attendees.
Equipment needed (projector, internet, whiteboard)	Access to internet Webinar /e-conference application/tool Recording equipment/team
Duration of the training program	3 h
Lecturer or. facilitator of the training programme *(add a new row if there are more lecturers)*	Vladimir Gumilar was born in Ljubljana in 1964. He holds Master of Science degree in construction from University of Ljubljana, Slovenia, and MBA degree from University of Kansas, USA. He is a director (cluster manager) of Construction Cluster of Slovenia (SLOVENSKI GRADBENI GROZD-GIZ). He was deeply involved in technological development in construction industry, coordinating different R&D projects and activities. His basic research topic was quality in construction industry: application of ISO 9000 management system, product and service assessment, quality marks and certification, total quality management, total quality products. Based on this

	research work, he has developed a scheme for a product and service assessment, which is a corner stone for a project Quality Mark in Construction. This project has been running successfully for since 1997. His second but not less important research topic was information technology to improve the quality of products and services in this industry. He was a research assistant in development of a national technical information system TIGRA and a manager of different information services in Building center of Slovenia. In last 15 years he has an important role in developing and managing national construction cluster. Since April 2004 he is a cluster manager of the Construction Cluster of Slovenia (CCS), a national cluster with members from different fields of construction industry, coordinating different RTD and other cluster's projects. In 2005, he also supported the development of the Slovenian Construction Technology Platform (SICTP). CCS became a SICTP's secretariat. Since 2005, he is also actively involved in EU R&D projects: e-NVISION, TECH-TRANSFER, REGCON and MESSIB, OPENHOUSE, RECTYRE, EE-HIGHRISE, NEWBEE, SILENTWALL, STEELPROST - supporting the R&D activities as a SME association and/or performing activities of the dissemination and exploitation. In REGCON project he developed the ICM333 methodology for the development of the innovation clusters in construction. He was coordinating two EU projects: STOREPET, Development of PCM-based innovative insulating solutions for the Light-weight building sector, FP7 programme; and ECCA, European Circular Construction Alliance – adopting Circular Economy for internationalization and global competitiveness of European SMEs in Building and Construction, EU COSME programme. Within this project he gained advanced competences in circular economy, in addition to core engineering and managerial ones. Professional competences: 1. Cluster and other new collaborative organisational and business models development and implementation, international networking and collaboration between clusters and other subjects of innovation eco systems. Cross sectoral collaboration. 2. Building sustainability planning and assessment, resource efficiency, green, circular construction and economy 3. Innovation management, open innovation, training and innovation competences development 4. Digitalization of construction sector, BIM, IOT, smart building 5. Preparation and collaboration in RTD projects, representing industry association and industry needs and expectations, and/or directly involving cluster members (industry actors) to project activities, and/or in dissemination and exploitation activities 6. EU and national R&D and innovation projects coordination and management, including costs / financial reporting and/or supporting dissemination and exploitation actions in EU funded RTD projects, technology transfer and intellectual property issues. https://www.linkedin.com/in/vladimirgumilar/

20. Communicating efficiently on Social Media (Linkedin and Twitter) for clusters and cluster members

Andro Goblon

TRAINING PROVIDER	CONSTRUCTION CLUSTER OF SLOVENIA
Title of the training programme	Communicating efficiently on Social Media (Linkedin and Twitter) for clusters and cluster members
Organization (training provider)	Slovenski gradbeni grozd (Construction Cluster of Slovenia)
Type of training event	• Seminar with a workshop or • Webinar or (tailored version for specific organization, under request) • Long-term distance learning training & coaching program (from few months to a year)
Objectives of the module (2-3 short paragraphs)	"How to use Twitter and Linkedin to efficient communicate the cluster and SMART4NZEB project" Practicing the use of social media can help in promotion and establishing a personal brand as a cluster manager, manager of the company (cluster member) or energy efficiency specialist, etc. or achieving some other goal for personal branding, cluster promotion, partnership and the project promotion and communication and in paralell or in the future, promote and communicate other cluster activities.
What will the participants know after completing the training?	Participants of the basic training (seminar with a workshop or webinar) will have a profiles on Linkedin and Twitter and basic understanding of potential benefits of being an active user.
What new competencies will they acquire?	(what the participants will understand, know how to do after the workshop, etc. …) They will also understand of how to prepare a post, using hashtags, taggings and visuals for achieving the most of the reach and feedback. During the training, attendees will prepare a post using the tips and insights from the training.
Who is the main target group for the training programme?	Cluster managers and practicioners, Managers of the companies (cluster members and potential cluster members) Professionals in the construction sector Sales and marketing profesionals HR professionals R&D professionals Etc.

Who else could attend the training programme?	Students Interns
Module content (describe the main content of the module in 8-12 indents)	Basic training (seminar with a workshop or webinar): • Basic understanding of Twitter network (who is there, why to follow someone and whom to follow, what and how to post, how many times, etc..) • Basic understanding of Linkedin network (who is there, why to have a profile on Linkedin, what and how to post, how many times, how to prepare a post for achieving a good reach, what else is important to achieving the more reach, what is the difference between posts and articles, etc..) Approximately one hour for each part.
Type of work (lecture, individual work, case study, pair and team work, etc.)	Short lecture with some case studies and individual work with menthoring. Attendees will also react on posts prepared by colleagues on training, to understand the impact of quick reactions on Linkedin and Twitter alghoritms.
Equipment needed (projector, internet, whiteboard, ...)	• Seminar with workshop: projector, internet, whiteboard • Webinar: internet, Zoom or Go to meeting or other similar application, Linkedin and Twitter application downloaded from the app store on the smart phone
Duration of the training program	Basic training: 2 hours (which could be repeated after few days for additional information and feedback from participants.)
Activities following the training program implemented (if any)	Attendees are invited to share their experience of using the networks with colleagues and the trainer.
Additional options (such as event extension if needed)	-
Lecturer or. facilitator of the training programme *(add a new row if there are more lecturers)*	The workshop will be lead by Andro Goblon, business model design specialist and project manager from Construction Cluster of Slovenia. He helps to create better business, based on solving real problems of todays and future customers and using insights from emerging technologies, new trends and cross industry innovation. He is also an active user of Linkedin and Twitter and willing to transfer his knowledge and experience. https://www.linkedin.com/in/androgoblon/

21. Introduction to Reservoir System Simulation, HEC-ResSim Program

Prof. Dr. Dragan Milićević, SAŠA ŽIVKOVIĆ, dipl. ing. građ.

TRAINING PROVIDER	**CONSTRUCTION CLUSTER DUNDJER**
Title of the training programme	**Introduction to Reservoir System Simulation, HEC-ResSim Program**
Organization (training provider)	Construction Cluster DUNDJER, Niš, Serbia
Type of training event	• Webinar • 1-2 days training
Objectives of the module (2-3 short paragraphs)	Program HEC-ResSim is the successor to the »HEC-5, Simulation of Flood Control and Conservation Systems« program (HEC, 1998). HEC-ResSim is used to model reservoir operation at one or more reservoirs for a variety of operational goals and constraints. The softwer simulates reservoir operations for flood risk management, low flow augmentation and water supply for planning studies, detailed reservoir regulation plan investigations, and real-time decision support. Thr software can be used as a decision support tool that meets the needs the needs of modelers performing reservoir project studies as well as meeting the needs of reservoire regulators during real-time events. HEC-ResSim is comprised of a graphical user interface (GUI), a computational program to simulate reservoir operation, data storage and management capabilities, and graphics and reporting facilities. The Data Storage Sysstem, HEC-DSS (HEC, 1955 and HEC, 2009) is used for storage and retrieval of input and output time-series data.
What will the participants know after completing the training?	ResSim program offers three separate sets of functions called Modules that provide access to specific types of data within a watershed. All three modules would enable complete simulation of watershed functions, so that participants will acquire knowlwdge on technique of Watershed setup, Reservoir Network Setup, and Simulation.
What new competencies will they acquire?	All three program modules will give new valuable knowledge in the field of watershed simulation, regulation, and management. Watershed Setup module is to provide a common framework for watershed creation and definition among different modeling applications. This module is currently common to HEC-ResSim, HEC-FIA, and CWMS CAVI. Reservoire Network module is to isolate the development of the reservoir model from the output analysis. In the Reservoire Network module one will build own network shematic, describe phisical and operational elements of reservoir model, and

	develop the alternatives to be analysed. Simulation module aims to isolate output analysis from the model development process. Onse the reservoir model is complete and the alternatives have been defined, the Simulation module is used to configure the simulation. The computations are performed and resulta are viewed within the Simulation module.
Who is the main target group for the training programme?	Watersheeds regulation engineers, managers, energy managers, public regulatory bodies members, environment engineers
Who else could attend the training programme?	Different stakeholders in water energy, environment, local government, municipalities, NGO,
Module content (describe the main content of the module in 8-12 indents)	**1. Watershed setup** Concept of HEC-ResSim, How to create and manage watersheds, How to work with map layers, How to establish a stream alignment, How to create and define watershed elements and projects (e.g. reservoirs, levees, etc.), How to create computation points (hydrograph locations), How to create watershed configurations. **2. Reservoire network** How to develop reservoir networks, how to edit element data (junctions, routing reaches and diversions), How to define physical reservoir data, How to edit physical reservoir data, How to develop reservoir operation data, How to define reservoir systems. How to define alternatives. **3. Simulation** How to develop and execute simulations, How to analyse results, How to calibrate model, How to menage simulations. **Additional units:** Detailed application settings, How to define the coordinate system, How to edit maps, How to change colors, How to use HEC-DSSVue, How to copy, export, and print tables, References.
Type of work (lecture, individual work, case study, pair and team work)	Lecture, Practice excersises, Case study
Equipment needed (projector, internet, whiteboard, ...)	Internet, Computer, Video beam / Display for biger groups
Duration of the	Intensive training 2 days, 10 hours (2 x 5 hours)

training program	Webinar, one week, 10 hours (5 days x 2 hours)
Activities following the training program implemented (if any)	Consultations and collaborations during implementation of software in practice.
Additional options (such as event extension if needed)	It is possible to organise training in the field, on examples of nearby watersheds with included close lakes.
Later options	
Lecturer or. facilitator of the training programme	**Prof. Dr. Dragan Milićević** https://www.linkedin.com/in/dragan-mili%C4%87evi%C4%87-1781ab48/ (Name and surname, short bio, Linkedin profile and other social media profiles, relevant to the topic)
	Dipl. Ing. Saša Živković https://www.linkedin.com/in/sasa-zivkovic-53072440/ (Name and surname, short bio, Linkedin profile and other social media profiles, relevant to the topic)

22. ZAKLJUČCI

EKSPERTSKE KONFERENCIJE O PRIVREDNOJ SARADNJI KLASTERA JUGOISTOČNE EVROPE KAO PRAVCU RAZVOJA POSLOVNO-OBRAZOVNOG TURIZMA GRADA NIŠA

Na ekspertskoj konferenciji na temu „PRIVREDNA SARADNJA KLASTERA JUGOISTOČNE EVROPE KAO PRAVAC RAZVOJA POSLOVNO-OBRAZOVNOG TURIZMA GRADA NIŠA“, održanoj 27. Avgusta 2020. u Nišu, usvojeni su sledeći zaključci:

1. *Grad Niš, kao univerzitetski centar jugoistočnog dela Srbije, poseduje bazične predispozicije za razvoj poslovno-obrazovnog turizma grada Niša.*

2. *Uz informacione i komunikacione tehnologije, kao i nacionalne i međunarodne programe mobilnosti (ERASMUS+, TEMPUS, ERASMUS MUNDUS, CEEPUS itd.), znacajno je povećana dostupnost novim naučnim i obrazovnim postignućima za sve potencijalne učesnike – studente, doktorante, nastavnike i saradnike.*

3. *Pravovremeno uvođenje internacionalizacije na univerzitetima u Srbiji i uzimanje u obzir efekata međunarodne saradnje i bolje prepoznatljivosti univerziteta izvan nacionalnog konteksta dovelo do **povećanja konkurentnosti izmedu njih**.*

4. *Direktna posledica tih promenjenih odnosa je sada već ustaljena praksa na univerzitetima i fakultetima da se **unapređuju postojeci studijski programi ili kreiraju novi**, savremeniji studijski programi.*

5. ***Neformalno obrazovanje, kao i dualno obrazovanje**, predstavljaju novi pravac u kreiranju onih zanimanja koja su prilagođena zahtevima tržišta, kako domaćeg tako i inostranog, a nisu prepoznata od strane formalnog obrazovnog sistema.*

6. *Potreba za **umrežavanjem ekonomskih subjekata kroz klastere**, kao i povezivanje i saradnja domaćih i stranih klastera, predstavljaju zahteve nove digitalne ekonomije, koja skraćuje i pojeftinjuje put od proizvođača do krajnjeg korisnika.*

7. ***Cirkularna ekonomija, kao snažan faktor povezivanja MSP** iz različitih grana privrede, nameće potrebu edukacije u sferama razvoja novih biznis modela i umrežavanja.*

8. ***Učešće na međunarodnim projektima** otvorilo je mogućnost MSP za brzi izlazak na mađunarodna tržišta, ali i stvorilo obavezu savladavanja novih veština iz oblasti pisanja i vođenja projekata.*

9. *Visok stepen zagađenja i emisije CO_2, kao i nerentabilna potrošnja energenata, uvodi zakonsku obavezu **poštovanja energetske efikasnosti**, kroz korišćenje obnovljivih izvora energije i približavanje nultoj potrošnji energije zgrade (NzEB) i adekvatnu obučenost projektanata za to.*

10. *Uvođenje ICT tehnologije u proces gradnje kroz **uvođenje standarda Open House** i sličnih, omogućava daljinsku kontrolu i upravljanje svim parametrima zgrade, ekološku gradnju i ekonomičan proces, ali i zahteva edukaciju u ovim oblastima.*