Original Text

PRODUCT DESIGN

Based on your responses, learning content related to product design is not a significant focus in the curricula developed for the Learning Factory. Activities associated with the product design phase do not appear to be a priority for your learning factory or the learning objectives you aim to emphasize.

Your expressed interest in product design activities is minimal, and in some cases, entirely absent. While this approach aligns with the fact that your learning factory programs are not directly linked to product design, it is worth noting that for a learning factory to operate effectively, it must include the manufacturing of a product. This necessitates at least a foundational level of attention to certain design-related activities. Minimum Requirements:

1.1 Product's basic design and specifications for quality assurance purposes: Choose a very simple product with minimum components.

1.3 Suitable manufacturing, assembly, or purchasing processes: Ensure proper selection of processes for the product or its components.

Translated Text

OBLIKOVANJE IZDELKA

Na podlagi vaših odgovorov vsebine, povezane z oblikovanjem izdelkov, niso pomemben poudarek v kurikulumu, razvitem za učno tovarno. Dejavnosti, povezane s fazo oblikovanja izdelka, očitno niso prednostna naloga vaše učne tovarne ali učnih ciljev, ki jih želite izpostaviti. Vaše izraženo zanimanje za dejavnosti, povezane z oblikovanjem izdelkov, je minimalno, v nekaterih primerih pa povsem odsotno. Čeprav je tak pristop skladen z dejstvom, da programi vaše učne tovarne niso neposredno povezani z oblikovanjem izdelkov, velja poudariti, da mora učna tovarna za učinkovito delovanje vključevati tudi proizvodnjo izdelka. To zahteva vsaj osnovno raven pozornosti namenjene določenim dejavnostim, povezanim z oblikovanjem.
Minimalne zahteve:
1.1 Osnovno oblikovanje izdelka in specifikacije za namene zagotavljanja kakovosti: Izberite zelo preprost izdelek z minimalnim številom komponent.
1.3 Ustrezni proizvodni, sestavni ali nabavni procesi: Zagotovite pravilno izbiro postopkov za izdelek ali njegove komponente.

Original Text

You have identified some activities associated with the product design phase as being transversely related to the curriculum to be implemented in the learning factory. Yet, these activities are not the primary focus of the curriculum you aim to primarily address. At this point, some relevant aspects should be considered:

Although product design may not be the main emphasis of your learning factory, the chosen product will significantly influence many aspects of the learning factory's operations, including those activities of the value chain that actually are the main focus for your own learning factory. For instance, a complex product will typically demand a more intricate manufacturing process. Similarly, the product's characteristics will impact the learning factory's digitization capabilities and overall complexity.

It is also important to note that, when we talk about product design, the focal point of the learning outcomes can be either the product itself or the manufacturing process used to produce it. In either case, the product and the process are deeply interconnected and mutually dependent. To enhance your learning factory's readiness, we suggest ensuring it is technically well-equipped to support learning activities related to product design. Additionally, consider incorporating foundational content on these topics into your PBL (Project-Based Learning) or CBL (Challenge-Based Learning) activities. We recommend reflecting on the following suggestions as you prepare the next set of activities: 1.1 Fundamental product design and specifications for quality assurance purposes. 1.3 Suitable manufacturing, assembly, or purchasing processes for the product or its components. 1.4 Product life cycle analysis. Optionally, you may also consider: 1.2 Prototyping and testing. 1.5 Simulation and digital twin technologies.

Translated Text

Opredelili ste nekatere dejavnosti, povezane s fazo oblikovanja izdelka, kot prečno povezane s kurikulumom, ki ga nameravate uvesti v učni tovarni. Kljub temu te dejavnosti niso osrednji poudarek kurikuluma, ki ga želite predvsem razvijati. V tej fazi je smiselno upoštevati nekatere relevantne vidike:

Čeprav oblikovanje izdelkov morda ni glavni poudarek vaše učne tovarne, bo izbrani izdelek bistveno vplival na številne vidike njenega delovanja, vključno s tistimi dejavnostmi v vrednostni verigi, ki so dejansko osrednji fokus vaše učne tovarne. Na primer, kompleksen izdelek bo običajno zahteval bolj zapleten proizvodni proces. Prav tako bodo značilnosti izdelka vplivale na zmožnosti digitalizacije učne tovarne in njeno splošno kompleksnost.

Pomembno je tudi poudariti, da je pri oblikovanju izdelkov lahko osrednja točka učnih izidov bodisi sam izdelek bodisi proizvodni proces, uporabljen za njegovo izdelavo. V obeh primerih sta izdelek in proces tesno povezana in medsebojno odvisna. Za izboljšanje pripravljenosti vaše učne tovarne priporočamo, da zagotovite ustrezno tehnično opremljenost za podporo učnim dejavnostim, povezanim z oblikovanjem izdelkov. Poleg tega razmislite o vključitvi osnovnih vsebin o teh temah v dejavnosti PBL (učenje na podlagi projektov) ali CBL (učenje na podlagi izzivov). Priporočamo, da pri načrtovanju naslednjega sklopa dejavnosti razmislite o naslednjih predlogih: 1.1 Osnovno oblikovanje izdelka in specifikacije za namene zagotavljanja kakovosti. 1.3 Ustrezni proizvodni, sestavni ali nabavni procesi za izdelek ali njegove komponente. 1.4 Analiza življenjskega cikla izdelka. Po želji lahko upoštevate tudi: 1.2 Prototipiranje in testiranje. 1.5 Simulacije in tehnologije digitalnega dvojčka.

Original Text

You have identified certain activities within the product design phase as integral to the curriculum you aim to develop in your learning factory. Notably, at least one of these product design-related activities is considered a core element of the curriculum. Consequently, it is clear that many learning activities in your learning factory align closely with these value chain processes. Recommendations for Successful Implementation:

Assess Product Complexity: The selected product will significantly impact the operations of your learning factory. A highly complex product may require a correspondingly intricate manufacturing process, affecting digitization capabilities and operational feasibility. Carefully evaluate the complexity your learning factory can handle and avoid overly complicated products to ensure practical implementation.
Enable Product Configuration: Consider offering multiple product versions that require tailored production processes, such as small-batch manufacturing, digital twins, or other variants. This flexibility can enhance the product design phase while maintaining manageability and avoiding unnecessary complexity.
Interconnect Product and Process Design: In product design, the focus can either be on the product itself or the manufacturing process. However, these two aspects are deeply interrelated. Design activities should highlight this interdependence to deliver comprehensive learning outcomes.
Technical Preparedness: Ensure that your learning factory is well-equipped to support product design-related activities. Incorporating foundational content into your PBL (Project-Based Learning) or CBL (Challenge-Based Learning) activities will strengthen the curriculum and facilitate practical engagement.
Collaborate with Other Learning Factories: Explore partnerships with other learning factories working on similar products. Collaborative efforts can enable the creation of common learning activities, resource sharing, and exchange of best practices, thereby enriching the learning experience.

By implementing these recommendations, you can enhance the effectiveness and relevance of your learning factory in supporting activities associated with the product design phase.

Translated Text

Opredelili ste določene dejavnosti v fazi oblikovanja izdelka kot sestavni del kurikuluma, ki ga nameravate razviti v svoji učni tovarni. Vsaj ena izmed teh dejavnosti, povezanih z oblikovanjem izdelkov, je opredeljena kot osrednji element kurikuluma. Posledično je jasno, da se številne učne dejavnosti v vaši učni tovarni tesno povezujejo s temi procesi vrednostne verige. Priporočila za uspešno izvedbo:

Ocenite kompleksnost izdelka: Izbrani izdelek bo pomembno vplival na delovanje vaše učne tovarne. Zelo kompleksen izdelek lahko zahteva sorazmerno zapleten proizvodni proces, kar vpliva na zmožnosti digitalizacije in izvedljivost delovanja. Previdno ocenite, kakšno stopnjo kompleksnosti lahko vaša učna tovarna obvlada, in se izogibajte pretirano zapletenim izdelkom, da zagotovite praktično izvedbo.
Omogočite konfiguracijo izdelka: Razmislite o ponudbi več različic izdelka, ki zahtevajo prilagojene proizvodne procese, kot so proizvodnja v majhnih serijah, digitalni dvojčki ali druge različice. Ta prilagodljivost lahko okrepi fazo oblikovanja izdelka, hkrati pa ohranja obvladljivost in preprečuje nepotrebno kompleksnost.

Povežite oblikovanje izdelka in procesa: Pri oblikovanju izdelka je lahko poudarek bodisi na samem izdelku bodisi na proizvodnem procesu. Vendar sta ti dve področji tesno povezani. Oblikovalske dejavnosti naj izpostavijo to medsebojno odvisnost, da bodo učni izidi celoviti.
Tehnična pripravljenost: Poskrbite, da bo vaša učna tovarna ustrezno opremljena za podporo dejavnostim, povezanih z oblikovanjem izdelkov. Vključitev temeljnih vsebin v dejavnosti PBL (učenje na podlagi projektov) ali CBL (učenje na podlagi izzivov) bo okrepila kurikulum in omogočila bolj praktično udeležbo.

Sodelujte z drugimi učnimi tovarnami: Raziskujte partnerstva z drugimi učnimi tovarnami, ki delajo na podobnih izdelkih. Sodelovanje lahko omogoči oblikovanje skupnih učnih dejavnosti, deljenje virov in izmenjavo dobrih praks, kar dodatno obogati učno izkušnjo.

Z izvajanjem teh priporočil lahko izboljšate učinkovitost in relevantnost vaše učne tovarne pri podpori dejavnostim, povezanih s fazo oblikovanja izdelkov.

Original Text

PROCESS ENGINEERING

Based on your responses, learning content related to process engineering are not a significant focus in the curricula developed for the Learning Factory. Activities associated with the process engineering phase do not appear to be a priority for your learning factory or the learning objectives you aim to emphasize.

Your expressed interest in process engineering activities is minimal, and in some cases, entirely absent. While this approach aligns with the fact that your learning factory programs are not directly linked to process engineering, it is worth noting that for a learning factory to operate effectively, it must include the manufacturing process to produce a product. This necessitates at least a foundational level of attention to process engineering-related activities. Moreover, a learning factory hardly would operate without a minimum focus on process engineering; it is not fully conceivable without an appropriate process definition. To assure the operability of the learning factory, we recommend considering the following minimum requirements:

2.1 Planning/Scheduling: Ensure that proper scheduling and planning activities are incorporated to maintain efficient operations.

2.4 IoT Infrastructure/Data Acquisition/Digitization of Production: Implement the necessary digital infrastructure for real-time monitoring and data analysis to optimize the production process.

Translated Text

PROCESNO INŽENIRSTVO

Na podlagi vaših odgovorov vsebine, povezane s procesnim inženiringom, niso pomemben poudarek v kurikulumu, razvitem za učno tovarno. Dejavnosti, povezane s fazo procesnega inženiringa, očitno niso prednostna naloga vaše učne tovarne ali učnih ciljev, ki jih želite izpostaviti.

Vaše izraženo zanimanje za dejavnosti, povezane s procesnim inženiringom, je minimalno, v nekaterih primerih pa povsem odsotno. Čeprav je tak pristop skladen z dejstvom, da programi vaše učne tovarne niso neposredno povezani s procesnim inženiringom, velja poudariti, da mora učna tovarna za učinkovito delovanje vključevati tudi proizvodni proces za izdelavo izdelka. To zahteva vsaj osnovno raven pozornosti, namenjene dejavnostim, povezanim s procesnim inženiringom. Poleg tega učna tovarna skorajda ne more delovati brez vsaj minimalnega poudarka na procesnem inženiringu; delovanje brez ustrezne definicije procesa si je težko predstavljati. Za zagotavljanje delovanja učne tovarne priporočamo, da razmislite o naslednjih minimalnih zahtevah:
2.1 Načrtovanje/razporejanje: Zagotovite, da so vpeljane ustrezne dejavnosti načrtovanja in razporejanja za ohranjanje učinkovitega delovanja.
2.4 IoT infrastruktura/Pridobivanje podatkov/Digitalizacija proizvodnje: Vzpostavite potrebno digitalno infrastrukturo za spremljanje v realnem času in analizo podatkov z namenom optimizacije proizvodnega procesa.

Original Text

You have identified some activities associated with the process engineering phase as being transversely related to the curriculum to be implemented in the learning factory. Yet, these activities are not the primary focus of the curriculum you aim to primarily address. Key Considerations

Influence on Value Chain Activities: Although process engineering is not the central emphasis of your learning factory, it significantly affects many aspects of its operation, including the value chain activities that are the main focus of your learning initiatives. The manufacturing process implemented will influence all steps in the value chain, either directly or indirectly. Regardless of the product and process chosen, it is critical to establish a robust process that ensures appropriate task planning and scheduling (Section 2.1: Planning/Scheduling).

IoT Infrastructure and Digitization: Achieving a digitized learning factory requires a consistent IoT infrastructure, regardless of the level of digitization. This infrastructure should be designed to scale as the learning factory evolves (Section 2.4: IoT Infrastructure/Data Acquisition/Digitization of Production). These foundational tasks must be carefully defined, as they underpin all other tasks and provide essential support for their successful execution. Additional Areas for Development

Lean Manufacturing: (Section 2.2)

Automation: (Section 2.3)

Robot Integration (e.g., cobots, AGVs, robots): (Section 2.4)

Energy Efficiency and Sustainability: (Section 2.5) Recommendations

Ensure your learning factory is technically equipped to support learning activities related to process engineering.

Consider developing an investment plan from a process engineering perspective to scale and optimize the learning factory.

Recognize that process engineering is closely tied to product design. It is essential to integrate product design considerations into your planning to ensure alignment with process engineering goals.

Translated Text

Opredelili ste nekatere dejavnosti, povezane s fazo procesnega inženiringa, kot prečno povezane s kurikulumom, ki ga nameravate uvesti v učni tovarni. Kljub temu te dejavnosti niso osrednji poudarek kurikuluma, ki ga želite predvsem razvijati. Ključni vidiki za razmislek

Vpliv na dejavnosti v vrednostni verigi: Čeprav procesni inženiring ni osrednji poudarek vaše učne tovarne, pomembno vpliva na številne vidike njenega delovanja, vključno z dejavnostmi v vrednostni verigi, ki so glavni fokus vaših učnih pobud. Izbrani proizvodni proces bo neposredno ali posredno vplival na vse korake v vrednostni verigi. Ne glede na izbran izdelek in proces je ključnega pomena vzpostaviti zanesljiv proces, ki zagotavlja ustrezno načrtovanje in razporejanje nalog (2.1 Načrtovanje/razporejanje).

IoT infrastruktura in digitalizacija: Za dosego digitalizirane učne tovarne je potrebna dosledna IoT infrastruktura, ne glede na stopnjo digitalizacije. Ta infrastruktura mora biti zasnovana tako, da se lahko razvija skupaj z rastjo in razvojem učne tovarne (2.4 IoT infrastruktura / Pridobivanje podatkov / Digitalizacija proizvodnje). Te temeljne naloge morajo biti natančno opredeljene, saj predstavljajo osnovo za vse druge naloge in nudijo ključno podporo za njihovo uspešno izvedbo. Dodatna področja za razvoj
Vitka proizvodnja: (2.2. poglavje)
Avtomatizacija: (2.3. poglavje)

Integracija robotov (npr. sodelujoči roboti – coboti, AGV-ji, roboti): (2.4. poglavje)
Energetska učinkovitost in trajnost: (2.5. poglavje) Priporočila
Zagotovite, da je vaša učna tovarna tehnično ustrezno opremljena za izvajanje učnih dejavnosti, povezanih s procesnim inženiringom.
Razmislite o oblikovanju investicijskega načrta z vidika procesnega inženiringa za širitev in optimizacijo učne tovarne.
Zavedajte se, da je procesni inženiring tesno povezan z oblikovanjem izdelkov. Ključno je, da v svoje načrtovanje vključite tudi vidike oblikovanja izdelkov, da zagotovite usklajenost s cilji procesnega inženiringa.

Original Text

You have identified some activities associated with the process engineering phase as integral to the curriculum you aim to develop in your learning factory. Notably, at least one of these process engineering related activities is considered a core element of the curriculum. Consequently, it is clear that many learning activities in your learning factory align closely with these value chain processes. Recommendations for Successful Implementation:
1. Approach to Process Engineering: The role of process engineering in the learning factory can be understood in two key ways:

Process Engineering as a Foundation: The manufacturing process serves as the cornerstone for all activities within the learning factory. Developing a robust process engineering framework is critical to ensure optimal conditions for lean manufacturing, robotics integration, automated production, energy efficiency, and more. Core elements to focus on include:
Section 2.1: Planning/Scheduling
Section 2.2: Lean Manufacturing
Section 2.5: Energy Efficiency and Sustainability

Process Creation as a Learning Activity: Alternatively, the creation of manufacturing processes can itself become a learning activity within the factory. This approach involves teaching methodologies for technology integration, workstation automation, and testing various technologies for different purposes. Key activities to address here include:
Section 2.3: Automation
Section 2.4: Robot Integration (e.g., cobots, AGVs, robots)

2. IoT Infrastructure and Digitization: Achieving a digitized learning factory requires a scalable IoT infrastructure. Regardless of the initial level of digitization, this infrastructure must be designed for growth as the factory evolves. Activities outlined in Section 2.4: IoT Infrastructure/Data Acquisition/Digitization of Production are essential to reaching these goals.
3. Technical Readiness for Process Engineering Activities: Ensure that the learning factory is technically equipped to support all relevant process engineering activities. Developing an investment plan from a process engineering perspective can help scale and optimize the learning factory effectively.

4. Integration of Product Design Considerations: Process engineering is intrinsically linked to product design. Incorporating product design considerations into your planning is essential to ensure alignment and synergy between product and process engineering goals.

Translated Text

Opredelili ste nekatere dejavnosti, povezane s fazo procesnega inženiringa, kot sestavni del kurikuluma, ki ga želite razviti v svoji učni tovarni. Vsaj ena od teh dejavnosti, povezanih s procesnim inženiringom, je opredeljena kot osrednji element kurikuluma. Posledično je jasno, da se številne učne dejavnosti v vaši učni tovarni tesno povezujejo s temi procesi vrednostne verige.
Priporočila za uspešno izvedbo:
Pristop k procesnemu inženiringu: Vloga procesnega inženiringa v učni tovarni se lahko razume na dva ključna načina:

Procesni inženiring kot temelj: Proizvodni proces služi kot temelj za vse dejavnosti v učni tovarni. Razvoj trdnega okvirja za procesni inženiring je ključen za zagotavljanje optimalnih pogojev za vitko proizvodnjo, integracijo robotike, avtomatizirano proizvodnjo, energetsko učinkovitost in drugo.
Ključni elementi, na katere se je treba osredotočiti, vključujejo
Poglavje 2.1: Načrtovanje/Razporejanje
Poglavje 2.2: Vitka proizvodnja
Poglavje 2.5: Energetska učinkovitost in trajnost

Ustvarjanje procesa kot učna dejavnost: Alternativno lahko ustvarjanje proizvodnih procesov samo po sebi postane učna dejavnost v tovarni. Ta pristop vključuje učne metodologije za integracijo tehnologije, avtomatizacijo delovnih postaj in preizkušanje različnih tehnologij za različne namene.
Ključne dejavnosti, ki jih je tukaj treba obravnavati, vključujejo:
Poglavje 2.3: Avtomatizacija
Poglavje 2.4: Integracija robotov (npr. sodelujoči roboti, AGV-ji, roboti)

2. IoT infrastruktura in digitalizacija: Za dosego digitalizirane učne tovarne je potrebna razširljiva IoT infrastruktura. Ne glede na začetno raven digitalizacije mora biti ta infrastruktura zasnovana za rast, ko se tovarna razvija. Dejavnosti, opisane v poglavju 2.4: IoT infrastruktura / Pridobivanje podatkov / Digitalizacija proizvodnje, so bistvene za dosego teh ciljev.
3. Tehnična pripravljenost za dejavnosti procesnega inženiringa: Poskrbite, da je učna tovarna tehnično opremljena za podporo vsem relevantnim dejavnostim procesnega inženiringa. Oblikovanje investicijskega načrta z vidika procesnega inženiringa lahko pripomore k učinkoviti širitvi in optimizaciji učne tovarne.

4. Vključevanje vidikov oblikovanja izdelkov: Procesni inženiring je neločljivo povezan z oblikovanjem izdelkov. Vključitev vidikov oblikovanja izdelkov v načrtovanje je bistvena za zagotavljanje usklajenosti in sinergije med cilji oblikovanja izdelka in procesnega inženiringa.

Original Text

MANUFACTURING, QUALITY & MAINTENANCE

Based on your responses, learning contents related to manufacturing, quality & maintenance are not a significant focus in the curricula developed for the Learning Factory. Activities associated with the manufacturing, quality & maintenance phase do not appear to be a priority for the learning objectives you aim to emphasize.

Your interest in manufacturing, quality, and maintenance activities appears to be minimal and, in some cases, entirely absent. It is important to note that a Learning Factory is designed to facilitate both the practical manufacturing of a product and the integration of learning activities based on that process. This inherently requires at least a basic level of attention to manufacturing-related processes, which can also serve as a foundation for piloting other value chain activities of greater interest to your institution, such as product design or process engineering. To Ensure the Operability of the Learning Factory, We Recommend Meeting the Following Minimum Requirements:

Define a Simple Manufacturing Process: Define a simple manufacturing process that includes at least the essential components necessary to operate the Learning Factory. This simplified process should allow for the integration of other activities that align more closely with your primary interests.

Straightforward Assembly Process: Generally, a straightforward assembly process (e.g., assisted, manual, or automated assembly) can provide sufficient functionality to support the development of various other learning activities.

Translated Text

PROIZVODNJA, KAKOVOST IN VZDRŽEVANJE

Na podlagi vaših odgovorov vsebine, povezane s proizvodnjo, kakovostjo in vzdrževanjem, niso pomemben poudarek v kurikulumu, razvitim za učno tovarno. Dejavnosti, povezane s fazo proizvodnje, kakovosti in vzdrževanja, očitno niso prednostna naloga za učne cilje, ki jih želite poudariti.

Vaše zanimanje za dejavnosti, povezane s proizvodnjo, kakovostjo in vzdrževanjem, je očitno minimalno ali v nekaterih primerih povsem odsotno. Pomembno je poudariti, da je učna tovarna zasnovana tako, da omogoča tako praktično izvedbo proizvodnje izdelka kot vključevanje učnih dejavnosti, temelječih na tem procesu. To že po naravi zahteva vsaj osnovno raven pozornosti proizvodnim procesom, ki lahko služijo tudi kot osnova za preizkušanje drugih dejavnosti v vrednostni verigi, ki so za vašo institucijo pomembnejše, kot sta oblikovanje izdelkov ali procesni inženiring. Za zagotovitev delovanja učne tovarne priporočamo izpolnjevanje naslednjih minimalnih zahtev:
Opredelite enostaven proizvodni proces: Opredelite enostaven proizvodni proces, ki vključuje vsaj osnovne sestavne dele, potrebne za delovanje učne tovarne. Ta poenostavljen proces naj omogoča vključevanje drugih dejavnosti, ki se bolj ujemajo z vašimi primarnimi interesi.

Enostaven sestavni proces: Na splošno lahko enostaven sestavni proces (npr. podprt, ročni ali avtomatiziran sestav) zagotovi zadostno funkcionalnost za podporo razvoju različnih drugih učnih dejavnosti.

Original Text

You have identified some activities associated with the manufacturing, quality & maintenance phase as being transversely related to the curriculum to be implemented in the learning factory. Yet, these activities are not the primary focus of the curriculum you aim to primarily address.

The activities in this value chain step are where the actual manufacturing process takes place. The previous 2 steps, product design and process engineering, are preparatory phases to achieve the production capabilities. Several aspects of advanced manufacturing can be reproduced within this step. Therefore, a consistent manufacturing process would allow to successfully integrate learning contents into the learning factory. Key Considerations:

Multiple Process Integration: In value chains that involve multiple manufacturing processes (e.g., Section 3.2), the learning factory becomes a versatile environment for knowledge acquisition. The ability to include content across processes enhances the curriculum and enables the simulation of diverse scenarios by operating the full production chain.
Quality Control & Maintenance: Processes such as product quality control (Section 3.4) and maintenance (Section 3.5) are critical for the viability of any production process. Quality control or maintenance have enough entity in a value chain to be considered independent activities, and therefore their integration into the learning factory is necessary to cover a comprehensive curriculum. It is advisable to include learning activities related to these essential processes in your learning factory, even at a basic level.
Cybersecurity & Digital Infrastructure: Like any digitalized industrial environment, the learning factory must ensure the cybersecurity of its production structure (Section 3.6). Incorporating OT cybersecurity, regardless of its weight in the curriculum, is indispensable. Additionally, the establishment of a robust digital infrastructure (Section 3.8) enables the creation of numerous learning scenarios. This digital foundation should include an MES system to manage data from the learning factory, facilitating smooth data processing and enabling the integration of advanced solutions like machine learning.

Industry 5.0 Practices: Although aspects related to Industry 5.0 (Section 3.7) might not have high relevance in your curriculum, it is essential to recognize their growing importance. The principles of human centricity, resilience, and sustainability are shaping industry practices. The learning factory offers an optimal platform to experiment with these elements, embedding them into learning activities for students. Recommendations:
Technical Preparedness: Equip the learning factory with the necessary infrastructure to support manufacturing, quality, and maintenance activities.
Investment Planning: Develop an investment plan focusing on manufacturing, quality control, and maintenance to scale and optimize the facility.
Improvement Opportunities: Enrich the following areas to provide a comprehensive and robust learning experience:
3.2 Multiple process integration (more than 1 manufacturing process i.e. CNC+ 3d printing, composites…)
3.3 Assembly (assisted, manual, automated…)
3.4 Quality control, metrology
3.5 Maintenance
3.6 Cybersecurity

3.7 Sustainability, Human Centricity, resilience, ergonomic, safety (Industry 5.0 & others)

3.8 Digital manufacturing (Data acquisition, MES-ERP- data processing, AI…)
3.9 Supply chain management

Translated Text

Opredelili ste nekatere dejavnosti, povezane s fazo proizvodnje, kakovosti in vzdrževanja, kot prečno povezane s kurikulumom, ki naj bi se izvajal v učni tovarni. Kljub temu te dejavnosti niso glavni poudarek kurikuluma, ki ga želite razvijati.

Dejavnosti v tem koraku vrednostne verige so tiste, kjer dejansko poteka proizvodni proces. Predhodna koraka, oblikovanje izdelka in procesni inženiring, sta pripravljalni fazi za dosego proizvodnih zmogljivosti. Več vidikov napredne proizvodnje je mogoče ponoviti znotraj tega koraka. Zato bi dosleden proizvodni proces omogočil uspešno vključevanje učnih vsebin v učno tovarno.
Ključni vidiki:

Vključevanje več proizvodnih procesov: V vrednostnih verigah, ki vključujejo več proizvodnih procesov (npr. poglavje 3.2), postane učna tovarna vsestransko okolje za pridobivanje znanja. Sposobnost vključevanja vsebin med različnimi procesi obogati kurikulum in omogoča simulacijo različnih scenarijev z delovanjem celotne proizvodne verige.
Kontrola kakovosti in vzdrževanje: Procesi, kot sta kontrola kakovosti izdelkov (poglavje 3.4) in vzdrževanje (poglavje 3.5), so ključni za vzdržnost katerega koli proizvodnega procesa. Kontrola kakovosti ali vzdrževanje imata dovolj pomembno vlogo v vrednostni verigi, da ju lahko obravnavamo kot samostojni dejavnosti, zato je njuna vključitev v učno tovarno potrebna za celovit kurikulum. Priporočljivo je vključiti učne dejavnosti, povezane s temi ključnimi procesi v vaši učni tovarni, tudi na osnovni ravni.

Kibernetska varnost in digitalna infrastruktura: Kot v vsakem digitaliziranem industrijskem okolju mora učna tovarna zagotoviti kibernetsko varnost svoje proizvodne strukture (poglavje 3.6). Vključitev OT kibernetske varnosti je nepogrešljiva, ne glede na njeno težo v kurikulumu. Poleg tega vzpostavitev robustne digitalne infrastrukture (poglavje 3.8) omogoča ustvarjanje številnih učnih scenarijev. Ta digitalna osnova naj vključuje MES sistem za upravljanje podatkov iz učne tovarne, kar omogoča nemoteno obdelavo podatkov in integracijo naprednih rešitev, kot je strojno učenje.

Prakse Industrije 5.0: Čeprav elementi, povezani z Industrijo 5.0 (poglavje 3.7), morda nimajo velike teže v vašem kurikulumu, je pomembno prepoznati njihov vse večji pomen. Načela osredotočenosti na človeka, odpornosti in trajnosti oblikujejo industrijsko prakso. Učna tovarna ponuja optimalno okolje za preizkušanje teh elementov in njihovo vključevanje v učne dejavnosti za študente.
Priporočila:
Tehnična pripravljenost: Opremljenost učne tovarne z ustrezno infrastrukturo za podporo dejavnostim, povezanih s proizvodnjo, kakovostjo in vzdrževanjem.
Načrtovanje investicij: Oblikovanje investicijskega načrta, osredotočenega na proizvodnjo, kontrolo kakovosti in vzdrževanje, za širitev in optimizacijo zmogljivosti.
Možnosti za izboljšave: Obogatitev naslednjih področij za zagotavljanje celovite in kakovostne učne izkušnje:
3.2 Vključevanje več proizvodnih procesov (več kot en proizvodni proces, npr. CNC + 3D tisk, kompoziti...)
3.3 Sestavljanje (podprto, ročno, avtomatizirano...)
3.4 Kontrola kakovosti, meroslovje
3.5 Vzdrževanje
3.6 Kibernetska varnost

3.7 Trajnost, osredotočenost na človeka, odpornost, ergonomija, varnost (Industrija 5.0 in drugi)

3.8 Digitalna proizvodnja (pridobivanje podatkov, MES-ERP, obdelava podatkov, umetna inteligenca...)
3.9 Upravljanje dobavne verige

MANUFACTURING, QUALITY & MAINTENANCE

You have identified some activities associated with the manufacturing, quality & maintenance phase as integral to the curriculum you aim to develop in your learning factory. Notably, at least one of these manufacturing, quality & maintenance related activities is considered a core element of the curriculum. Consequently, it is clear that many learning activities in your learning factory align closely with these value chain processes.
The activities in this value chain step are where the actual manufacturing process takes place. The previous 2 steps, product design and process engineering, are preparatory phases to achieve the production capabilities. Several aspects of advanced manufacturing can be reproduced within this step. Therefore, a consistent manufacturing process would allow to successfully integrate learning contents into the learning factory. Key Considerations & Recommendations:

Multiple Process Integration: In value chains that involve multiple manufacturing processes (e.g., Section 3.2), the learning factory becomes a versatile environment for knowledge acquisition. The ability to include content across processes enhances the curriculum and enables the simulation of diverse scenarios by operating the full production chain. A balance of integrating additional processes and the operational complexity of managing multiple processes should be considered. Along with assembly workstations, production workstations are the most suitable places in the learning factory to include learning content related to lean manufacturing, production scheduling, automated production, assisted production, human technology integration, and many others.

Quality Control & Maintenance: Processes such as product quality control (Section 3.4) and maintenance (Section 3.5) are critical for the viability of any production process. Quality control or maintenance have enough entity in a value chain to be considered independent activities from the actual manufacturing. Therefore, if quality control and/or maintenance are key elements within your curriculum, you may consider the creation of a specific value chain step for them. Learning activities such as metrology, functional and/or mechanical testing, process inspection, statistical process control including in-line automated control, traceability, machine learning, and others would be managed under the quality control area. On the other hand, when activities related to maintenance gain relevance, an independent section for maintenance makes a lot of sense, to include learning activities such as predictive, preventive, and corrective maintenance, maintenance management systems (GMAO), machine learning related to maintenance.

Robust Digital Infrastructure: The establishment of a robust digital infrastructure (Section 3.8) forms the backbone of all digital activities within the learning factory and facilitates the creation of numerous learning scenarios. For advanced learning factories, the digital foundation must include an MES system to manage data from the learning factory, integrated with an ERP system. The significance of this infrastructure lies in the fact that many essential activities depend on it, including manufacturing scheduling, digitalized manufacturing links, OEE calculation, digital twins of the process, digital maintenance, product traceability, learning process traceability, and the availability of learning materials within the learning factory, among others. It also assures the appropriate collaboration among learning factories. Equally important are the data processing systems, without which the entire infrastructure would be ineffective.
Cybersecurity: Cybersecurity can be placed among the main current responsibilities of companies, and it is equally necessary in learning factories. In addition to ensuring OT cybersecurity within the learning factory, it is also essential to enable learning tasks related to this topic (Section 3.6). An advanced learning factory must include learning activities related to cybersecurity.

Industry 5.0 Practices: Aspects related to Industry 5.0 (Section 3.7) have a growing importance in industry. The principles of human centrality, resilience, and sustainability are shaping industry practices. The learning factory offers an optimal platform to experiment with these elements, embedding them into learning activities for students.

Supply Chain Management: An optimal process management (Section 3.9) includes also the supply chain management where elements such as warehouse management, parts and components stock management, (raw) material management, supplier management, distribution & logistics, and others come into play. Explore the opportunities that the learning factory offers to add learning activities related to those aspects. Recommendations:
Technical Preparedness: Equip the learning factory with the necessary infrastructure to support manufacturing, quality, and maintenance activities.
Investment Planning: Develop an investment plan focusing on manufacturing, quality control, and maintenance to scale and optimize the facility.

Translated Text

Opredelili ste nekatere dejavnosti, povezane s fazo proizvodnje, kakovosti in vzdrževanja, kot sestavni del kurikuluma, ki ga želite razviti v svoji učni tovarni. Vsaj ena od teh dejavnosti je opredeljena kot osrednji element kurikuluma. Posledično je jasno, da se številne učne dejavnosti v vaši učni tovarni tesno povezujejo s temi procesi vrednostne verige.

Dejavnosti v tem koraku vrednostne verige so tiste, kjer dejansko poteka proizvodni proces. Predhodna koraka, oblikovanje izdelka in procesni inženiring, sta pripravljalni fazi za dosego proizvodnih zmogljivosti. V tem koraku je mogoče ponoviti več vidikov napredne proizvodnje. Zato bi dosleden proizvodni proces omogočil uspešno vključevanje učnih vsebin v učno tovarno. Ključni vidiki in priporočila:

Vključevanje več procesov: V vrednostnih verigah, ki vključujejo več proizvodnih procesov (npr. poglavje 3.2), postane učna tovarna vsestransko okolje za pridobivanje znanja. Sposobnost vključevanja vsebin med različnimi procesi bogati kurikulum in omogoča simulacijo različnih scenarijev z delovanjem celotne proizvodne verige. Treba je razmisliti o ravnovesju med integracijo dodatnih procesov in operativno kompleksnostjo njihovega upravljanja. Poleg sestavnih delovnih postaj so proizvodne postaje najbolj primerna mesta v učni tovarni za vključitev vsebin, povezanih z vitko proizvodnjo, načrtovanjem proizvodnje, avtomatizirano proizvodnjo, podprto proizvodnjo, integracijo človeka in tehnologije ter številnimi drugimi temami.

Kontrola kakovosti in vzdrževanje: Procesi, kot sta kontrola kakovosti izdelkov (poglavje 3.4) in vzdrževanje (poglavje 3.5), so ključni za uspešno izvajanje katerega koli proizvodnega procesa. Kontrola kakovosti ali vzdrževanje imata dovolj močan pomen v vrednostni verigi, da ju lahko obravnavamo kot samostojni dejavnosti. Če sta kontrola kakovosti in/ali vzdrževanje ključna elementa vašega kurikuluma, lahko razmislite o vzpostavitvi posebnega koraka v vrednostni verigi, namenjenega tem vsebinam. Učne dejavnosti, kot so meroslovje, funkcionalno in/ali mehansko testiranje, pregled procesa, statistični nadzor procesa, vključno z avtomatiziranim nadzorom v realnem času, sledljivost, strojno učenje in druge, bi spadale pod področje kontrole kakovosti. Ko pa postanejo pomembnejše dejavnosti, povezane z vzdrževanjem, je smiselno vzpostaviti ločen odsek, ki vključuje učne vsebine, kot so prediktivno, preventivno in korektivno vzdrževanje, sistemi za upravljanje vzdrževanja (GMAO) in strojno učenje, povezano z vzdrževanjem.

Zanesljiva digitalna infrastruktura: Vzpostavitev robustne digitalne infrastrukture (poglavje 3.8) predstavlja temelj vseh digitalnih dejavnosti znotraj učne tovarne in omogoča oblikovanje številnih učnih scenarijev. Za napredne učne tovarne mora ta digitalna osnova vključevati MES sistem za upravljanje podatkov iz učne tovarne, povezan z ERP sistemom. Pomembnost te infrastrukture je v tem, da številne ključne dejavnosti temeljijo nanjo, kot so načrtovanje proizvodnje, digitalne povezave proizvodnje, izračun OEE, digitalni dvojčki procesa, digitalno vzdrževanje, sledljivost izdelkov, sledljivost učnih procesov in razpoložljivost učnih vsebin v učni tovarni. Prav tako zagotavlja ustrezno sodelovanje med učnimi tovarnami. Enako pomembni so sistemi za obdelavo podatkov, brez katerih celotna infrastruktura ne bi delovala učinkovito.

Kibernetska varnost: Kibernetska varnost je ena od glavnih sodobnih odgovornosti podjetij, enako pa velja za učne tovarne. Poleg zagotavljanja OT kibernetske varnosti v učni tovarni je pomembno omogočiti tudi učne naloge, povezane s to temo (poglavje 3.6). Napredna učna tovarna mora vključevati učne dejavnosti, povezane s kibernetsko varnostjo.

Prakse Industrije 5.0: Vidiki, povezani z Industrijo 5.0 (poglavje 3.7), imajo vedno večji pomen v industriji. Načela osredotočenosti na človeka, odpornosti in trajnosti oblikujejo industrijsko prakso. Učna tovarna ponuja optimalno platformo za eksperimentiranje s temi elementi in njihovo vključevanje v učne dejavnosti za študente.

Upravljanje dobavne verige: Optimalno upravljanje procesov (poglavje 3.9) vključuje tudi upravljanje dobavne verige, kjer pridejo v poštev elementi, kot so upravljanje skladišč, zalog delov in komponent, upravljanje (surovin) in materialov, upravljanje dobaviteljev, distribucija in logistika ter drugo. Raziskujte priložnosti, ki jih učna tovarna ponuja za vključitev učnih dejavnosti, povezanih s temi vidiki. Priporočila:
Tehnična pripravljenost: Opremljenost učne tovarne z ustrezno infrastrukturo za podporo dejavnostim, povezanih s proizvodnjo, kakovostjo in vzdrževanjem.
Načrtovanje investicij: Razvoj investicijskega načrta s poudarkom na proizvodnji, kontroli kakovosti in vzdrževanju za širitev in optimizacijo zmogljivosti.

Original Text

LOGISTICS

Based on your responses, learning content related to logistics is not a significant focus in the curricula developed for the Learning Factory. Activities associated with logistics do not appear to be a priority for your learning factory or the learning objectives you aim to emphasize.

Your expressed interest in logistics activities is minimal, and in some cases, entirely absent. While this approach aligns with the fact that your learning factory programs are not directly linked to logistics, it is worth noting that for a learning factory to operate effectively, it includes the manufacturing of a product. In that process, a foundational level of attention to logistics-related activities is needed. Therefore, we recommend considering the following minimum requirements:

4.1 Intra-logistics, warehouse control: Take care of the basic aspects of material flow management, inventory management, warehouse management, and similar.

4.2 Traceability: We suggest identifying the critical materials or components circulating in your learning factory and taking actions to track their progress in the production process. Additionally, traceability can refer also to tracking the student's learning progress.

Translated Text

LOGISTIKA

Na podlagi vaših odgovorov vsebine, povezane z logistiko, niso pomemben poudarek v kurikulumu, razvitem za učno tovarno. Dejavnosti, povezane z logistiko, očitno niso prednostna naloga vaše učne tovarne ali učnih ciljev, ki jih želite izpostaviti.

Vaše izraženo zanimanje za logistične dejavnosti je minimalno in v nekaterih primerih celo popolnoma odsotno. Čeprav je tak pristop skladen z dejstvom, da programi vaše učne tovarne niso neposredno povezani z logistiko, velja poudariti, da učinkovito delovanje učne tovarne vključuje tudi proizvodnjo izdelka. V tem procesu je potrebna osnovna raven pozornosti logističnim dejavnostim. Zato priporočamo, da razmislite o naslednjih minimalnih zahtevah:

4.1 Intralogistika, nadzor skladišča: Poskrbite za osnovne vidike upravljanja pretoka materiala, upravljanja zalog, upravljanja skladišča in podobno.
4.2 Sledljivost: Predlagamo, da prepoznate ključne materiale ali komponente, ki krožijo v vaši učni tovarni, in uvedete ukrepe za sledenje njihovemu napredku v proizvodnem procesu. Poleg tega se lahko sledljivost nanaša tudi na sledenje napredku učečih v učnem procesu.

Original Text

You have identified some activities associated with the logistics phase as being transversely related to the curriculum to be implemented in the learning factory. Yet, these activities are not the primary focus of the curriculum you aim to primarily address.

At this point, some relevant aspects should be considered: Although logistics may not be the main emphasis of your learning factory, the logistics process chosen will significantly influence many aspects of the learning factory's operations, including those activities of the value chain that actually are the main focus for your own learning factory. For instance, the layout of the equipment and workstations defines certain material flow that will be dependent on the (intra)logistics system and will limit the changeability or modularity of your learning factory.

Depending on the manufacturing process chosen for your learning factory, the logistics will delimit several aspects of the operations. Here you have a list of key aspects to consider in logistics: Key Aspects to Address in Logistics:

Material Flow Management: Planning and controlling the movement of raw materials, components, and finished goods within the learning factory. Optimization of storage, handling, and transportation processes.

Inventory Management: Techniques for tracking and managing stock levels to ensure efficient supply chain operations. Use of inventory control systems to minimize costs while meeting demand.

Supply Chain Integration: Coordination between different stages of the supply chain, including procurement, production, and distribution. Real-time data sharing and collaboration among supply chain participants.

Digital Logistics: Application of digital tools like ERP (Enterprise Resource Planning), WMS (Warehouse Management Systems), and IoT devices to enhance visibility and decision-making. Simulating smart logistics scenarios, such as autonomous vehicle routing or drone-based inventory checks.

Sustainability in Logistics: Reducing the environmental impact of logistics operations through green practices. Experimenting with renewable energy solutions, optimized routing, and recyclable packaging.

Reverse Logistics: Handling returns, recycling, and disposal processes efficiently. Exploring circular economy models within the learning factory. Recommendations to Enhance Logistic Readiness:

Incorporate advanced equipment: Such as digital twin technologies, automated guided vehicles, augmented reality/virtual reality systems, and real-time location systems (RTLS).

Implement Logistics 4.0 tools: Including conveyor belt systems, order-picking systems, and connected material flow systems to enhance operational efficiency.

Focus on connected and integrated systems: To align with modern logistical practices.

Translated Text

Opredelili ste nekatere dejavnosti, povezane z logistično fazo, kot prečno povezane s kurikulumom, ki bo izveden v učni tovarni. Kljub temu te dejavnosti niso glavni poudarek kurikuluma, ki ga želite razvijati.

Na tej točki je smiselno upoštevati nekatere pomembne vidike: Čeprav logistika morda ni glavni poudarek vaše učne tovarne, bo izbrani logistični proces pomembno vplival na številne vidike njenega delovanja, vključno s tistimi dejavnostmi v vrednostni verigi, ki dejansko predstavljajo osrednji fokus vaše učne tovarne. Na primer, razporeditev opreme in delovnih postaj določa določen tok materiala, ki bo odvisen od (intra)logističnega sistema in bo omejeval prilagodljivost ali modularnost vaše učne tovarne.

Glede na izbrani proizvodni proces v vaši učni tovarni bo logistika določala več vidikov delovanja. Tukaj je seznam ključnih vidikov, ki jih je treba upoštevati v logistiki: Ključni vidiki za obravnavo v logistiki:

Upravljanje pretoka materiala: Načrtovanje in nadzor premikanja surovin, komponent in končnih izdelkov znotraj učne tovarne. Optimizacija skladiščenja, ravnanja z materiali in transportnih procesov.
Upravljanje zalog: Tehnike za spremljanje in upravljanje zalog za zagotavljanje učinkovitega delovanja oskrbovalne verige. Uporaba sistemov za upravljanje zalog za zmanjšanje stroškov ob hkratnem zadovoljevanju povpraševanja.
Integracija oskrbovalne verige: Koordinacija med različnimi fazami oskrbovalne verige, vključno z nabavo, proizvodnjo in distribucijo. Izmenjava podatkov v realnem času in sodelovanje med udeleženci v oskrbovalni verigi.
Digitalna logistika: Uporaba digitalnih orodij, kot so ERP (načrtovanje virov podjetja), WMS (sistemi za upravljanje skladišč) in IoT naprave za večjo preglednost in podporo pri odločanju. Simulacija pametnih logističnih scenarijev, kot so avtonomna vozila ali inventurne kontrole z droni.
Trajnost v logistiki: Zmanjševanje okoljskega vpliva logističnih dejavnosti z zelenimi praksami. Preizkušanje rešitev z obnovljivimi viri energije, optimizacija poti in uporaba reciklirane embalaže.
Povratna logistika: Učinkovito obravnavanje vračil, recikliranja in odlaganja. Raziskovanje modelov krožnega gospodarstva znotraj učne tovarne.
Priporočila za izboljšanje pripravljenosti na področju logistike: Vključite napredno opremo: Na primer tehnologije digitalnih dvojčkov, avtomatizirana vodena vozila, sisteme obogatene/virtualne resničnosti in sisteme za sledenje v realnem času (RTLS).
Uvedite orodja logistike 4.0: Vključno s sistemi transportnih trakov, sistemi za pripravo naročil in povezanimi sistemi za pretok materiala za večjo operativno učinkovitost.

Osredotočite se na povezane in integrirane sisteme: Da zagotovite skladnost s sodobnimi logističnimi praksami.

Original Text

You have identified certain activities within the logistic phase as integral to the curriculum you aim to develop in your learning factory. Notably, at least one of these logistic-related activities is considered a core element of the curriculum. Consequently, it is clear that many learning activities in your learning factory align closely with these value chain processes.

Key Considerations

The reasons to foster the logistics phase in your learning factory may be different:

To equip learners with the knowledge and skills to manage logistics systems effectively.

To foster innovation in logistics through experimentation and research.

To assure an effective logistics system within your learning factory, which will allow further learning activities in other value chain steps.

Key Areas of Focus:

The logistics system will influence several aspects of your learning factory, depending on the manufacturing process chosen. Within the logistics phase, you have opportunities to boost learning activities in the following areas, among others (Sections 4.1, 4.2):

Material Flow Management: Planning and controlling the movement of raw materials, components, and finished goods within the learning factory. Optimization of storage, handling, and transportation processes.

Inventory Management: Techniques for tracking and managing stock levels to ensure efficient supply chain operations. Use of inventory control systems to minimize costs while meeting demand.

Supply Chain Integration: Coordination between different stages of the supply chain, including procurement, production, and distribution. Real-time data sharing and collaboration among supply chain participants.

Digital Logistics: Application of digital tools like ERP (Enterprise Resource Planning), WMS (Warehouse Management Systems), and IoT devices to enhance visibility and decision-making. Simulating smart logistics scenarios, such as autonomous vehicle routing or drone-based inventory checks.

Sustainability in Logistics: Reducing the environmental impact of logistics operations through green practices. Experimenting with renewable energy solutions, optimized routing, and recyclable packaging.

Reverse Logistics: Handling returns, recycling, and disposal processes efficiently. Exploring circular economy models within the learning factory.

Recommendations to Enhance Logistic Readiness:

Incorporate advanced equipment such as digital twin technologies, automated guided vehicles, augmented reality/virtual reality systems, and real-time location systems (RTLS).

Implement Logistics 4.0 tools, including conveyor belt systems, order-picking systems, and connected material flow systems, to enhance operational efficiency.

Focus on connected and integrated systems to align with modern logistical practices.

Translated Text

Ugotovili ste, da so nekatere dejavnosti v okviru logistične faze sestavni del kurikuluma, ki ga želite razviti v svoji učni tovarni. Vsaj ena od teh logističnih dejavnosti je opredeljena kot osrednji element kurikuluma. Posledično je jasno, da se številne učne dejavnosti v vaši učni tovarni tesno povezujejo s temi procesi vrednostne verige.

Ključni vidiki

Razlogi za krepitev logistične faze v vaši učni tovarni so lahko različni:

Opremljanje učečih z znanjem in veščinami za učinkovito upravljanje logističnih sistemov.

Spodbujanje inovacij v logistiki skozi eksperimentiranje in raziskave.

Zagotavljanje učinkovitega logističnega sistema v vaši učni tovarni, ki bo omogočal nadaljnje učne dejavnosti v drugih korakih vrednostne verige.

Ključna področja osredotočenosti:

Logistični sistem bo vplival na več vidikov vaše učne tovarne, odvisno od izbranega proizvodnega procesa. V okviru logistične faze imate priložnost okrepiti učne dejavnosti na naslednjih področjih (med drugim tudi v sklopih 4.1, 4.2):

Upravljanje pretoka materiala: Načrtovanje in nadzor gibanja surovin, komponent in končnih izdelkov znotraj učne tovarne. Optimizacija skladiščenja, rokovanja in transportnih procesov.

Upravljanje zalog: Tehnike za spremljanje in upravljanje zalog za zagotavljanje učinkovitega delovanja oskrbovalne verige. Uporaba sistemov za upravljanje zalog za zmanjšanje stroškov ob hkratnem izpolnjevanju povpraševanja.

Integracija oskrbovalne verige: Koordinacija med različnimi fazami oskrbovalne verige, vključno z nabavo, proizvodnjo in distribucijo. Izmenjava podatkov v realnem času in sodelovanje med udeleženci v oskrbovalni verigi.

Digitalna logistika: Uporaba digitalnih orodij, kot so ERP (načrtovanje virov podjetja), WMS (sistemi za upravljanje skladišč) in IoT naprave za večjo preglednost in podporo pri odločanju. Simulacija pametnih logističnih scenarijev, kot so usmerjanje avtonomnih vozil ali inventura z uporabo dronov.

Trajnost v logistiki: Zmanjševanje okoljskega vpliva logističnih dejavnosti z uporabo zelenih praks. Preizkušanje rešitev z obnovljivimi viri energije, optimizacija poti in reciklirana embalaža.

Povratna logistika: Učinkovito upravljanje vračil, recikliranja in postopkov odstranjevanja. Raziskovanje modelov krožnega gospodarstva v učni tovarni.

Priporočila za izboljšanje logistične pripravljenosti:

Vključite napredno opremo, kot so tehnologije digitalnih dvojčkov, avtomatizirana vodena vozila, sistemi obogatene/virtualne resničnosti in sistemi za sledenje v realnem času (RTLS).

Uvedite orodja logistike 4.0, vključno s transportnimi trakovi, sistemi za pripravo naročil in povezanimi sistemi pretoka materiala za izboljšanje operativne učinkovitosti.

Osredotočite se na povezane in integrirane sisteme, da se uskladite s sodobnimi logističnimi praksami.

Original Text

Based on your responses, learning content related to virtualization is not a significant focus in the curricula developed for your Learning Factory, nor is the use of virtual tools among your current priorities.
Your expressed interest in virtualization appears minimal, and in some cases, entirely absent. While this aligns with the fact that your Learning Factory programs are not directly centered on virtualization, it is worth highlighting that virtualization offers several opportunities to enhance your Learning Factory's effectiveness. Virtual solutions can often significantly reduce the investment required in physical equipment. Additionally, they enable didactic approaches that may be challenging or impractical to replicate in real-world scenarios.
Key Considerations:
We recommend exploring simple and cost-effective virtual solutions, such as simulation software or virtual reality tools, to support your Learning Factory initiatives.

Concerning the learning factory value chain, Manufacturing (Production and Assembly) stages could be good points to pilot virtual solutions. Indeed, hands-on processes are ideal for introducing AR/VR, as they can simplify training, assembly guidance, and error reduction. Additionally, Maintenance processes are suitable for these solutions as maintenance requires repetitive training and troubleshooting, making it a natural fit for virtual tools. These technologies can enhance the attractiveness and motivational appeal of your programs for students.

Translated Text

Na podlagi vaših odgovorov vsebine, povezane z virtualizacijo, niso pomemben poudarek v kurikulumu, razvitem za vašo učno tovarno, prav tako pa uporaba virtualnih orodij trenutno ni med vašimi prednostnimi nalogami. Vaše izraženo zanimanje za virtualizacijo je minimalno in v nekaterih primerih popolnoma odsotno. Čeprav je to skladno z dejstvom, da programi vaše učne tovarne niso neposredno osredotočeni na virtualizacijo, je vendarle vredno poudariti, da virtualizacija ponuja več priložnosti za izboljšanje učinkovitosti učne tovarne. Virtualne rešitve lahko pogosto bistveno zmanjšajo potrebo po vlaganju v fizično opremo. Poleg tega omogočajo didaktične pristope, ki bi jih bilo v resničnih scenarijih težko ali nemogoče ponoviti.

Ključni vidiki

Priporočamo raziskovanje enostavnih in stroškovno učinkovitih virtualnih rešitev, kot so programska oprema za simulacije ali orodja za virtualno resničnost, za podporo pobudam vaše učne tovarne.

V okviru vrednostne verige učne tovarne bi lahko bile faze proizvodnje (izdelava in sestavljanje) primerne točke za preizkus virtualnih rešitev. Praktični procesi so namreč idealni za uvedbo AR/VR, saj lahko poenostavijo usposabljanje, vodenje pri sestavi in zmanjšanje napak. Poleg tega so tudi postopki vzdrževanja primerni za tovrstne rešitve, saj zahtevajo ponavljajoče se usposabljanje in odpravljanje napak, kar virtualna orodja dobro podpirajo.

Te tehnologije lahko povečajo privlačnost in motivacijsko vrednost vaših programov za študente.

Original Text

You have identified certain activities associated with the virtualization phase as being indirectly related to the curriculum intended for implementation in your Learning Factory. This suggests that your institution may have a partial interest in leveraging virtual solutions to enhance learning activities, although these solutions are not the primary focus of the curriculum you aim to address.
Key Considerations:
While virtual solutions may not currently play a prominent role in your Learning Factory, their potential impact cannot be overlooked. We recommend carrying out an analysis of the potential use of virtual solutions and evaluating its impact, balancing costs and benefits.
Relevant Aspects to Consider:
Cost Reduction: Virtual solutions can significantly reduce the investment required for physical equipment, making them a cost-effective alternative.

Enhanced Didactic Opportunities: Virtual tools enable innovative teaching approaches that are challenging or impractical to replicate in real-world scenarios, thereby enriching the learning experience.
Applicability Across the Value Chain: Virtual solutions can be applied to all stages of the value chain, regardless of your institution's primary area of interest.
We encourage you to explore these possibilities as a means to complement and enhance your Learning Factory's curriculum, ensuring it remains both innovative and effective.

Translated Text

Ugotovili ste, da so določene dejavnosti, povezane z virtualizacijsko fazo, posredno povezane s kurikulumom, namenjenim za izvajanje v vaši učni tovarni. To nakazuje, da ima vaša institucija delno zanimanje za izkoriščanje virtualnih rešitev za nadgradnjo učnih dejavnosti, čeprav te rešitve niso osrednji poudarek kurikuluma, ki ga želite izvajati.
Ključni vidiki:
Čeprav virtualne rešitve trenutno morda ne igrajo vidne vloge v vaši učni tovarni, njihovega potencialnega vpliva ne gre spregledati. Priporočamo izvedbo analize potencialne uporabe virtualnih rešitev ter oceno njihovega vpliva ob upoštevanju stroškov in koristi.
Pomembni vidiki, ki jih je treba upoštevati:
Zmanjšanje stroškov: Virtualne rešitve lahko bistveno zmanjšajo naložbe, potrebne za fizično opremo, kar jih naredi stroškovno učinkovito alternativo.

Izboljšane didaktične možnosti: Virtualna orodja omogočajo inovativne pristope k poučevanju, ki jih je v resničnem okolju težko ali nemogoče izvesti, s čimer obogatijo učne izkušnje.
Uporabnost v celotni vrednostni verigi: Virtualne rešitve je mogoče uporabiti v vseh fazah vrednostne verige, ne glede na glavno področje zanimanja vaše institucije.
Spodbujamo vas, da raziščete te možnosti kot sredstvo za dopolnitev in nadgradnjo kurikuluma vaše učne tovarne ter tako zagotovite, da ostane hkrati inovativen in učinkovit.

Original Text

VIRTUALIZATION

You have identified certain activities within the virtualization phase as integral to the curriculum you aim to develop in your learning factory. Notably, at least one of these virtualization activities is considered a core element of the curriculum. Consequently, it is clear that many learning activities in your learning factory align closely with these value chain processes.
Key Areas of Focus:
You already are aware of the opportunities that virtualization brings to a learning factory:

Cost Reduction: Virtual solutions can significantly reduce the investment required for physical equipment, making them a cost-effective alternative.
Enhanced Didactic Opportunities: Virtual tools enable innovative teaching approaches that are challenging or impractical to replicate in real-world scenarios, thereby enriching the learning experience.
Applicability Across the Value Chain: Virtual solutions can be applied to all stages of the value chain, regardless of your institution's primary area of interest.

Depending on which sections you are most interested in, you can develop different strategies to scale up the virtual solution across the learning factory:

5.1 Virtualization of Product: Digital twin and/or any simulation techniques.
5.2 Virtualization of Process: Digital twin modeling and/or virtual commissioning.
5.3 VR/AR for Immersive Interaction: Virtual and augmented reality for interactive engagement with products or processes.
Recommendations:

Leverage advanced digital twin capabilities, integrate real-time data, and connect digital twins across different value chain steps.
Implement enterprise-wide AR/VR solutions.
Expand virtualization across the entire value chain.

Enhance scalability and accessibility by standardizing content creation and ensuring interoperability with existing systems like ERP, MES, and PLM.
Invest in cutting-edge technologies.
Enhance collaboration with technology providers, startups, and research institutions.
Participate in open innovation networks or platforms to co-develop new virtual solutions.

Translated Text

VIRTUALIZACIJA

Identificirali ste določene dejavnosti v fazi virtualizacije kot sestavni del kurikuluma, ki ga želite razviti v svoji učni tovarni. Vsaj ena od teh virtualizacijskih dejavnosti je opredeljena kot osrednji element kurikuluma. Posledično je jasno, da se številne učne dejavnosti v vaši učni tovarni tesno povezujejo s temi procesi vrednostne verige.
Ključna področja osredotočenosti:

Že ste seznanjeni s priložnostmi, ki jih virtualizacija prinaša učni tovarni.

Zmanjšanje stroškov: Virtualne rešitve lahko bistveno zmanjšajo naložbe v fizično opremo, saj predstavljajo stroškovno učinkovito alternativo.
Izboljšane didaktične možnosti: Virtualna orodja omogočajo inovativne učne pristope, ki jih je v resničnih situacijah težko ali nemogoče ponoviti, s čimer bogatijo učne izkušnje.
Uporabnost skozi celotno vrednostno verigo: Virtualne rešitve se lahko uporabijo v vseh fazah vrednostne verige, ne glede na primarno področje zanimanja vaše institucije.

Glede na to, kateri deli vas najbolj zanimajo, lahko razvijete različne strategije za razširitev virtualnih rešitev v učni tovarni.
5.1 Virtualizacija izdelka: Digitalni dvojček in/ali kateri koli simulacijski postopki.
5.2 Virtualizacija procesa: Modeliranje digitalnega dvojčka in/ali virtualno zagon.
5.3 VR/AR za imerzivno interakcijo: Virtualna in obogatena resničnost za interaktivno delo s produkti ali procesi.
Priporočila:
Izkoristite napredne zmogljivosti digitalnih dvojčkov, vključite podatke v realnem času in povežite digitalne dvojčke v različnih korakih vrednostne verige.
Uvedite rešitve AR/VR na ravni celotne organizacije.
Razširite virtualizacijo na celotno vrednostno verigo

Izboljšajte prilagodljivost in dostopnost z usklajevanjem ustvarjanja vsebin ter zagotovite povezljivost z obstoječimi sistemi, kot so ERP, MES in PLM.
Vlagajte v najsodobnejše tehnologije.
Okrepite sodelovanje s ponudniki tehnologij, zagonskimi podjetji in raziskovalnimi institucijami.
Sodelujte v odprtih inovacijskih omrežjih ali platformah za so-razvoj novih virtualnih rešitev.