

SITEC



HRC-CODE: THE SUCCESS STORY OF A GERMAN-HUNGARIAN EUREKA COLLABORATION

R. Schulze, J. Toth

7th December, 2021



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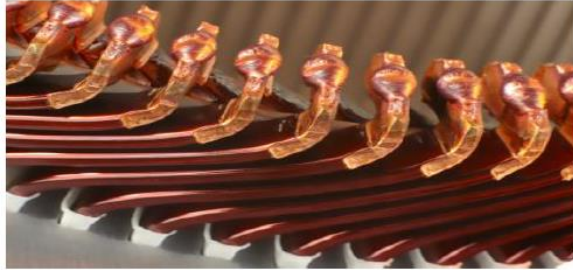
- 1 SITEC Industrietechnologie GmbH Mr. Schulze (SITEC)
- 2 HRC-Code in a short overview Mr. Schulze (SITEC)
- 3 Work and results SITEC Mr. Schulze (SITEC)
- 4 HEPENIX Kft. Mr. Toth (Hepenix)
- 5 Work and results HEPENIX Mr. Toth (Hepenix)



-  AUTOMOTIVE
-  E-MOBILITY
-  HYDROGEN
-  RENEWABLE ENERGIES
-  MEDICAL TECHNOLOGY
-  ELECTRONICS & SEMICONDUCTORS
-  AEROSPACE
-  CONSUMER GOODS

3.000
delivered production systems

300.000.000
delivered components and assemblies



Machinery

Automation

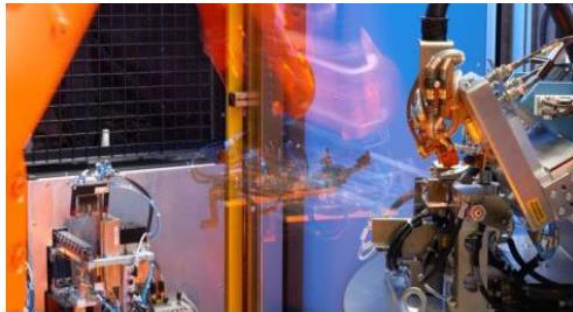


Assembly

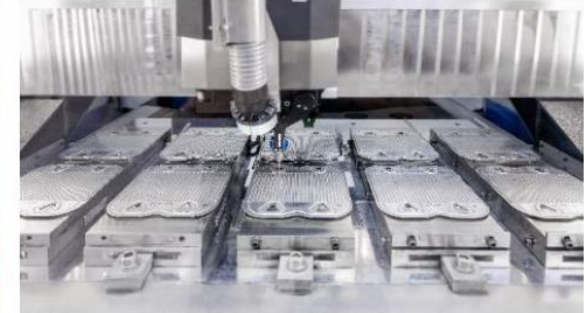
Laser

ECM

Series production



We develop technologies.





GERMANY (Chemnitz & Regensburg)

- SITEC Industrietechnologie GmbH
- Institut Chemnitzer Maschinen und Anlagenbau e.V. (ICM)
- Innok Robotics GmbH

HUNGARY (Budapest)

- HEPENIX Kft.
- SZTAKI - Institute for Computer Science and Control (subcontract)

➤ DEVELOPMENT OF A CONFIGURATOR FOR IMPLEMENTING HUMAN ROBOT COLLABORATION (HRC)

No.	content	2019				2020								2021																
		Q3				Q4				Q1		Q2		Q3		Q4		Q1		Q2		Q3		Q4						
		07	08	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11
WP 1	Analysis (HRC-Scenarios, system design, mobility, component design)																													
WP 2	modul-development (determination and development of bulding blocks, configuration of descision tree)																													
WP 3	tool-kit implementation (database design, programing of functional model)																													
WP 4	pilot-applications (pilot selection, pilot descption pilot implementation)																													
WP 5	validation (validation of software and pilot applications)																													
WP 6	project management																													

milestones

MS 1

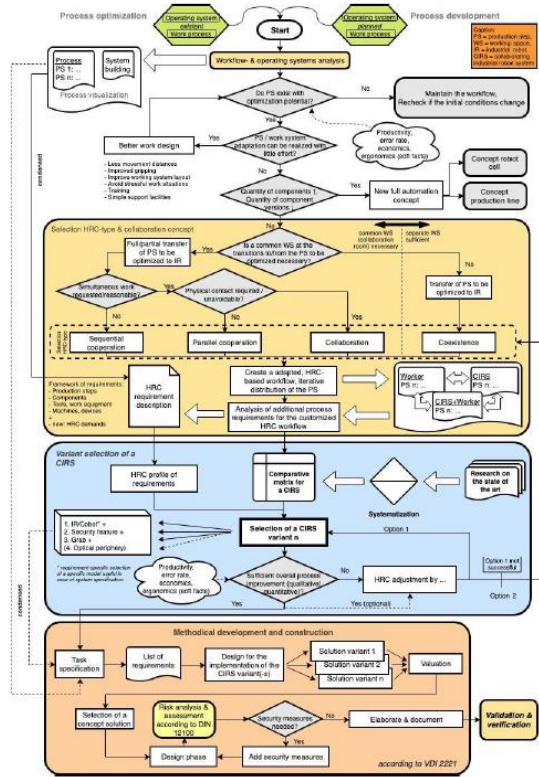
MS 2

project extension

MS 1 - building blocks are determined and created

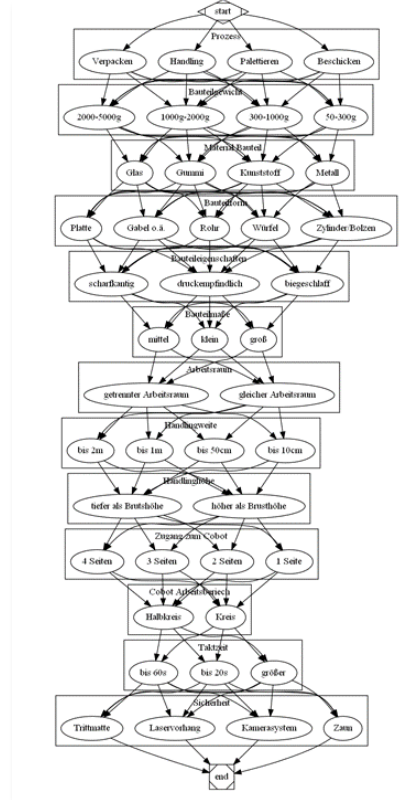
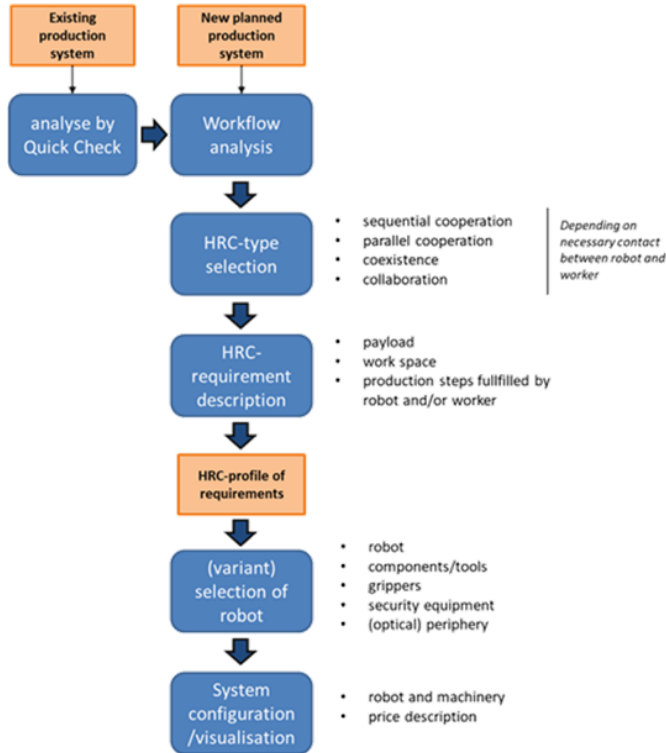
MS 2 - functional model of the software is developed & validated

Work package 1

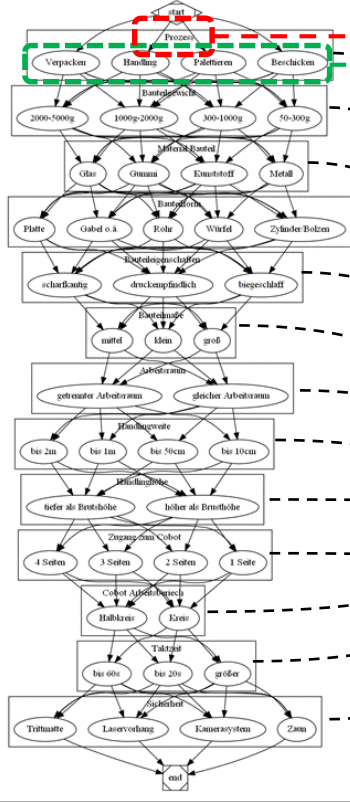


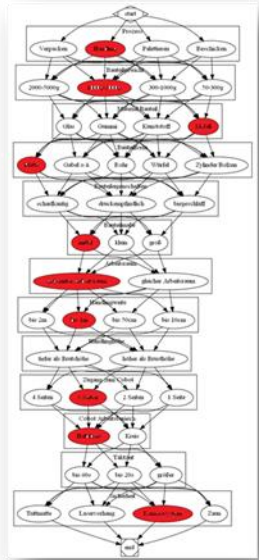
- Workflow analysis
- Is production system suiteable for HRC?
 - **Quick-Check** developed by partner ICM e.V.
- HRC requirement description
- HRC-type selection (coexistence, collaboration...)
- Selection of robot (variant)
- Selection of components (grippers, security...)
- System configuration and visualisation

Work package 2



Work package 3





Hauptmenü: Nachdem alle Auswahlsschritte erfolgreich ausgeführt wurden erreicht man die Angebotsseite.

Prozess: Hier werden alle ausgewählten Optionen noch einmal zusammengefasst

Bauteil Gewicht: • Hauptmenü:

- o Sitec

Bauteil Material: • Prozess:

- o Handling

Bauteil Form: • Bauteil Gewicht:

- o Gewichtsklasse 2

Bauteil Eigenschaften: • Bauteil Material:

- o Kunststoff

Bauteil Abmaße: • Bauteil Form:

- o Zylinder / Bolzen

Arbeitsraum: • Bauteil Eigenschaften:

- o druckempfindlich

Arbeitsweise: • Arbeitsraum:

- o gleicher Arbeitsraum

Handlungswahl: • Arbeitsweise:

- o Zeitversetzt

Handlungshöhe: • Handlungshöhe:

- o größer als Brusthöhe

Zugang zum Cobot: • Cobot Arbeitsbereich:

- o Halbkreis

Arbeitsbereich: • Sicherheitssystem:

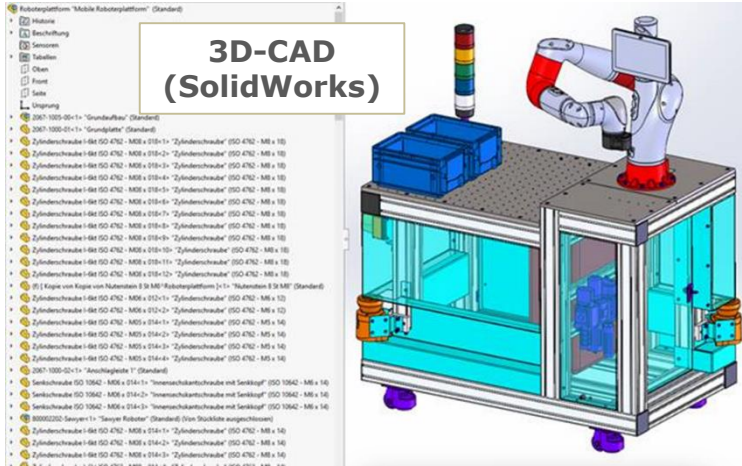
- o Kamerasystem

Arbeitszeit: **by Angebot**

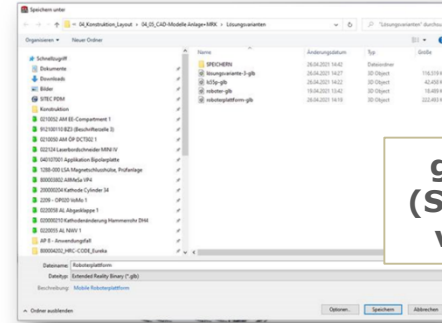
- Summary (?)
- Mail (?)
- PDF-file (?)

3 – WORK AND RESULTS SITEC

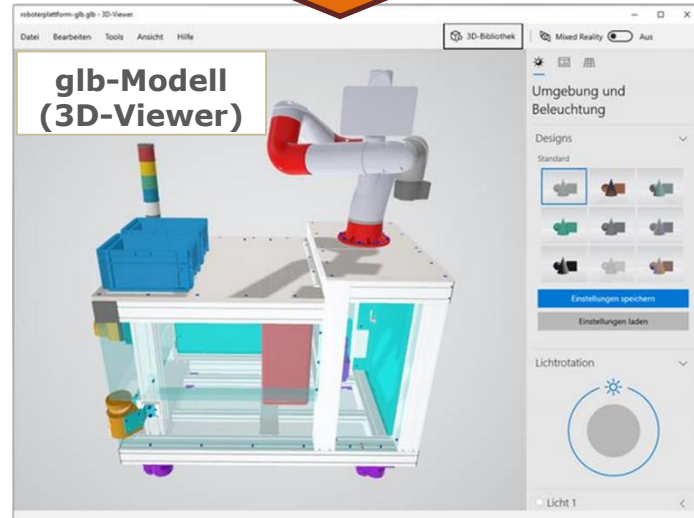
Work package 4 & 5



**3D-CAD
(SolidWorks)**



**glt-Export
(SolidWorks)
via add-in**



**glt-Modell
(3D-Viewer)**

**glt-Import
(configurator)**

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000
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Thank you!

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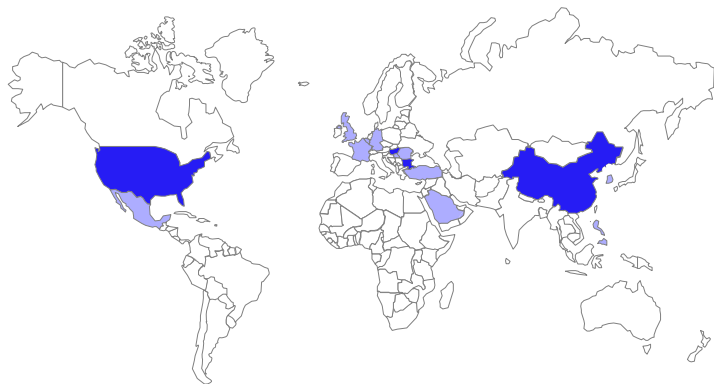
Telefax: +49 371/4708-240

E-Mail: Robin.Schulze@sitec-technology.de

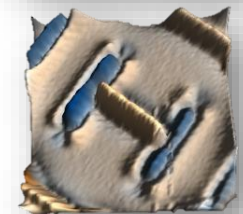
Internet: <https://www.sitec-technology.de>

HEPENIX

Turnkey solutions for the challenges of the industry since 1991



1000 projects, team: 72+ employees
€6M turnover



Automotive

- Assembly lines, stations and components
- Custom machinery

Nuclear

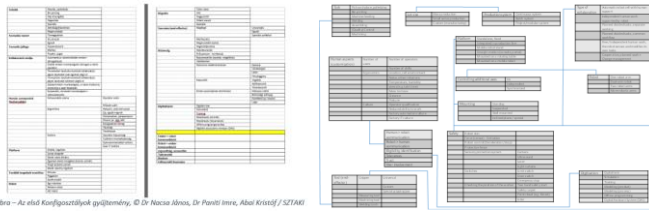
- Equipment and technology development
- Decontamination robots

R&D

- Regional and international cooperation
- Industry 4.0

5 – WORK AND RESULTS HEPENIX

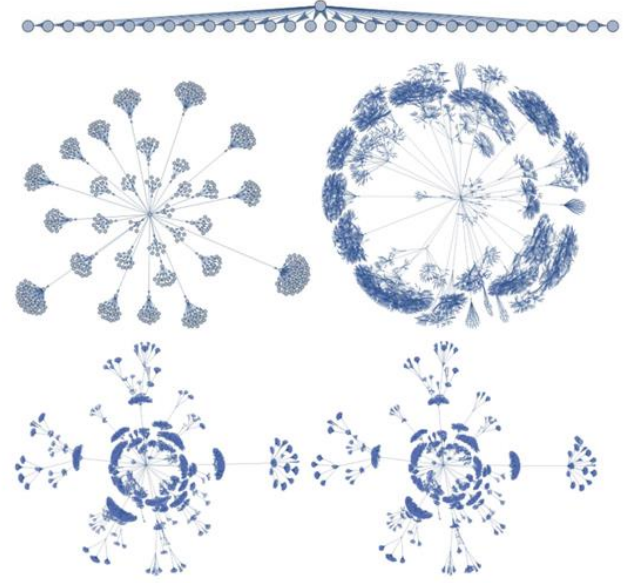
Work package 1



1. ábra – Az első Konfigurációs gyűjtemény, © Dr. Nacsá János, Dr. Paniti Imre, Abai Kristóf / SZTAKI

Config classes, multiple approaches, © Dr Nacsá János, Dr Paniti Imre, Abai Kristóf, Tipary Bence / SZTAKI

Group #	Group name	Level	Mérdések	Questions	Choice mode	Possible choices (preliminary list)
1	Industry	1.1	ipari	Industry	Drop-down selection	Automotive, Electronics, Nuclear, Food
		1.2	Közelgő környezeti igény	Special environment request	Drop-down selection	Simple, ISO, Clean room, etc.
		2.1	Termék típus sokfélesége	Range of the products (L/B)	Value entry	
2	Product	2.2	Termék megnevezése	Name of the product	Text entry	
		2.3	Méret? (Hossz, szélesség, magasság)	Size (width, height, length)	Value entry	
		2.4	Tömeg	Weight	Value entry	
		2.5	Felrakási sebesség? Darab/óra	Number of subassemblies (1-20)	Value entry	
		2.6	Darabszám? (Egység) / db/h	Capacity (range) (pcs/h)	Value entry	
3	Function	3.1	Termék összetétel? Termék összetevő	Quantity choice for product data management	Drop-down list (value entry)	
		3.2	Mi a robot funkciója?	functionality of the robot	Drop-down selection	Maintainance, Technologies
		3.3	Használható akkor művelés és effektor kezel?	Is an effector, what kind of end effector is used?	Drop-down selection	Robot effector
		3.4	Használható miként, milyen a szerkezet?	Technologies, what kind of technology is used?	Drop-down selection	Robot technologies
		4.1	Működési akciók száma? Vagy nem?	Working application?	Drop-down selection	Yes, No
4	Layout	4.2	Munkaáll. pontok (x, y, z) - Max 5	Worktable opportunities (x, y, z) - max. 5 pcs	Value entry	
		4.3	Pontosság? Akkor? pontosság	Accuracy, repeatability requirements	Value entry	
		4.4	Működési mód? Vagy a szervó	the level of automation	Drop-down selection	Full automation, Sequential cooperation, Parallel cooperation
		4.5	Ha ITC, akkor milyen?	ITRC, the level of I	Drop-down selection	Sequential cooperation, Parallel cooperation
		4.6	Adott biztonsági elemek? Kell-e tovább?	Any additional safety device	Drop-down selection	Safety laser scanner, Light curtain, etc.
5	Energy supply	4.7	Reprodukciós sebesség	Reproducible speed rate	Value entry	
		4.8	Robot érzékelők típusa	Orientation of the robot	Drop-down selection	Hanging, Wall-mount, Upper rail system, Standing
		5.1	Kezelés módja	Control mode	Value entry	
		5.2	Kezelés módja, fázis	Kezelési módok listája	Value entry	
		5.3	Kezelési módja	Kezelési módok listája	Value entry	
6	Control	5.4	Kezelési módja	Kezelési módok listája	Value entry	
		6.1	Kezelési módja	Kezelési módok listája	Drop-down selection	Monitor, Touch pendant, Mouse, keyboard, Other
		6.2	Kezelési módja	Kezelési módok listája	Drop-down selection	PLC, Robot controller, Other
		6.3	Kezelési módja	Kezelési módok listája	Drop-down selection	SCADA, PC, HMI, Other
		7.1	Kezelési módja	Kezelési módok listája	Drop-down selection	SCADA, PC, HMI, Other
7	Business Development	7.2	Kezelési módja	Kezelési módok listája	Value entry	
		7.3	Milyen szintű az operációs készség?	Operator qualification level	Drop-down selection	Description (string)
		7.4	Vann-e robot/CHC művelés végzők?	Are of CNC machines/Robots at the Factory	Value entry	
		7.5	Vann-e robot/CHC kezelési tapasztalat művelés végzők?	CNC machine/Robot user experience at the Factory	Value entry	
7.6	Munkaáll. tárolás módja	Budget information	Value entry			



Levels:Nodes (with Services) - 0:30, 1:487, 2:5950, 3:7355, 4:7471

- Quick-Check: Is the production system suitable for HRC?

5 – WORK AND RESULTS HEPENIX

Work package 2

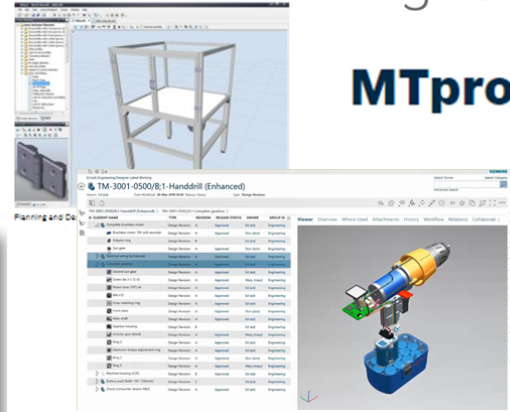
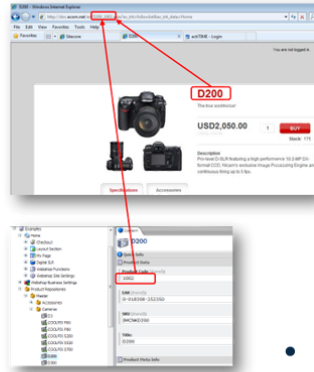
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WP2	Task 1	Deliverable 1.1	2020-01-01	2020-03-31	Lead	Co-Lead	Contributors	Sub-Task 1.1.1	Deliverable 1.1.1	2020-01-01	2020-02-28	Lead	Co-Lead	Contributors	Sub-Task 1.1.2	Deliverable 1.1.2	2020-03-01	2020-03-31	Lead	Co-Lead	Contributors	Sub-Task 1.1.3	Deliverable 1.1.3	2020-01-01	2020-03-31	Lead	Co-Lead	Contributors	Sub-Task 1.1.4	Deliverable 1.1.4	2020-01-01	2020-03-31	Lead	Co-Lead	Contributors
			2020-04-01	2020-06-30	Lead	Co-Lead	Contributors	Sub-Task 1.1.5	Deliverable 1.1.5	2020-04-01	2020-06-30	Lead	Co-Lead	Contributors	Sub-Task 1.1.6	Deliverable 1.1.6	2020-04-01	2020-06-30	Lead	Co-Lead	Contributors	Sub-Task 1.1.7	Deliverable 1.1.7	2020-04-01	2020-06-30	Lead	Co-Lead	Contributors	Sub-Task 1.1.8	Deliverable 1.1.8	2020-04-01	2020-06-30	Lead	Co-Lead	Contributors
WP2	Task 2	Deliverable 2.1	2020-07-01	2020-09-30	Lead	Co-Lead	Contributors	Sub-Task 2.1.1	Deliverable 2.1.1	2020-07-01	2020-08-31	Lead	Co-Lead	Contributors	Sub-Task 2.1.2	Deliverable 2.1.2	2020-09-01	2020-09-30	Lead	Co-Lead	Contributors	Sub-Task 2.1.3	Deliverable 2.1.3	2020-07-01	2020-09-30	Lead	Co-Lead	Contributors	Sub-Task 2.1.4	Deliverable 2.1.4	2020-07-01	2020-09-30	Lead	Co-Lead	Contributors
			2020-10-01	2020-12-31	Lead	Co-Lead	Contributors	Sub-Task 2.1.5	Deliverable 2.1.5	2020-10-01	2020-12-31	Lead	Co-Lead	Contributors	Sub-Task 2.1.6	Deliverable 2.1.6	2020-10-01	2020-12-31	Lead	Co-Lead	Contributors	Sub-Task 2.1.7	Deliverable 2.1.7	2020-10-01	2020-12-31	Lead	Co-Lead	Contributors	Sub-Task 2.1.8	Deliverable 2.1.8	2020-10-01	2020-12-31	Lead	Co-Lead	Contributors
WP2	Task 3	Deliverable 3.1	2021-01-01	2021-03-31	Lead	Co-Lead	Contributors	Sub-Task 3.1.1	Deliverable 3.1.1	2021-01-01	2021-02-28	Lead	Co-Lead	Contributors	Sub-Task 3.1.2	Deliverable 3.1.2	2021-03-01	2021-03-31	Lead	Co-Lead	Contributors	Sub-Task 3.1.3	Deliverable 3.1.3	2021-01-01	2021-03-31	Lead	Co-Lead	Contributors	Sub-Task 3.1.4	Deliverable 3.1.4	2021-01-01	2021-03-31	Lead	Co-Lead	Contributors
			2021-04-01	2021-06-30	Lead	Co-Lead	Contributors	Sub-Task 3.1.5	Deliverable 3.1.5	2021-04-01	2021-06-30	Lead	Co-Lead	Contributors	Sub-Task 3.1.6	Deliverable 3.1.6	2021-04-01	2021-06-30	Lead	Co-Lead	Contributors	Sub-Task 3.1.7	Deliverable 3.1.7	2021-04-01	2021-06-30	Lead	Co-Lead	Contributors	Sub-Task 3.1.8	Deliverable 3.1.8	2021-04-01	2021-06-30	Lead	Co-Lead	Contributors
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			2021-10-01	2021-12-31	Lead	Co-Lead	Contributors	Sub-Task 4.1.5	Deliverable 4.1.5	2021-10-01	2021-12-31	Lead	Co-Lead	Contributors	Sub-Task 4.1.6	Deliverable 4.1.6	2021-10-01	2021-12-31	Lead	Co-Lead	Contributors	Sub-Task 4.1.7	Deliverable 4.1.7	2021-10-01	2021-12-31	Lead	Co-Lead	Contributors	Sub-Task 4.1.8	Deliverable 4.1.8	2021-10-01	2021-12-31	Lead	Co-Lead	Contributors
WP2	Task 5	Deliverable 5.1	2022-01-01	2022-03-31	Lead	Co-Lead	Contributors	Sub-Task 5.1.1	Deliverable 5.1.1	2022-01-01	2022-02-28	Lead	Co-Lead	Contributors	Sub-Task 5.1.2	Deliverable 5.1.2	2022-03-01	2022-03-31	Lead	Co-Lead	Contributors	Sub-Task 5.1.3	Deliverable 5.1.3	2022-01-01	2022-03-31	Lead	Co-Lead	Contributors	Sub-Task 5.1.4	Deliverable 5.1.4	2022-01-01	2022-03-31	Lead	Co-Lead	Contributors
			2022-04-01	2022-06-30	Lead	Co-Lead	Contributors	Sub-Task 5.1.5	Deliverable 5.1.5	2022-04-01	2022-06-30	Lead	Co-Lead	Contributors	Sub-Task 5.1.6	Deliverable 5.1.6	2022-04-01	2022-06-30	Lead	Co-Lead	Contributors	Sub-Task 5.1.7	Deliverable 5.1.7	2022-04-01	2022-06-30	Lead	Co-Lead	Contributors	Sub-Task 5.1.8	Deliverable 5.1.8	2022-04-01	2022-06-30	Lead	Co-Lead	Contributors

Extract from the compilation of Results at TechTogether for HRC-CODE

Work package 3

- Simple and straightforward to use (self-explanatory)
- Users: internal and external users
- Easy to maintain / keep up to date
- Proper balance in generalisation / specifics
- Runs on all hardware solutions
- The solution can be refined
- Retains the final solution
- Graphics for aesthetics
- Multiple languages

KEEP IT SIMPLE



Powered by GlobalSpec
Engineering 360

MTpro rexroth
A Bosch Company


- Forms
- Excel ()
- Chatbots
- Webshops
- CTQ, Configure-to-Quote systems
- 3D modeling systems with metainfo
- PDM/PLM solutions a.k.a. mega-modelling

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Progress

HRC Configurator

Start
Project info
Product & Handling
HRC & Robot
Control system
Process flow
Energy supply
Additional info
3D cell
Finish



Pick and place

Palletizing

Handling of the technology

Operation of the technology

Robot

Estimated working range of robot: 700 mm

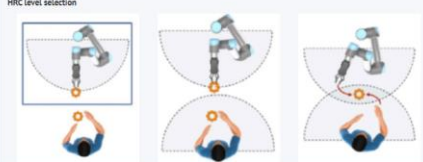
Max payload: 3 kg

Absolute accuracy +/-: 0.1 mm

Relative accuracy +/-: 0.1 mm

Number of the robot arms: 1

HRC level selection



My robot cell

Company
Partner Company Ltd

Project
HRC rocket 2 Szönyöv

Product
Product name: Remote key
Handling method: Simple manual with fixed JIG

Subject areas

➔

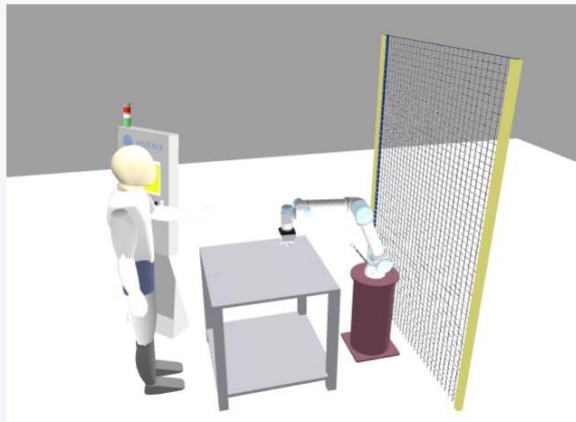
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Clear and Start over

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 Portions: Innok Robotics (3D), SITEC GmbH
 Additional credits: ICM, SZTAKI, HEPENIX

HRC Configurator

Start
Project info
Product & Handling
HRC & Robot
Control system
Process flow
Energy supply
Additional info
3D cell
Finish

Visualization



My robot cell


Company
HEPENIX LTD.

Project
Remote lock Assembly Cell

Product
Product name: Remote Lock MKIII
Handling method: Simple manual with fixed JIG

Robot cell
Function of the robot: Palletizing
Robot type: 6 DoF
End-effector type: Pneumatic gripper
Location & Orientation of the robot: Standing on the pedestal

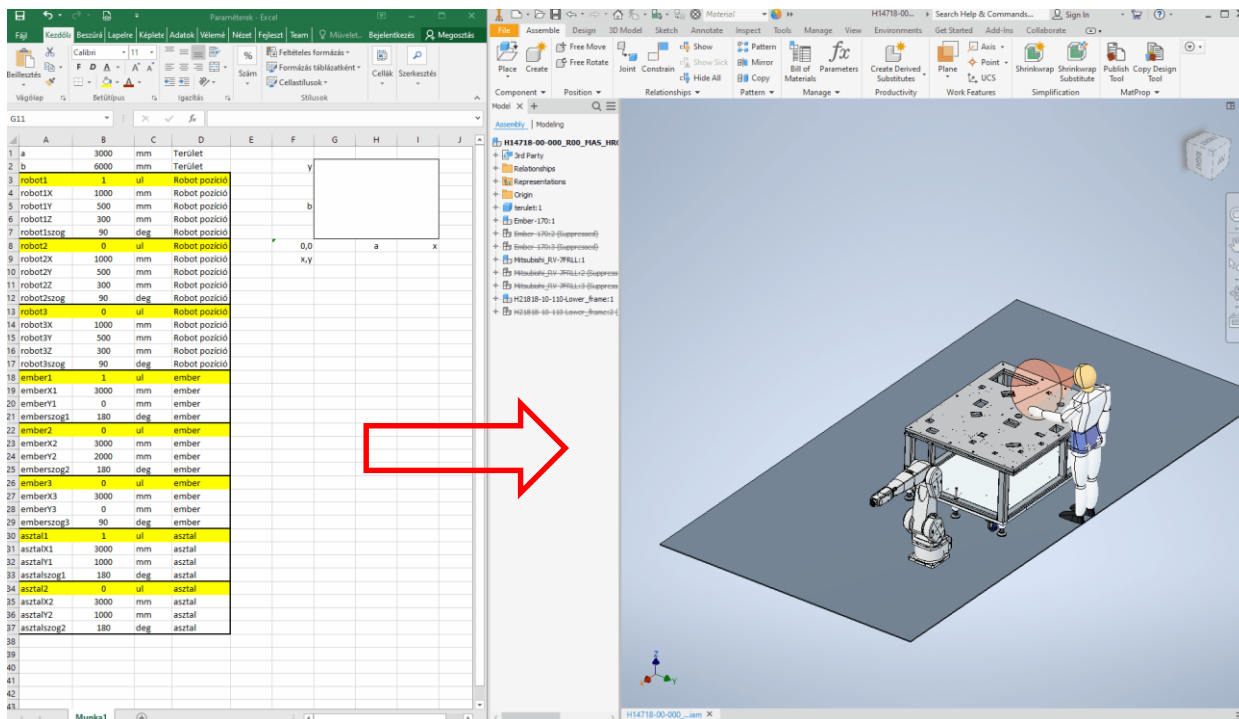
Robot fence



3D area: rotate, pan, zoom

Result list:
email, pdf, +

Back
Next
Clear and Start over



Mega-model:

- Glb Exports for web

Results on web:

- Summary, list
- 3D visualization
- Hidden export

Further detailing through an import of Configurator results into native 3D CAD system (Autodesk Inventor) via MS EXCEL: table-driven feature.

FINALIZATION

Validation of the configurator:

1 physical and 2 virtual/mixed prototypes with SZTAKI

EXPLOITATION

- Partner network
- Media, articles
- Use of knowledge in product offerings
- Safety-by-Design





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PROGRAM FINANCED
FROM THE NRDI FUND

Thank you!

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