SIEMENS

25th Sep 2022

The Registrar ,
SRM University ,Delhi – NCR , Sonepat ,
Haryana

1. Reference : Ref: SIEMENS/SRM/COE/1608/VER2.0, 16th Aug 2020
2. SRM PO no : SRMH-ET-PUR/Sep/20-21/00005 dated 18th Sep 2020

Subject: Siemens "Grant in Kind"

Dear Sir,

Siemens Industry Software provides integrated software solutions for product design, manufacturing planning and lifecycle knowledge management at the enterprise level. Siemens is enabling Students , Professionals, Start-ups, Industries etc. to reach closer to automation principle and achieving digitalization towards Industry 4.0.
Further to our discussion on the subject we would like to inform you that Siemens provides "GRANT (in- kind)" through its global program where "GRANT in the form of Kind" is given to specific Institutes (Global/India) through its GO PLM GRANT portal , One such Grant is being offered for setting up of a COE to SRM University – Delhi NCR.

We would like to clarify that this Grant-in-Kind or Contribution-in-Kind can be treated as steeply Discounted offer for this initiative to the institute. Siemens has offered 89.9% discount to SRM.

Yours Truly

For Siemens Industry Software (India) Private Limited

Anil Solanki ,
Business Head

TRIPARTITE AGREEMENT

AMONG

SRM University Delhi NCR, Sonepat

AND

SIEMENS INDUSTRY SOFTWARE (INDIA) PRIVATE LIMITED

AND

3D Engineering Automation LLP

The Tripartite Agreement ("**Agreement**") is made on the **15th**day of **September 2020** between,

SRM University Delhi-NCR, Sonepat, Haryana located at Plot No. 39, Rajiv Gandhi Education City Delhi-NCR Sonepat – Kundli Urban Complex, Post Office P.S.Rai, Sonepat, Haryana 131029, India hereinafter called the "**Institute**" (which expression shall unless repugnant to the context or meaning thereof be deemed to mean and include its successors and assigns) of the first part;

And

SIEMENS INDUSTRY SOFTWARE (INDIA) PRIVATE LIMITED, having a sales office at Tower D, 16th Floor, Global Business Park, MG Road, Gurgaon 122002 Haryana, India and registered office at E-20, 1st & 2nd Floor, Hauz Khas, New Delhi - 110016, hereinafter called "**SISW**" (which expression shall unless repugnant to the context or meaning thereof be deemed to mean and include its successors and assigns) of the second part;

And

3D Engineering Automation LLP, having its registered office at4th Floor, Shreyas Eterna, Pashan-NDA Road, Above Bank Of Maharashtra, Bavdhan, Pune- 411021 India, hereinafter called **"Partner"** (which expression shall unless repugnant to the context or meaning thereof be deemed to mean and include its successors and assigns) of the third part.

Hereinafter, Institute, SISW, and Partner have individually been referred to also as a "Party" and collectively as the "Parties".

WHEREAS:

1. Institute has expressed the desire to set up a Centre of Excellence ("CoE") in its campus located at Plot No. 39, Rajiv Gandhi Education City Delhi-NCR Sonepat – Kundli Urban Complex, Post Office P.S.Rai, Sonepat, Haryana 131029, India;

2. SISW a business unit of the Digital Industry division is a provider of product lifecycle management (PLM) software, and services to customers in India;

3. Partner, a reseller of SISW is engaged in the business of marketing and licensing software applications and providing associated value-added services and has agreed to supply PLM software, hardware, and other Third-Party Products for purposes of setting up of the CoE under this Agreement;

NOW, THEREFORE, in consideration of the mutual promises contained herein and other good and valuable consideration, the receipt of which is hereby acknowledged, the parties agree as follows:

1. DEFINITIONS

In this Agreement, the following expressions shall have the meaning stated herein:

a. **"Agreement"** shall mean this agreement executed between the Institute, Siemens Industry Software (India) Private Limited and Partner include any written modifications thereof and the schedules attached hereto.

b. **"Centre of Excellence" or "CoE"** shall mean industry-linked multi-skill focused Siemens Centre of Excellence which shall be setup on the campus of the Institute.

c. **"Confidential Information"** means any information concerning the disclosing party's business, pricing, terms of this Agreement, and such other information that has not been made public, provided that such information is identified as confidential at the time of disclosure or the confidential nature of which is evident to a reasonable person**.**

d. **"End User License Agreement" or "EULA"** refers to the terms and conditions to be signed between SISW and Institute which govern the use of Software, Hardware and services provided by SISW.

e. **"Hardware"** means equipment, systems, devices, accessories and parts delivered by SISW, excluding Software storage media.

f. **"Siemens Go-PLM Grant"** provides Siemens PLM software to support the academic programs of leading universities and institutes.

g. **"Supplemental Terms"** means those separate terms and conditions that apply to SISW's Software or Hardware or services offerings, set forth or referenced in an Order form/LSDA, or otherwise agreed by the parties.

h. **"Software"** means software licensed or distributed by SISW, including updates, modifications, and design data.

i. **"Third-Party Products**" means such software products that are not the proprietary products of SISW or its affiliate entities.

Parties agree the following annexures shall form part of this Agreement:

a. Annexure "A" - Commercial details;
b. Annexure "B" – Bill of Material

2. SCOPE OF SERVICES FORCENTRE OF EXCELLENCE

The following shall be the scope of the CoE:

a. To make qualitative improvements in technical education by setting up of CoE:
   - Provide facilities in CoE labs by adopting latest open technologies in engineering, design, manufacturing, planning, analysis and management to serve the needs of industrial clusters;
   - Provide joint certificate courses for students, and faculty;
   - Skill up-gradation of faculty at CoE by providing training. (Train the Trainer);

3. TERM

This Agreement shall commence from the date Agreement is made or the date it is signed by all parties, whichever is later (the "**Effective Date**") and shall continue in effect for a period of three (3) years from the date of commencement of operation of CoE unless terminated earlier or renewed for such period according to the terms mentioned in this Agreement.

4. TERMS OF PAYMENT

a. Institute will pay an amount of ₹ 3,85,66,708 (Rupees) plus taxes applicable at actuals ("**Total Contract Price**") in accordance with the following schedule to the Bank account of the Partner.

   - 50% of Total Basic Price+ 100% GST of Total Contract Value will be paid immediately on execution of the Agreement, against the single performa invoice raised by the Partner;

   - 40% of Total Basic Price against a supply of goods and submission of invoices – payment will be cleared against each supply and submission of individual invoices on delivery of Software, Hardware and other Third-Party Products as mentioned in **Annexure A**;

     Payment to be made within 2 weeks from the date of invoice and delivery at site.

   - 10% of Total Basic Price against supply and submission of individual commissioning certificate of Software, Hardware and other Third-Party Products as mentioned in **Annexure A**. Payment to be made within 2 weeks from the date of completion of commissioning of labs.

   - Partner Bank Account No: 283500100000144
     3D Engineering Automation LLP
     Bank Name: The Saraswat Cooperative Bank Ltd
     Branch: SME Branch, Sangamwadi, Pune
     IFSC Code: SRCB0000283
     (PAN AABFZ1781E)

b. Institute shall ensure timely disbursement of the above-sanctioned amount for the supply of Software, Hardware, and Third-Party Products for the CoE.

c. The total value of products to be supplied under this Agreement by Partner shall be of ₹ 3,85,66,708 exclusive of taxes and the total amount of supplies by SISW shall be of ₹ 3,03,03,780 exclusive of taxes.

5. ROLES AND RESPONSIBILITIES OFINSTITUTE

a. Institute will demarcate the required area in its campus to set-up the laboratories, provide the necessary infrastructure as per the CoE project specifications outlined in the proposal, including, but not limited to electricity, water, plumbing/ pneumatic piping, furniture, fixtures, adequate security, internet and student training consumables (at actual usage). Institute will also arrange to provide necessary approvals, permissions, etc., as required from various government departments, local authorities, etc.

b. Institute understands and agrees that any delay in providing necessary infrastructure support, approvals or permissions, etc., may impact the timely supply of products and performance of services by SISW and/or Partner. Institute shall make infrastructure and other permissions available at least 30 days prior to the scheduled delivery date or installation work.

c. Institute shall intimate in writing to both SISW and Partner of any discrepancy in the supplied products within five (5) days of deliveries made by the Partner. Institute shall discuss and resolve the case before installation by the Partner to enable SISW and Partner to take necessary corrective action. Any deficiency in services shall be informed in writing, along with reasons, to both Partner and SISW within five (5) days of completion of each milestone/ specific part of services. Institute may discuss reasons for deficiency in services during the committee review meeting.

d. Institute shall ensure to keep all Hardware and Third-Party Products supplied to the CoE at a secured location and, also ensure that no damage is caused thereto by any student or faculty of the Institute. Any damage caused to Hardware and Third-Party Products, after it is delivered to the Institute, shall be the responsibility of Institute. The risk of loss or damage and title to the Hardware and Third-Party Products shall pass from SISW and/or Partner to Institute upon delivery. In case incoterms for the applicable Software, Hardware or Third- Party Products as mentioned in the respective documents differ from those mentioned herein, then applicable terms as mentioned in the respective documents of Software, Hardware and Third-Party Products shall prevail.

e. Institute shall provide written acceptance of deliveries made by Partner of SISW Software, Hardware or Third-Party Products for the CoE. Institute sign a delivery challan / note within five (5) working days from the date of submission by it and shall furnish to the Partner.

f. Institute will operate and maintain the CoE

g. Institute shall permit SISW to replace the Partner under this Agreement if Partner is terminated in accordance with terms of clause 15. In such a case, SISW shall enter into a separate agreement with a new partner, which shall be an addendum to this Agreement. Institute understands and accepts that replacement of the Partner may take reasonable time and, therefore, timeliness mentioned in the Agreement for deliveries and setting up of the CoE shall extend accordingly. The revised timeliness shall be mutually decided by the Parties.

6. ROLE AND RESPONSIBILITIES OF SISW

a. It shall provide Software in accordance with the purchase order of the Institute and as mentioned in the **Annexure B.**

b. It shall appoint a Partner to impart training at the CoE.

c. SISW shall implement the Siemens Go-PLM Grant cooperation program for the Institute. Within the Siemens Go-PLM Grant cooperation framework, SISW will deliver the available version of the Software to Institute. For the sake of clarity, it is stated that Siemens Go-PLM grant shall be applicable only to the Software of SISW.

d. It shall monitor the training provided by Partner and shall take feedback from faculty.

e. It shall participate in the Review Committee meetings of the CoE.

7. ROLE AND RESPONSIBILITIES OF PARTNER

a. It shall act as the implementer and system integrator for the CoE in accordance with the terms mentioned in the Agreement. It shall set-up the CoE and take necessary advice from SISW related to it. It shall provide the necessary support to the Institute during the term of this Agreement.

b. It shall set up the CoE and supply, install and system integrate the Hardware, Software, provided by SISW and Third-Party Products to the Institute. Details of products which shall be supplied by the Partner to the CoE are mentioned in **Annexure – B**.

c. It shall conduct training for the faculty of the Institute on SISW Software supplied by it. Training shall be provided to the faculty pursuant to a schedule mutually agreed between Partner and the Institute. All training shall be conducted as per SISW's standard training protocols and will be based on SISW's standard training material.

d. It shall provide support to the Institute for the following:

   i. Train the Trainers on SISW Software.

   ii. Provide certificate to the students, and faculty at the CoE upon successful completion of the training as may be agreed between the parties herein, in the format approved by SISW.

e. It shall endeavor to set-up the CoE within 120 days from the date of receipt of the above-mentioned amount in the Partner's bank account from the Institute, except in case of delay caused by Force Majeure conditions or for reasons which are not directly attributable to Partner or for delay caused in providing necessary approvals, infrastructure, resources, etc., by the Institute

f. It shall take acceptance/ sign-off letter for each of the products supplied to the Institute and a copy of such acceptance/ sign-off letter shall be shared with SISW before withdrawal of the amount from the account mentioned in clause 4.

g. It shall provide annual maintenance support on the Software and Hardware in accordance with terms as mentioned in the Annexure B

8. PARTNER'S REPRESENTATIONS AND WARRANTIES

a. It has the professional skills, experience, personnel and resources that are necessary for providing services as are necessary to fulfill its obligations under this Agreement.

b. It has the right to enter this Agreement, is a corporation duly organized, validly existing, has the power and authority, corporate and otherwise, to execute and deliver this Agreement and to perform its obligations hereunder.

c. All notices or claims for any contravention, infringement or misuse received by SISW in its name or the name of Partner under this Agreement from any of the authorities in respect of any violation or non-compliance by Partner with any of the applicable regulations/laws shall be the sole responsibility of Partner and will be handled or dealt with by Partner.

d. The execution, delivery and performance of this Agreement, any other agreement, document or instrument now or hereafter executed and delivered by Partner pursuant thereto or in connection herewith will not: (i) conflict with or violate any provision of any law, rule, regulation, authorization or judgment of any governmental authority having applicability to either Party or its actions; or (ii) conflict with or result in any breach of, or constitute a default under, any note, security agreement, commitment, contract or other agreement, instrument or undertaking to which Partner is a party or by which any of its property is bound.

e. As on the date of signing of this Agreement, there are no pending or threatened legal proceedings against Partner which if adversely determined, would affect/ may affect the performance of Partner under this Agreement.

f. It shall not knowingly engage any person with criminal record/ conviction and any such person shall be barred from participating directly or indirectly in providing the services under this Agreement.

g. It shall comply with all applicable laws, rules and regulations in relation to the provision of services including any registration, licensing, certification, permit or filing requirements therein that may be applicable to it and for employment or engagement of personnel for provision of the services.

h. It shall ensure that the financial assistance from the Institute is utilized in a proper way for setting up of CoE. It shall provide a progress report on the amount spent on setting up the CoE and such other details as may be requested by SISW from time-to-time.

i. It shall timely release amount to third parties for the respective Third-Party Products supplied by them under this Agreement.

j. It shall allow SISW to conduct an audit wherein SISW shall be permitted to check books of accounts, agreements and other financial records pertaining to transactions entered into by Partner for the purposes of supply of SISW's Software, Hardware, services or Third-Party Products under this Agreement.

9. SISW'S REPRESENTATIONS AND WARRANTIES

a. It has the right to enter this Agreement, is a corporation duly organized, validly existing, has the power and authority, corporate and otherwise, to execute and deliver this Agreement and to perform its obligations hereunder.

b. It shall comply with all applicable laws, rules and regulations in relation to provision of supply of Software or Hardware that may be applicable to it under this Agreement

c. It shall not knowingly engage any person with criminal record/ conviction and any such person shall be barred from participating directly or indirectly in providing the services under this Agreement.

d. As on the date of this Agreement, there are no pending or threatened legal proceedings against SISW for engaging with the Partner which if adversely determined, would affect the performance of SISW under this Agreement.

10. INSTITUTE'S REPRESENTATIONS AND WARRANTIES

a. It has the right to enter this Agreement, is a corporation duly organized, validly existing, has the power and authority, corporate and otherwise, to execute and deliver this Agreement and to perform its obligations hereunder. It shall timely provide all approvals, authorizations, infrastructure and other support required for setting up of CoEs.

b. It shall comply with all applicable laws, rules and regulations that may be applicable to it under this Agreement.

c. It warrants that it shall sign the EULA and Supplemental Terms related for use of Software and/or Hardware and comply with such terms. Institute accepts that Software and Hardware shall be governed by the EULA and applicable Supplemental Terms and shall prevail in case of conflict with terms of this Agreement.

d. It warrants that the use of Third-Party Products shall be in accordance with applicable terms delivered by Partner for CoE's and it shall sign terms related thereto.

e. It warrants that it shall timely release payments to SISW and Partner for deliverables and services provided to it in accordance with the payment terms agreed between the Parties. It will provide acceptance/ sign-off letter within five (5) days of each of the deliveries made either by SISW or Partner and thereafter, such deliverables shall be deemed accepted.

11. CONFIDENTIAL INFORMATION

a. Parties agree that they shall hold the Confidential Information of other Parties in strict confidence. Parties further agree that they will not make any disclosure of the Confidential Information to anyone without the express written consent of the other, except to employees, affiliates to whom disclosure is necessary to the performance of this Agreement and who have agreed in writing to hold such information in confidence in relative accordance to the terms of this clause. Parties shall undertake all reasonable steps to ensure the confidentiality of Confidential Information and shall ensure that its personnel, subcontractors, agents and affiliates comply with the confidentiality provisions of this Agreement.

b. Within ten (10) business days after any termination of this Agreement, or promptly upon request by the disclosing Party, all originals and copies of the disclosing Party's Confidential Information in the other Party's possession shall be returned to the disclosing Party or destroyed, and confirmation thereof shall be provided to the disclosing party.

c. Notwithstanding the other provisions of this Agreement, data and information disclosed by either Party hereunder shall not be considered to be Confidential Information if: (a) it has been published or is otherwise readily available to the public other than by a breach of this Agreement; (b) it has been independently developed by the receiving Party prior to disclosure by the disclosing Party; (c) it has been intentionally disclosed by the Party claiming that the information is Confidential Information to a third party without restriction on disclosure; or (d) it is required to be disclosed under the binding laws, regulations or governmental orders of any applicable jurisdiction; provided that the disclosing Party shall give written notice to the other Party of any such disclosure requirements prior to the disclosure of any such Confidential Information hereunder.

d. Parties are aware of and acknowledge the fact that any breach by the other Party of any of the terms of confidentiality as contained in this section in this Agreement could cause the former Party to suffer a grave loss and would prejudicially affect its business and interests. Parties recognize and agree that in the event of such a breach and/or apprehended breach, each Party shall be entitled to immediate injunctive or other interlocutory relief. This remedy shall be in addition to other remedies available to the Parties under law.

e. The obligation of Parties under this clause shall survive the expiry or termination of this Agreement.

12. COORDINATION AND REVIEWCOMMITTEE

a. To ensure coordination, Parties shall set up a review committee comprising of 5 members (Review Committee). Both SISW and Partner shall appoint one (1) person each and Institute shall have two (2) members and one (1) independent representative mutually agreed upon by all parties. The Review Committee shall be the principal authority to discuss and resolve matters arising under this Agreement.

b. Progress meetings will be scheduled by Review Committee at agreed upon times and, one (1) meeting shall be held quarterly to monitor the progress of the project under this Agreement. Review Committee shall prepare minutes of meetings which shall be signed by Parties. Review Committee shall meet on a regular basis for the purposes of reviewing the progress of the project under this Agreement, and to suggest changes, and implement improvements.

13. INDEMNIFICATION

a. Institute and SISW each will indemnify, defend and hold harmless the other, its directors, officers and employees from any and all claims, actions, damages, liabilities, costs and expenses, including reasonable attorney's fees and expenses for:

(i) the death or personal injury of third parties, including employees of the indemnitor, arising out of, or in any way resulting from, the negligent or willful acts or omissions of the indemnitor or any of its employees; and/or

(ii) the damage, loss or destruction of real or tangible property of the other Party, arising out of, or in any way resulting from, the negligent or willful acts or omissions of the indemnitor or its employees.

(iii) on account of any unauthorized disclosure of Confidential Information.

(iv) for violation of EULA terms of Software, Hardware and/or Third-Party Products.

b. Partner hereby agrees to indemnify**,** defend and hold SISW harmless at all times from any loss, claim, damage, costs, taxes, duties, penalties or interest thereon or expenses of any kind, notices, claims, demands, action, suits or proceedings, including reasonable attorney's fees and legal costs to which SISW may be subjected, either from Institute or from a third party and undertakes to fully compensate SISW for such breach:

i. by virtue of a breach of the Representations and Warranties made by Partner;
ii. by virtue of any contravention and/or non-compliance on the part of Partner with any laws, ordinance, and regulations as may be applicable to Partner from time to time in relation to the Agreement;
iii. on account of any act, commission or omission or to the negligence of any person of Partner, which has resulted whether on account of breach of any of the conditions of this Agreement by Partner and/or its employees;
iv. on account of any unauthorized disclosure of Confidential Information, and
v. on account of any act of Partner's deficiency of services, gross negligence, willful misconduct or fraud or dishonesty.
vi. the death or personal injury of third parties, including employees of SISW or Institute, arising out of, or in any way resulting from, the negligent or willful acts or omissions of Partner or any of its employees.
vii. the damage, loss or destruction of real or tangible property of either SISW or Institute, arising out of, or in any way resulting from, the negligent or willful acts or omissions of Partner or its employees.

c. The provisions of this section shall be without prejudice to any other rights available to an aggrieved party.

d. Foregoing indemnities are subject to the following:

(i) Indemnified party gives prompt notice of indemnity event to the indemnifier together with sufficient details of such an event.
(ii) Indemnified party gives sole control of defense of any claim to the indemnifier, to the extent possible.
(iii) Indemnified party shall not settle any claim with the third party without the prior written consent from the indemnifier.
(iv) Indemnity shall not apply if any loss or damage is caused by the acts of the indemnified party.
(v) The indemnified party shall have the duty to mitigate losses or damages caused.

14. LIMITATION OF LIABILITY

SISW's entire liability for all claims or damages arising out of or related to this Agreement, regardless of the form of action, whether in contract, tort or otherwise, will be limited to and will not exceed, in the aggregate the amount received from Institute respectively for the supply of Software or Hardware of SISW.

Partner's entire liability for all claims or damages arising out of or related to this Agreement, regardless of the form of action, whether in contract, tort or otherwise, will be limited to and will not exceed, in the aggregate the amount received from Institute respectively for the supply of Software or Hardware of SISW or Third-Party Products, which is a subject matter of breach. The above limitation for Partner shall not be applicable in case of indemnification as mentioned under clause 13(b).

In no event will the measure of damages payable by SISW and/or Partner include, nor will SISW and/or Partner be liable for, any amounts for loss of income, profit or savings or indirect, incidental, consequential, exemplary, punitive or special damages of any party, including third parties, even if SISW and /or Partner have been advised of the possibility of such damages in advance, and all such damages are expressly disclaimed.

15. TERMINATION

a. A Party may terminate this Agreement, effective upon thirty (30) business days written notice to the other Party, upon an Event of Default under this sub-section (b) of this clause or based on any legal, or regulatory restriction as a result of which the services cannot continue to be provided. Termination under this clause shall be without prejudice to any other rights and remedies that any Party may have at law or in equity for damages or otherwise.

b. Anyone or more of the following shall constitute an "Event of Default" hereunder:

   (i) A Party to this Agreement fails to perform or observe any material obligation set forth herein in any material respect which remains uncured within thirty (30) business days' written notice; or

   (ii) Any representation or warranty contained herein is false or misleading in any material respect as of the date made or deemed to have been made and is not rectified upon notice of the same within thirty (30) business days of such written notice.

c. SISW reserves a right to terminate the Partner, by prior written notice of thirty (30) days, for gross negligence, willful misconduct, fraud, violation of applicable laws or any reason which adversely affects the continuation of the Agreement with the Partner or for reasons mentioned under Event of Default, provided that termination shall not take effect unless the breach complained of remains uncured for a period of thirty (30) days from the date of notice. Notwithstanding anything contrary contained herein, the Institute shall have no right to terminate the Partner.

d. A Party shall have a right to terminate the Agreement effective upon receipt of a written notice by the any Party, if a Party (i) commences proceeding seeking a voluntary winding up, reorganization or other relief with respect to itself or its debts under any bankruptcy, insolvency, corporation or other similar law now or hereafter in effect that authorizes the reorganization or liquidation of such Party or its debt or the appointment of a trustee, receiver, liquidator, custodian or other similar officials of it or any substantial part of its property, or (ii) consents to any such relief or to the appointment of or taking possession by any such official in an involuntary case or other proceeding commenced against it, or (iii) makes a general assignment for the benefit of creditors, or (iv) fails generally to pay its debts as they become due.

e. Notwithstanding anything contrary in this Agreement, in the event this Agreement is terminated either by SISW or Institute for reasons mentioned under Event of Default, then Institute shall accept delivery of all SISW Hardware and Third-Party Products ordered by the Institute prior to the date of termination of the Agreement and, shall release all payments for such products supplied, including, for services which have been rendered till the date of termination.

16. PUBLICITY

No Party shall make any public disclosure, except as may be required by applicable law, relating to discussions and or terms related to this Agreement, without obtaining the prior written consent of the other Party/Parties. A Party shall not use and shall not let their employees, agents and subcontractors from using the name, trademark or logo of the other Parties in any sale, marketing publication, advertisement, or other publication. A Party shall not make, or let its employees, agents or subcontractors make, any public statement relating to the other Party.

17. MODIFICATION, AMENDMENT, SUPPLEMENT OR WAIVER

No modification, amendment, supplement to or waiver of this Agreement or any of its provisions shall be binding upon the Parties hereto unless made in writing and duly signed by the party against whom enforcement thereof is sought. A failure or delay of any Party to this Agreement to enforce at any time any of the provisions of this Agreement or to exercise any option which is herein provided, or to require at any time performance of any of the provisions hereof, shall in no way be construed to be a waiver of such provisions of this Agreement.

18. ASSIGNMENT AND SUBCONTRACTING

a. Institute or SISW shall not assign, in whole or in part, its obligations under this Agreement to any third party without prior written consent of the other Party except to a subsidiary or an affiliated company, for which approval shall not be unreasonably withheld. Partner will not assign in whole or in part, its obligations under this Agreement to any third party without prior written consent of SISW.

b. SISW may subcontract, a portion of this Agreement to third parties, without any approval from Institute. Institute or Partner is not permitted to subcontract any portion of this Agreement to any third party without taking prior written approval from SISW.

c. If approved to subcontract, Partner and/or Institute shall be solely responsible for any liabilities, acts, defaults and neglects of any sub-contractor, its agents or employees as fully as if they were its acts, defaults or neglects.

19. FORCE MAJEURE

a. The Force Majeure Events include exceptional events or circumstances of the kind illustrated below:
- war, hostilities (whether war be declared or not), invasion, an act of foreign enemies,
- rebellion, terrorism, revolution, insurrection, military or usurped power, or civil war,
- riot, commotion, disorder, strike or lockout by persons other than Party's personnel,
- natural catastrophes such as earthquake, disaster, virus, epidemic, lockouts, fire, accident, torrential rain, flood or any act of God,
- munitions of war, explosive materials, ionizing radiation or contamination of such munitions, explosives, radiation or radioactivity,
- Governmental acts or actions.

b. If either Party is prevented from performing any of its obligations under this Agreement by such cases of Force Majeure, it shall give written notice to the other Party within twenty (20) business days of such occurrence to the events, describing the event and its effects supported by authentic evidence. The affected Party shall, having given notice, be wholly or partially excused performance of such obligation for so long as such Force Majeure prevents it from performing them. Party shall not be excused to make payment for the deliverables provided or services rendered. No Party shall have any claim/ compensation for the loss incurred due to the Force Majeure conditions.

c. The affected Party shall use all reasonable efforts to minimize any delay in its performance of the Agreement as a result of Force Majeure Events.

d. The Party unable to perform this Agreement due to the effect of Force Majeure Events occurrence may, after consultation with the other Party, extend the duration of this Agreement by a period commensurate to the time actually lost due to the Force Majeure occurrence. The other Party shall not claim compensation for the loss thus incurred.

e. In case of an extension up to 90 (Ninety) days in the performance of this Agreement due to the effect of the Force Majeure occurrence, Parties shall have a consultation on the performance of this Agreement or termination of the Agreement.

20. SEVERABILITY

If any provision of this Agreement is held to be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions will not in any way be affected or impaired and the remainder of this Agreement will continue to be binding upon the Parties hereto. The offending provisions will be deemed to be restated to reflect the original intentions of the Parties as nearly as possible in accordance with applicable law.

21. NOTICE

All notices, and other communications required or permitted under this Agreement shall be in writing and shall be deemed given when delivered in hand or when mailed by registered national mail service, return receipt requested, postage prepaid, and addressed to the address stated in the Agreement or emailed to the official email ID of the representatives of Parties. Either Party may change its address for notification purposes by giving the other Party notice of the new address and the date upon which it will become effective.

22. DISPUTE RESOLUTION AND GOVERNING LAW

The parties shall endeavor to resolve all or any dispute arising out of or in connection with this Agreement, amicably within 15 business days of a notice being issued by the non-defaulting party to the defaulting party. In case no amicable solution is arrived between the parties within the said 15 business days, then such dispute/s shall be settled through the competent courts located in India.

This Agreement, the construction and enforcement of its terms, and the interpretation of the rights and duties of the parties hereto shall be governed by the laws of India. The parties hereby submit to the non-exclusive jurisdiction of the courts of New Delhi, India.

23. MISCELLANEOUS

a. Neither Party nor any of its employees shall have the authority to enter into or conclude any agreements on behalf of the other Party nor otherwise bind nor obligate the other Party, except as provided in terms of this Agreement. For additional clarity, it is acknowledged and agreed that neither Party may or will make any statement, amendment to the Agreement or engage in any activity or make

any representation which would have an effect on the other party, without the written consent of the other Party.

b. No term or condition of this Agreement or any document incorporated herein by reference shall be deemed waived and no breach shall be deemed excused unless such waiver or consent shall be in writing and signed by the Party claimed to have waived or consented. No consent by any Party to, or waiver of, a breach by the other, whether express or implied, shall constitute a consent to, waiver of, or excuse for any different or subsequent breach.

c. Unless otherwise specified in this Agreement, all consents, approvals, notices, and requests, acceptances or similar actions to be given by either Party under this Agreement shall not be unreasonably withheld or delayed and each Party shall make only reasonable requests under this Agreement.

d. Either party will not make or offer to make any payments to, or confer, or offer to confer any benefit upon any employee, agent or fiduciary of any third party, with the intent to influence the conduct of such employee, agent or fiduciary in relation to the business of such third party, in connection with this Agreement or the provision of services hereunder. The parties represent and warrant that none of the other party's officers, directors, employees (collectively, "Personnel") has received anything of value of any kind, in connection with this Agreement; and that no Personnel has a business relationship of any kind with other party's officers, directors, employees or agents.

e. Nothing in this Agreement shall be construed to constitute or appoint either party as the agent, partner, joint venture, or representative of the other party for any purpose whatsoever, or to grant to either party any right or authority to assume or create any obligation or responsibility, express or implied, for, or on behalf of, or in the name of any other party designated herein, or to bind any such other party in any way or manner whatsoever.

f. Each party shall bear all legal and administrative fees and expenses incurred in performing its obligations under this Agreement.

g. This Agreement together with all exhibits, or schedules, and attachments attached hereto constitute the entire agreement between the Parties and supersede all previous agreements, promises, representations, understandings and negotiations, whether written or oral, between the parties with respect to the subject matter hereof. The terms of any purchase order or similar customer document are excluded; such terms will not apply to EULA and/or Supplemental Terms, and will not supplement or modify this Agreement.

In witness hereof, the Siemens Industry Software (India) Pvt. Limited, Institute and Partner have executed in manner hereinafter mentioned hereinabove.

Signed on behalf of
SRM University Delhi – NCR , Sonepat Haryana

Name: **Prof. Manish Bhalla**

Signature Manish Bhalla

REGISTRAR
SRM University, Delhi-NCR Sonepat,
Plot no. 39, R.G.E.C., P.S. Rai,
Sonepat (HR.)- 131029

Designation: **Registrar& Officiating VC**

Date: **September 15th, 2020**

Siemens Industry Software (India) Pvt. Ltd.

Name: MATHEW THOMAS

Signature:

Siemens Industry Software (India) Pvt. Ltd.

Designation: COUNTRY SALES LEADER

Date: **September 15th, 2020**

3D Engineering Automation LLP

Name: Ajay Deshkar

Signature:

3D Engineering Automation LLP

Designation: Designated Partner

Date: **September 15th, 2020**

Siemens Industry Software (India) Pvt. Ltd.

Name : _____

Signature: _____

Designation: _____

Date: **September 15th, 2020**

ANNEXURE A

COMMERCIAL DETAILS

S No	Scope	Contribution by SRM
1	Product Digitalization – Design Lab	₹ 1,69,52,707
2	Process Digitalization – Production Planning Lab	
3	Bio Tech Specialised Lab	
4	Simulation & Analysis Lab	₹ 1,11,77,444
5	CNC Controller Lab	₹ 53,62,927
	Content Learning IP Software	₹ 21,73,629
	Project Management, Train the Trainers, Seminars (3 , One per year)	₹ 29,00,000
		₹ 3,85,66,707

ANNEXURE B

BILL OF MATERIAL

S No	Product Code	Particulars	Units per Center
Lab 1 , Lab2 and Lab 3 : Product Digitalization ,Process Digitalization Lab , Bio Tech Specialised Lab			
1	NXACAD100	NX Academic Perpetual License Core+CAD	10
2	NXACAD101	NX Academic Perpetual License CAE+CAM	10
3	NXAMACAD100	NX AM Academic Add-on	10
4	NXCACAD100	Solid Edge CAM Pro Academic Perpetual	10
5	SE294	Solid Edge University Edition Perpetual	10
6	SEACAD100	Solid Edge Master Academic Bundle (Subscription)	10
7	FS2NX100	Fibersim for NX Perpetual Academic Bundle	10
8	TCUACAD100	Teamcenter Unified Academic Perpetual License	10
9	TNACAD100C	Tecnomatix Manufacturing Acad Perpetual License	10
10	E080	Femap with NX Nastran: Basic Educational License	1
11	SF2NX100	Syncrofit for NX Academic Bundle (Perpetual)	10
12	SITACAD101	Academic Bundle for SIT UA and Manufacturing Intelligence	10
13	TG20000E	5+ Educators/Administrator memberships (subscription)	1
14	PLNACAD100	Polarion ALM Academic Product (subscription)	10
15	PLNACAD101	Polarion VARIANTS (Add-on) Named User (Subscription)	1
Lab 4 : Simulation & Analysis Lab			
16	SCACAD100	Simcenter 3D Academic Bundle	10
17	STAR1035	STAR-CCM+ Academic Pack -(Subscription)	10
18	ILACAD100	Simcenter Amesim Academic Bundle	10
19	NXNACAD100	NX Nastran Academic Perpetual License	10
20	STAR3040	HEEDS Academic Teaching Package (Subscription)	1
21	TA50500E	PreScan/Base Educational (Subscription)	10
22	TA50700R	Prescan/Base RS	1
23	TA10111F	MADYMO/University/Standard Floating	10
Training : IP Software			
24	LAAS31001	PA-Perform SMB Membership	30
Lab 5: CNC Controller Lab			
25		808D Turning Kit table top	2
26		808D Milling Kit table top	2
27		840Dsl Kit	1
28		SINUTrain(classroom license for 18 users)	1

- Perpetual Software are with 3 year support from the date of LSDA/EULA acceptance
- Subscription license/ software are for 3 year from the date of LSDA/EULA acceptance.
- Server Mac ID and Temp Server will be provided by SRM UNIVERSITY for license Key generation and storage
- All hardware is with 3 years Standard and Applicable Support from the date of Dispatch
- Hardware delivery will take 10-14 weeks
- Items considered as consumables are not under support
- All third party Hardware and Software will follow their standard Support Terms

Techno – Commercial Proposal

Siemens Center of Excellence

SRM UNIVERSITY (Sonipat , Delhi NCR)

Dated 16th August 2020

SIEMENS/SRM/COE/1608/VER2.0

Statement of Confidentiality

Siemens Digital Industries Software has prepared the information in this document exclusively to address the business objectives of SRM UNIVERSITY. This document is Siemens confidential and proprietary. Siemens provides this document to SRM UNIVERSITY with the understanding that its contents will be held in strict confidence and will not be duplicated or used in whole or in part for any purpose other than evaluation of business needs, without prior written consent from Siemens.

This document reflects Siemens' understanding of SRM UNIVERSITY's business needs and project requirements and was prepared based on the information available at that point in time. Any changes to these needs or requirements may require changes to any portion of this budgetary estimate. This document does not represent a functional Statement of Work and is not intended to outline specific scopes, deliverables or costs.

Table of Contents

1 Executive Summary

The revolution in modern Industrial systems is one of the most critical business and societal changes we're experiencing. Urbanization, global environmental impacts, and government regulations are accelerating the demand for automation.

Developing product with adequate range, capabilities, and multiple design variants is a great challenge. Achieving all this with the same (or lower) cost of ownership requires bringing innovations and engineering efficiency that has been unheard of in the industry - without risking safety, reliability, and quality.

Siemens PLM Software offers simulation and testing solutions covering every aspect of Automation. Siemens is the only solution provider that offers a complete, integrated, and accurate digital twin addressing challenges for all aspects of Automation. This not only enables companies to achieve a significant competitive advantage, ROI, and operational performance edge in developing electric vehicles but also empowers them to adapt and evolve in the fast- approaching era of new mobility.

Siemens has established itself as a market leader by driving the expansion of the world's most complete innovation ecosystem that creates the technical foundation for our customers' journey to their digital enterprise. Driven by a deep understanding of what it takes to deliver successful products, Siemens partners with our customers to provide industry software solutions that help companies everywhere achieve sustainable competitive advantage by making real the innovations that matter.

Siemens proposes an integrated Centre of Excellence for SRM UNIVERSITY which will help students upskill, innovate, improve their skill

NOTE: These software and solution proposed in the COE are only for Education, Research and Training Purpose. No commercial use of software is allowed.

2 Background

2.1 SRM UNIVERSITY

SRM University Delhi-NCR, Sonepat, Haryana aims to emerge as a leading world-class university that creates and disseminates knowledge upholding the highest standards of instruction in Engineering & Technology, Science, Management, Law, Science & Humanities. Along with academic excellence and skills, university curriculum imparts integrity and social sensitivity to mould university graduates who may be best suited to serve the nation and the world.

Vision

SRM University Delhi-NCR, Sonepat, Haryana aims to emerge as a leading world-class university that creates and disseminates knowledge upholding the highest standards of instruction in Medicine & Health Sciences, Engineering & Technology, Management, Law, Science & Humanities. Along with academic excellence and skills, our curriculum imparts integrity and social sensitivity to mould our graduates who may be best suited to serve the nation and the world.

Mission

- To create a diverse community campus that inspires freedom and innovation.
- Promote excellence in educational & skill development processes.
- Continue to build productive international alliances.
- Explore optimal development opportunities available to students and faculty.
- Cultivate an exciting and rigorous research environment.

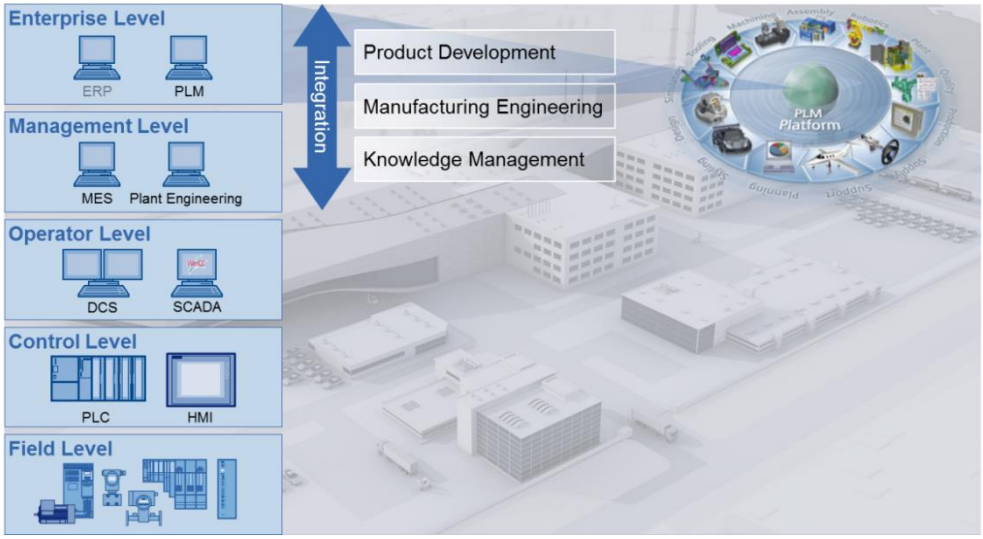
2.2 Siemens – A Global Leader in Engineering

Siemens is an integrated technology company. With business activities in 4 sectors: Energy, Healthcare, Industry and Infrastructure & Cities, Siemens is a clear global market and technology leader in its areas of operation. Technology excellence, innovation, quality, reliability and international focus have been Siemens' hallmark for over 160 years. Present in 190 countries, Siemens association with India dates back to 1867 when it laid the first telegraph line linking Britain and India. Siemens currently has over 21 manufacturing plants in India.

Siemens “Industry Sector” is one of the leading suppliers of innovative eco-friendly products and solutions globally for industrial customers.

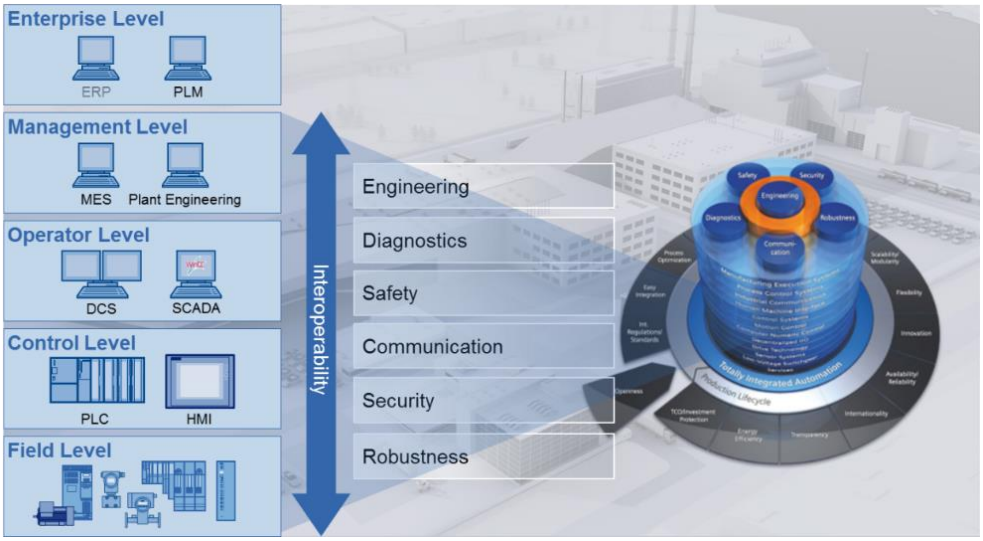
“Siemens Industry Software” provides integrated software solutions for product design, manufacturing planning and lifecycle knowledge management at the enterprise level. The solution integrates entire product information generated across an organization to help build first time right products, and validate the underlying processes required to do so in a digital environment. The solution expands beyond the boundaries of an extended enterprise to include suppliers, partners, and customers. All of these solutions are further integrated with manufacturing execution systems and plant engineering solutions to provide end-to-end visibility and control. At operations management level, Siemens “Totally Integrated Automation” offers unique open-standards based approach to automate and integrate the entire process ranging from Manufacturing Execution, PLC and HMI programming, and provide field level control. Interoperability with all Siemens and third party applications is its core advantage.

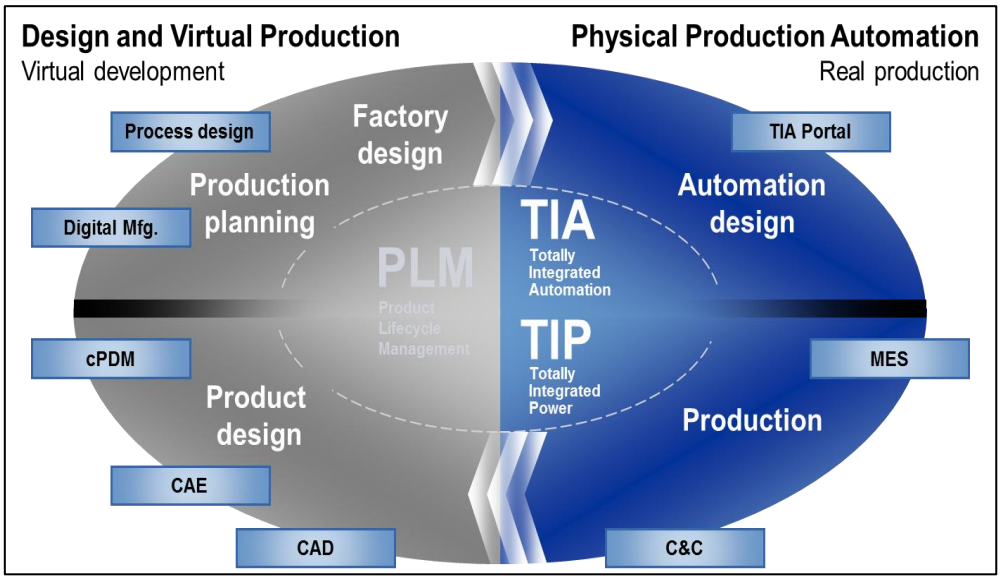
Siemens integrates enterprise level applications with manufacturing operations and plant engineering to shop floor automation. Combining the virtual and the real world, Siemens unifies product knowledge with process innovation. This unique offer from Siemens, for the entire lifecycle of product, process and production, is the foundation for Digital Enterprise. It includes “Totally



Integrated Automation” and “Product Lifecycle Management”.

Siemens unifies product knowledge with process innovation and manages all value creation elements of enterprise processes. Siemens provides digital enterprise platform that underpins a digital enterprise by creating unified product and production lifecycle – the entire lifecycle of product, process and manufacturing, from its conception, through design and manufacturing, to service, renewal and disposal.





Siemens is the only company in the world who can connect intelligent product and production lifecycle with virtual tools used for product and production design, in order to enable physical production planning validate its complete execution environment.

2.3 Siemens Digital Industries Software

Siemens Digital Industries Software, a business unit of the Siemens Digital Factory Division, is a leading provider of product lifecycle management (PLM), manufacturing operations management (MOM), and performance analytics software and services. We help thousands of companies make great products by optimizing their lifecycle processes, from planning and development through manufacturing and support.

Headquartered in Plano, Texas, Siemens Industry Software works collaboratively with companies, delivering open solutions to help them make smarter decisions that result in better products.

2.4 Our Values

At Siemens, everything we do – both within our company and for our customers – is guided by our core values. Everybody in our organization is driven to be:

- Responsible – Committed to ethical and responsible actions. We build trust and add value in all interactions, acting with the highest integrity and respecting the investments and dependencies of our partners.
- Excellent – Achieving high performance and excellent results. We lead and inspire our community and industry by delivering high value that goes beyond what is expected, building quality into everything we do.
- Innovative – Creating sustainable value for our customers. We engineer broadly applicable, engaging solutions to challenging problems that empower individuals and teams to reach their maximum potential.
- Open – Maximizing value in an open world. We embrace the open exchange of ideas, processes, information and software within our ecosystem. We also deliver a stable, standards-based, open foundation for software development.

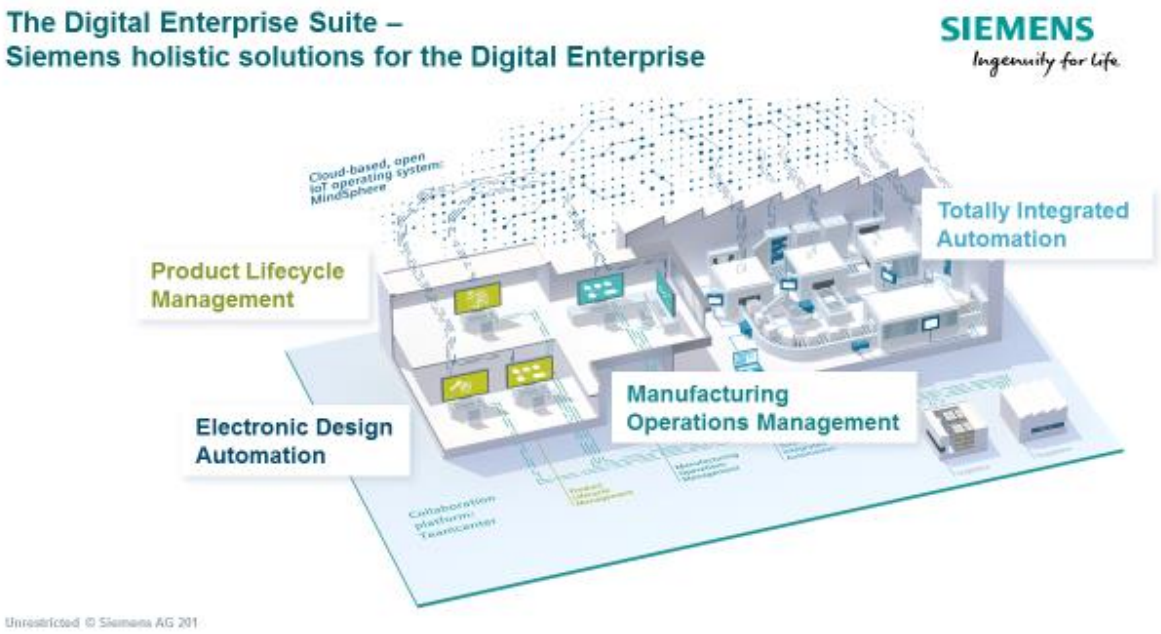
2.5 Our Vision and Strategy

In a world of smart, connected products, where entire markets can vanish with a single innovation, manufacturers must take a new approach to business. Some closely watch how products are being used, and feed data back from product utilization into product ideation and development in order to anticipate trends. But even if you know what to make, you still have to make it. That's why manufacturing – the realization phase of innovation – is vital in this new era.

Siemens' vision is to enable the digitalization of the enterprise to improve the collaboration of the processes and knowledge in ideation, realization, and utilization of products through the use of digital twins that can represent the complete definition of a product and manufacturing processes throughout its lifecycle. Siemens Digital Enterprise portfolio creates a digital thread through all product development disciplines to ensure accurate, timely, and multi-directional collaboration.

Siemens, a world leader in engineering and automation, is delivering solutions to integrate the virtual world of product development with the real world of production to enable our customers to realize innovation.

- Product Lifecycle Management Solutions to plan, develop, build and support products
- Factory Automation Solutions to engineer and commission production equipment
- Motion Control Solutions that link the virtual machine module with the real control system



Our software provides the technical foundation for our customers' Digital Enterprise, supporting their transformation. Our software portfolio weaves a digital thread that creates a tapestry of information that connects people with data and applications for real-time, informed decision making. This digital thread enables our customers to intelligently connect smart virtual models (digital twins) and real-time production information across lifecycle phases of ideation, realization and utilization, and across value chain participants to form a smart innovation environment. This enables our customers to digitalize across their entire ecosystem of products and plants, making it possible for them to realize the enormous benefits of digitalization, including dramatically shortening time-to-market, providing much greater production flexibility and significantly reducing costs.

2.6 Our Customers

With customers in 90 countries, Siemens helps thousands of companies make great products by optimizing their lifecycle processes, from planning and development through manufacturing and support. By digitalizing their entire product lifecycle process, our customers are better equipped to initiate or respond to disruptive innovation in their industries.

Our customers are looking to partner with a company they trust who can accelerate them into the future with technology, tools, and expertise – something Siemens Digital Industries Software is the only company in the world that can deliver – and do it in unique ways.

Personalized, adaptable and new ways of working.

- Flexible and adaptable applications, new business models

- Ability to meet rapidly changing consumer preferences
- With insights and data we can predict, we can adapt products to future needs

Blurring boundaries between domains.

- Merging of virtual and real world, hardware and software, design and manufacturing, the most comprehensive digital twin
- Enabling a complete digital transformation in discrete and process industries
- The only partner with domain knowledge in all disciplines of the digital enterprise

Open, modern, flexible ecosystem.

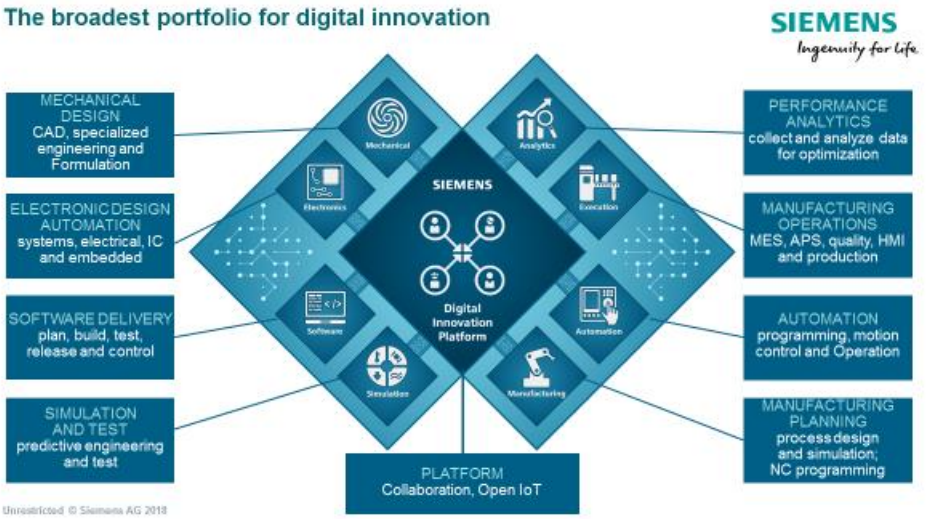
- Rapid application development to easily build, integrate and extend existing data and systems
- Access to a wide field of technology and solution partners
- Native cloud and cloud-connected products

Siemens Digital Industries Software. Where today meets tomorrow.

Customer success stories can be found on our website at:
https://www.plm.automation.siemens.com/global/en/our-story/customers/

2.7 Our Products & Services

Siemens provides a fully integrated software solution across our customers' entire value chains, from initial conceptual design, manufacturing planning and execution through service and support of both the products and plants that produce them.



2.8 Quality

Siemens believes quality is achieved through continuous improvement and performance excellence to ensure the high standards of our products, services, processes and technology offered to our customers. Our commitment to quality stems from the Siemens Quality Vision which is based on the Siemens Fundamental Quality Principles:

- Customer and business focus in all we do
- Personal commitment to quality in everything we do
- Check and test early to learn fast
- Real time data and openness
- Prevention, risk management, and systematic improvement
- Quality competence for everybody

We are driven by the Siemens Quality Policy of:

"Continual improvement with the purpose of constantly increasing the value of the products and services provided to our customers."

To deliver on the Quality Vision, the Quality Policy relies on our Quality Management System (QMS) that leverages International Standards, best practices, and quality principles to help eliminate or minimize risks in products, projects, and processes. The certification of the QMS by an accredited independent third-party documents our commitment to quality, and is yet another reason that allows our customers to derive measurable benefit in their own processes and products because they can confidently rely on the tools we provide to drive innovation. Our ISO 9001 quality certificates are available for viewing or download at: https://www.plm.automation.siemens.com/global/en/our-story/quality.html.

3 Centre of Excellence

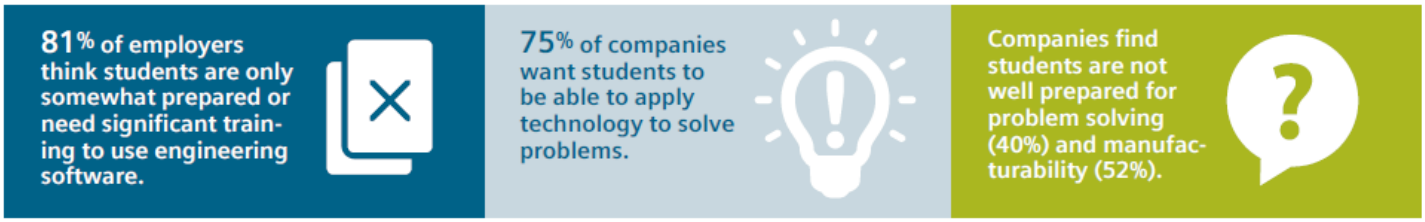
The program has following key components

1. Enablement program – Enable technical institutions
2. Learning Program – Enhance industry relevant skills
3. Youth Development Program – Develop next generation technicians and engineers
4. Creating a conducive eco-system for encouraging R&D, Innovation, Entrepreneurship.

Objectives of the Program

The broad objectives of the Program are as follows:

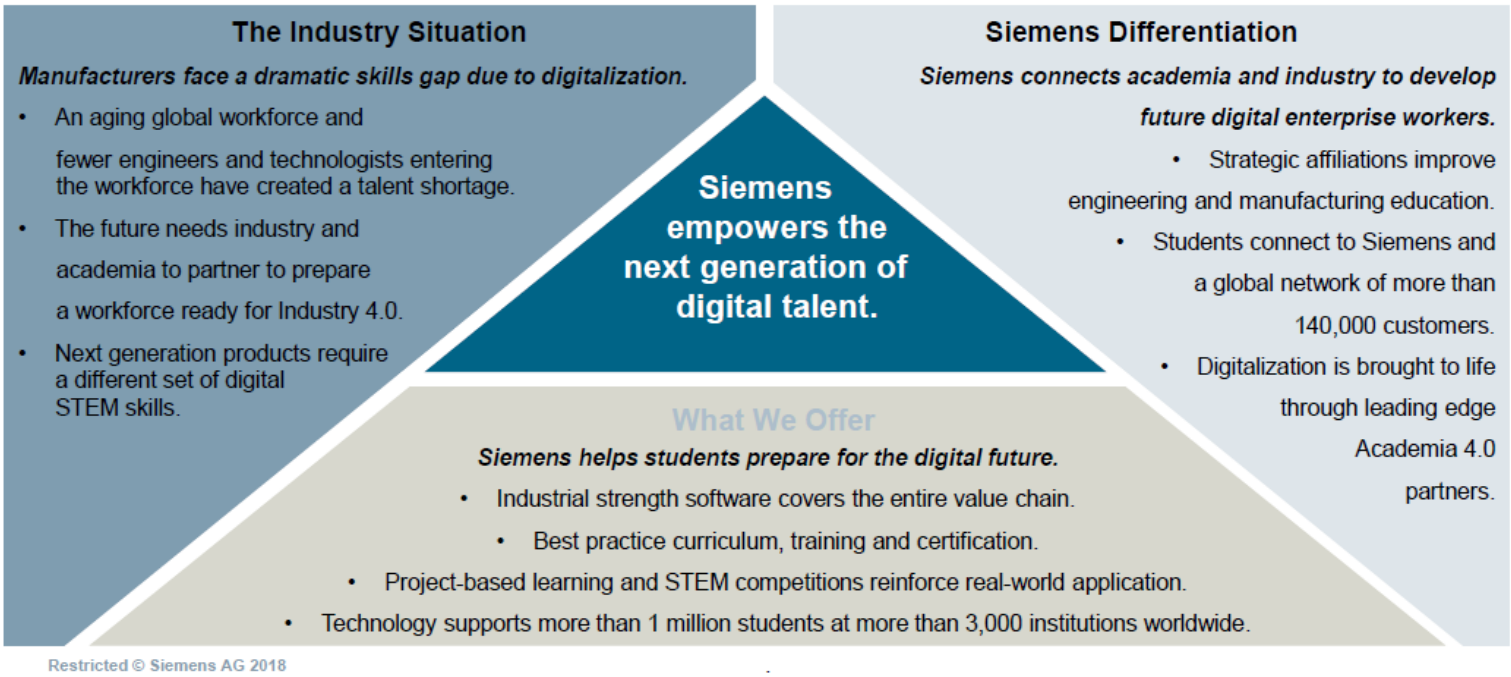
1. Qualitative improvements in Technical Education
   a) Improvements in Labs infrastructure by adopting latest open technologies in engineering design, manufacturing, analysis and management to serve the needs of targeted industries.
   b) Update Course curriculum to align with modern industrial practices.
   c) Promote Innovation.
2. Promote Industry – Academia partnership
3. Train students to improve remuneration
4. Create skilled manpower pool to cater to current and future industrial landscape of the region.
   a) Availability of trained workforce to attract industries to set up units in the State.



Intended Outcomes of the Project and Benefits to Stakeholders

The intended outcomes of the project are:

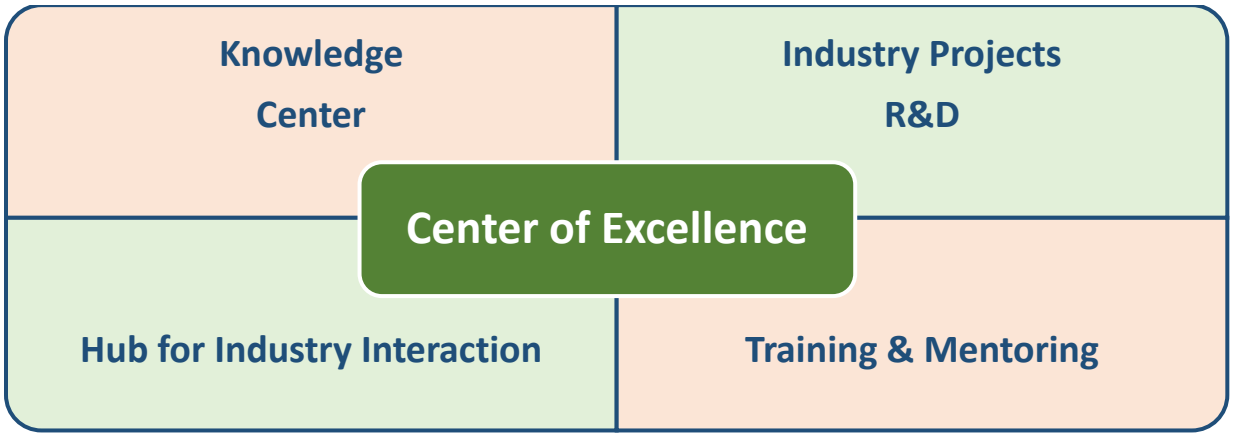
1. Build a world-class integrated Development infrastructure
2. Improved faculty competency at Institutions.
3. Centres of Excellence to train students with Industry relevant skills.
4. Improved Research and Development Activities
5. Industry partnership
6. Research & Development activities
7. Innovation & Entrepreneurship.



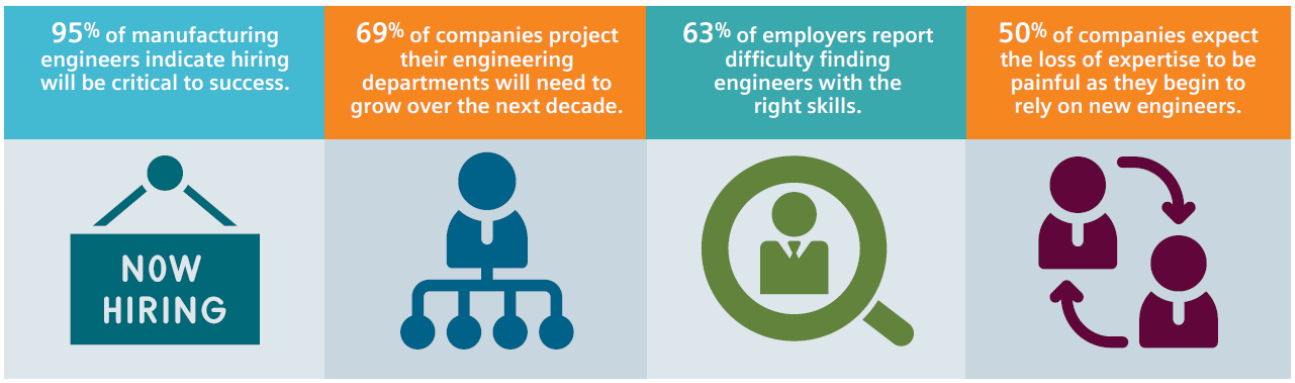
Siemens Centre of Excellence

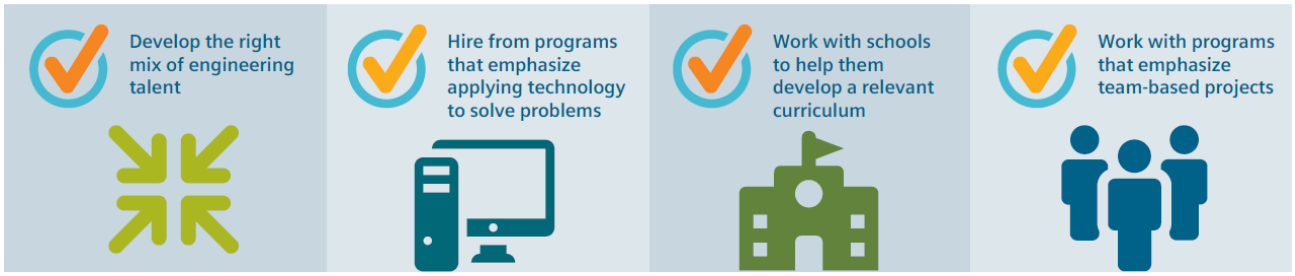
"Siemens Centre of Excellence" is an interdisciplinary, industry backed, centre focused on developing skill excellence for the Manufacturing Sector. Through the training and implementation of automotive industry-relevant technology and processes, the centre aims to facilitate a multi-disciplinary learning environment across Technology, Engineering, Science and Management faculties. It is designed to meet the demands of the industries' ever changing processes and help build skills around collaboration and innovation. The centre will leverage Siemens' integrated platform to draw upon the expertise from various areas of automotive community and provide its partners with knowledge and tools.

The centre aims to bridge the skill gap of students vis-à-vis automotive industry needs and impart state-of-the-art industry oriented training to help foster significant innovation and learning in technical education. The mission of Siemens Centre of Excellence is to promote advancement and implementation of PLM and advanced digital manufacturing-factory concepts through research and education partnership with the industry.



Making strong hires will be key





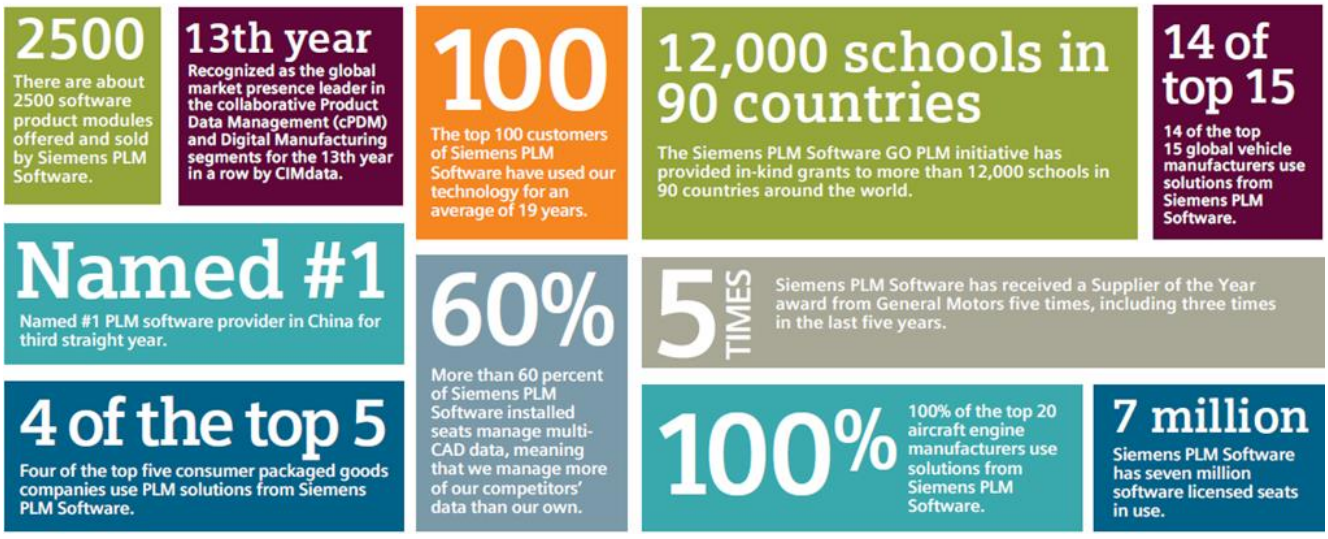
(Source for this entire infographic: "Close the Engineering Skills Gap: Prepare New Graduates to be Real-World Ready," Tech-Clarity, Inc., 2017. Percentages quoted represent the answers of 201 manufacturers who responded to the Tech-Clarity survey.)

Siemens Global Academic Program

Siemens PLM is addressing in increasing the research and Development capabilities with a comprehensive solution suite that connects industry producers to academic institutions and their students. We do this through academic partnership grants, providing solutions, industry-tailored curriculum and global support of research and development.

Siemens PLM provides its academic partners with industrial strength solutions to make sure that research capabilities are built from day one in the respective Institution/ Universities.

Siemens encourages academic growth by providing our academic partners with ready-made, industry-driven curriculums, such as mechanical design, 3D simulation, digital manufacturing, additive manufacturing and systems driven product development (SDPD). We also provide free self-paced training courses for educators and students via the e-Learning portal Learning Advantage. Siemens recognizes the industry need for new, experienced talent and students' desire for meaningful employment in industry. By working with Institutes around the world, Siemens is helping to close the gap and connect industry with academic institutions that will help develop a



new age of digital talent. Siemens PLM Software supports many real-world projects and competitions developed within industry

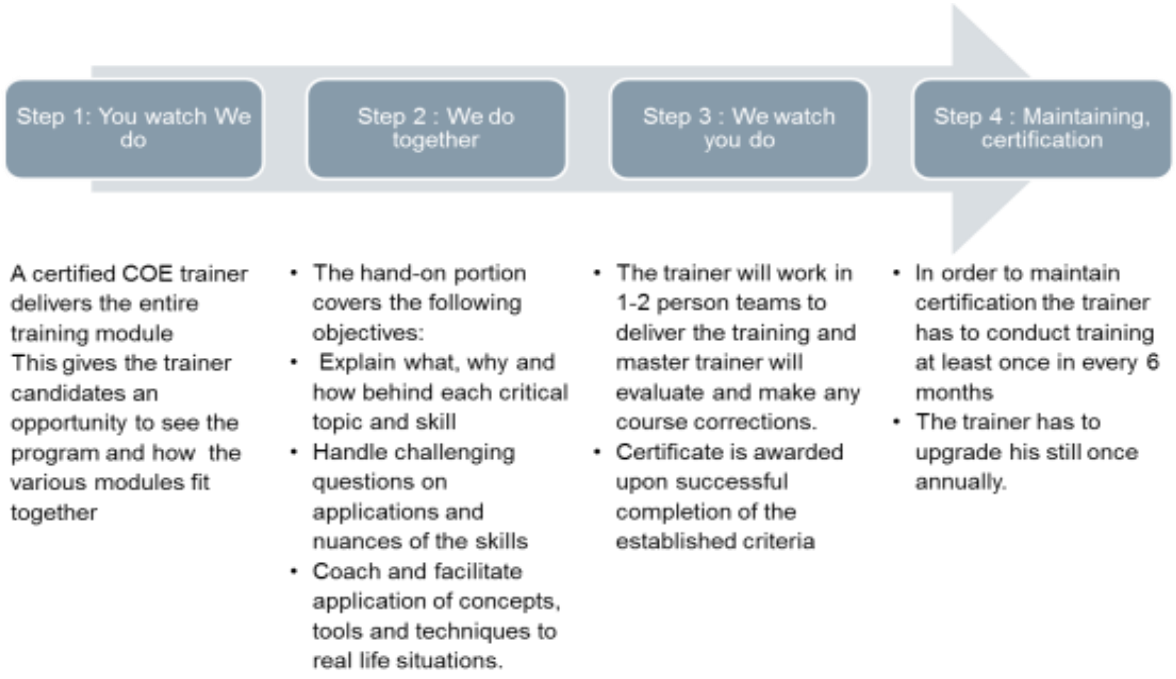
Industry Partnership

Siemens has been actively involved in organizing Industry conferences to address skill gap plaguing India. We intend to leverage these centres to build Industry-Academia partnership:

i. **Producer – Consumer Interactions:** This relationship necessitates some collaboration as the producer (academia) has to ensure that the output satisfies the needs of the consumer (industry) to a large extent, and vice versa. Hence, one form of collaboration, which is more in the nature of a feedback loop, is for the industry to provide inputs back to the academic institutions regarding their perception or evaluation of their products (students).
ii. **Collaboration in Continuing Education:** One of the core competencies of academic institutions is teaching. Many institutes, who are engaged in education at high end, have the wherewithal to provide training for high-end manpower development in topics relevant to industry. Therefore, a natural collaboration is possible for the institutes to conduct training in various topics of interest for the industry.
iii. **Collaboration in Research:** In a world driven by Intellectual Property, there is an increased interest in research collaboration. Though academicians in most good institutes engage in Research, collaboration is only possible when industry has a need for the same. Though the goal of research is to create new knowledge, industry wants is to utilize this to create products and generate revenue. Today academic institutions are conducting both basic and applied researches, the latter of greater interest to industry.
iv. **Industry linked learning model:** Industry Skill development program aims at linking education system to Industry. The learning model connects the four spokes of Individuals & Institutions to industry and knowledge bodies.

Train the Trainer (Facilitator)

The digitally interactive learning systems necessitate more the role facilitators, rather than teachers/ trainers. The facilitators address student learning problems, coordinate industry projects and interactions, and conduct the various learning administration processes viz. availability of necessary IT infrastructure, centre/ course registration, etc.



"Train the Trainer" (Facilitator) program aims to develop facilitators equipped with necessary skills and tools to facilitate the self-learning process of students. They are trained to impart training using Verbal, Visual & KINESTHETHIC approaches, and are equipped to train in both Instructor led & Self-paced learning methods.

i. **Understanding the training process:** The program starts by establishing needs and outcome of the training, profiling of trainers attending the training, designing specific training requirements and inviting delegates and trainers. Once the preliminary preparation is done, the training is delivered. The outcome is evaluated both in the training environment and at the institute.

ii. **Assessing training needs:** Design training program based on specific needs of institute requirement or trainer. A facilitator can be equipped to impart training across functions based on the self-paced learning methods.

iii. **Design and development of the training program:** The program follows "Present, Pair, Co-teach and Assume (Take over)" model. First the candidates are trained by a certified COE trainer. Then the candidates pick up certain topics and present, after which they get paired with a certified trainer to co–teach a class, before they finally assume the complete responsibility and take over the full training session. This rigorous process ensures that the new trainers are evaluated and feedback is provided at all stages of their training.

iv. **Understanding learning styles:** Each candidate has his own learning style. The program enables the candidate to access learning styles of their students and modify the pace of the modules accordingly.

v. **Using various training techniques:** A trainer needs to have additional skills other than subject matter expertise. The program is designed to include various training techniques as well as the personal skills required by a good trainer.

vi. **Giving and receiving feedback, and assessing training:** The program includes two-way feedback at different stages.

4 Laboratories to be set up at COE

S No	LABORATORIES	
	PHASE I	**SqFt**
1	Product Digitalization – Design Lab	400
2	Process Digitalization – Production Planning Lab	
3	Bio Tech Specialised Lab	
4	Simulation & Analysis Lab	400
5	CNC Controller Lab	300
		1100

5 Scope of Engagement

Scope of Engagement under Siemens COE Program

1. Setting up of Siemens Centre of Excellence
2. Training of Trainers for the COE labs
    a. Assumption is taken – SRM UNIVERSITY has adequate number of Trainers and can upscale post Train the Trainer approach.
    b. Training will be in Year one only
    c. No Man power will be provided by 3D Engineering or Siemens

6 Support Required

In order to successfully implement the program, Siemens Industry Software Ltd. require the following support from SRM UNIVERSITY:

1. Letter of consent from SRM UNIVERSITY on the proposal to ensure in-kind grant approval by Siemens.
2. Memorandum of Agreement between SRM UNIVERSITY, Siemens Industry Software and its Partner
    - Train the Trainer, Training Program handholding/ handover
    - Detailing – Scope of Work, Deliverables from Siemens, Timelines for execution as per the proposal, grant allocation to Siemens, Stakeholders' roles and responsibilities & other contract conditions mutually agreed
3. Allocation of space for Siemens Centre of Excellence
4. Upgrade labs to min. specified configuration (Internet connectivity, network cabling and switching, electrical wiring and switches (industrial grade), AC, Furniture & Fixtures, Flooring, Power backup etc.)
5. Allocation of funds for the program
6. Appointment of nodal person to coordinate and monitor the program
7. Physical Infrastructure required from the Institute
    - Space for Labs (as prescribed in this document)
    - Flooring, Furniture and Fixtures
    - Air Conditioning
    - Internet connectivity :Min. 20Mbps Internet Connection with live Static IP Address with the LAN connection.
    - Power supply (incl. Backup)
    - Generator/ UPS Backup
    - Compressor for the labs
    - Water Supply
    - Running expenses for utilities
    - Security (Manned/ CCTV)
    - Furnitures for placing the computers, equipment, chairs etc, will be arranged by the Institute in the LABs, Siemens, will provide the exact numbers and details for each lab in their site readiness document.
    - Lab consumables as required
    - Faculty rooms for the trainers will be provided.
    - Storewel for storing the raw Materials and tools will be provided.
    - Projectors, white boards, board markers, dusters, A4 papers, folders etc.

- Separate location / compressor room outside the lab. From there complete pneumatic lines will be given till the labs.
- IT Infrastructure, such as Server , Computers (Work Stations/PCs) – with specific configuration , Printer, LAN Connectivity
- Third party software to be provided by SRM UNIVERSITY
  - MS WINDOWs Sever OS
  - AutoCAD
  - MS SQL Data Base and
  - Oracle Enterprise DB (Data Base)
- Details will be shared post Placement of Work Order
- Man-power (labour) support for unloading, positioning of the equipment in the respective labs& installation of the all lab equipment.
- Institute should provide machine operated 5ton forklift and Crane wherever applicable, for unloading, positioning of equipment& installation of heavy lab equipment.
- Electricity Input both single and three phase connection will be provided with earthing. Required Support need to be provided to the Teams , related to Electricity.

8. Post completion of the contract (3 years) – yearly Support Renewal of licenses , Upgradation & regular AMC / Maintenance of Hardware etc.

7 Roles and Responsibilities

Activity	SRM UNIVERSITY	Siemens Execution Partner	Siemens
MoA with SRM UNIVERSITY	√	√	√
Allocation of Labs Space	√		
Preparation of Labs (as mentioned in the pre-Requisite)	√		
Installation – Software & Content (Digital Content)		√	
Installation – Hardware	√	√	
Industry Interaction Sessions/Seminar	√	√	√
Space & Logistics for Training of Teachers	√		
Training of Teachers		√	
Training of Students	√		

8 Program Budget

Table 1 Capital Support Required for Siemens Centre of Excellence

S. No.	Particulars	Price	Grant in-Kind by Siemens and Siemens Partner	Contribution by SRM
1	Project Expenditure (CAPEX & OPEX)	₹ 36,20,68,550	₹ 32,35,01,843	₹ 3,85,66,708
2	Expenditure in %		89.35%	10.65%
Total		**₹ 36,20,68,550**	**₹ 32,35,01,843**	**₹ 3,85,66,708**

Note: The Grant is only on Software.

S No	Scope	Total Project Cost	Academic Grant	Contribution by SRM
		₹ 36,20,68,550	₹ 32,35,01,843	
1	Product Digitalization – Design Lab			₹ 1,69,52,707
2	Process Digitalization – Production Planning Lab			
3	Bio Tech Specialised Lab			
4	Simulation & Analysis Lab			₹ 1,11,77,445
5	CNC Controller Lab			₹ 53,62,927
	Content Learning IP Software			₹ 21,73,629
	Project Management , Train the Trainers, Seminars (3 , One per year)			₹ 29,00,000
		₹ 36,20,68,550	₹ 32,35,01,843	₹ 3,85,66,708
			89.35%	10.65%

- Applicable Taxes (GST) would be charged at actuals at the time of invoicing.
- Any other Taxes , Duties will be extra.
  - Any change in Taxes will be borne by SRM UNIVERSITY .
- All Exception Certificate need to be provided along with the Purchase Order
- GO – PLM , Grant (in Kind) is only on Software
- **The COE is only for Educational, Training and Research Purpose. Its not meant for Commercial purpose. No commercial activity is allowed with these tools .**

9 Terms and Conditions

1. Order to be placed at 3D Engineering
2. SRM UNIVERSITY will execute a Tri-partite MOA with Siemens Industry Software Limited and 3D Engineering .
3. Payment Terms : Will be 100% advance , along with purchase Order in SISW – 3D Engineering joint ESCROW account- Details as per MOA, Payment within 7 days of invoice submission.
4. SRM UNIVERSITY should make available the site as per requirements specified in the proposal. A pre-requisite will be shared by 3D Engineering
5. Support / AMC of
    a. The Software start from the date of online acceptance of EULA /LSDA .
    b. The hardware will start from date of Dispatch
    c. Delivery of Hardware will take 12-16 weeks.
    d. All Third party Software and Hardware will be with their standard Support and Terms
    e. Items under Consumables are not applicable for Support
6. A GO-PLM document has to be filled and to be share by SRM UNIVERSITY , for availing the Software Grant.
    a. Any tax implication due to Grant need to be borne by SRM UNIVERSITY
    b. MOA / PO shall not be having the Grant mentioned.
7. A Business Overview Document (BOD) need to be filled either by SRM UNIVERSITY , 3D Engineering or SISW on behalf of SRM UNIVERSITY – which gives a brief about your business and to highlight the Organisation is Not – for – Profit.
8. Acceptance of few Online LDAP (LSDA – License Software Designation Agreement) – EULA , Standard License agreement(s) from Siemens Software to be accepted by SRM UNIVERSITY within 1 day of the receiving of such mails.
9. Yearly Support renewal to be done for Software Licenses & Hardware post 3 years.

10 Labs in Centre of Excellence

S No	LABORATORIES	
	PHASE I	**SqFt**
1	Product Digitalization – Design Lab	400
2	Process Digitalization – Production Planning Lab	
3	Bio Tech Specialised Lab	
4	Simulation & Analysis Lab	400
5	CNC Controller Lab	300
		1100

**3D Engineering will further discuss on the size and Lab requirement as per space availability. Few Labs can be clubbed together.*

A typical layout of labs (computer and equipment labs), we at Siemens believe that the facilitator / teacher / instructor should be in position to work with each student while he/she is attending the courses in the COE.

We recommend U-shaped inner core for theory / concept deliberations and discussions and out U-shaped core for computers / equipment facing the wall. In the subsequent sections we have given lab wise indicative drawings for better understanding.

11 Bill of Material for Centre of Excellence

Table 2 Bill of Material for Siemens Centre of Excellence

S No	Product Code	Particulars	Units per Center
Lab 1 , Lab2 and Lab 3 : Product Digitalization ,Process Digitalization Lab , Bio Tech Specialised Lab			
1	NXACAD100	NX Academic Perpetual License Core+CAD	10
2	NXACAD101	NX Academic Perpetual License CAE+CAM	10
3	NXAMACAD100	NX AM Academic Add-on	10
4	NXCACAD100	Solid Edge CAM Pro Academic Perpetual	10
5	SE294	Solid Edge University Edition Perpetual	10
6	SEACAD100	Solid Edge Master Academic Bundle (Subscription)	10
7	FS2NX100	Fibersim for NX Perpetual Academic Bundle	10
8	TCUACAD100	Teamcenter Unified Academic Perpetual License	10
9	TNACAD100C	Tecnomatix Manufacturing Acad Perpetual License	10
10	E080	Femap with NX Nastran: Basic Educational License	1
11	SF2NX100	Syncrofit for NX Academic Bundle (Perpetual)	10
12	SITACAD101	Academic Bundle for SIT UA and Manufacturing Intelligence	10
13	TG20000E	5+ Educators/Administrator memberships (subscription)	1
14	PLNACAD100	Polarion ALM Academic Product (subscription)	10
15	PLNACAD101	Polarion VARIANTS (Add-on) Named User (Subscription)	1
Lab 4 : Simulation & Analysis Lab			
16	SCACAD100	Simcenter 3D Academic Bundle	10
17	STAR1035	STAR-CCM+ Academic Pack -(Subscription)	10
18	ILACAD100	Simcenter Amesim Academic Bundle	10
19	NXNACAD100	NX Nastran Academic Perpetual License	10
20	STAR3040	HEEDS Academic Teaching Package (Subscription)	1
21	TA50500E	PreScan/Base Educational (Subscription)	10
22	TA50700R	Prescan/Base RS	1
23	TA10111F	MADYMO/University/Standard Floating	10
Training : IP Software			
24	LAAS31001	PA-Perform SMB Membership	30
Lab 5: CNC Controller Lab			
25		808D Turning Kit table top	2
26		808D Milling Kit table top	2
27		840Dsl Kit	1
28		SINUTrain (classroom license for 18 users)	1

- Most of the software are Perpetual with 3 year support from the date of LSDA/EULA acceptance
- Subscription license/ software are for 3 year from the date of LSDA/EULA acceptance.

- Server Mac ID and Temp Server will be provided by SRM UNIVERSITY for license Key generation and storage
- All hardware are with 3 years Standard and Applicable Support from the date of Dispatch
- Hardware delivery will take 10-14 weeks
- Items considered as consumables are not under support
- All third party Hardware and Software will follow their standard Support Terms

12 SRM UNIVERSITY – Proposed LABs

12.1 Siemens Digitalization Center of Excellence

"To survive disruption and thrive in the digital era, incumbents need to become digital enterprises, rethinking every element of their business." -- 2016 World Economic Forum

All industries are feeling the pressure of digital transformation. For some, the risk of market disruption is threatening their very existence, and for others it is creating unparalleled opportunities for growth. Many companies are not as impregnable as they may seem. Consider that since 2000, 50 percent of the Fortune 500 has vanished. It is expected that an additional 40 percent will disappear in the next 10 years if they don't adapt to change.

Products and the factories that produce them continue to become smarter and more complex. Rapidly advancing digital technology is driving innovation everywhere, especially in electronics and software. Next-generation smart products are complex system of systems and require a new approach to development.

Digitalization is transforming all areas of our life as well as existing business models. Manufacturing industries can largely benefit from taking advantage of technology trends such as generative design and intelligent systems. Production becomes more innovative through additive manufacturing, advanced robotics, Artificial Intelligence (AI), and new service models are being developed with the use of cloud solutions and knowledge automation.

Trends	Need for Digitalization
Technology disruptions Rapid product development	Product innovation
Global competition	Customer experience
High product mix, low volume	Smart manufacturing

For the Industries to remain competitive, they should reimagine the complete value chain with the advent of new technologies to improve Product innovation, Smart manufacturing and Customer experience. Industries should be aware of the changing business scenario of the technologies, global competition and the need for produce in low volume, high mix conditions.

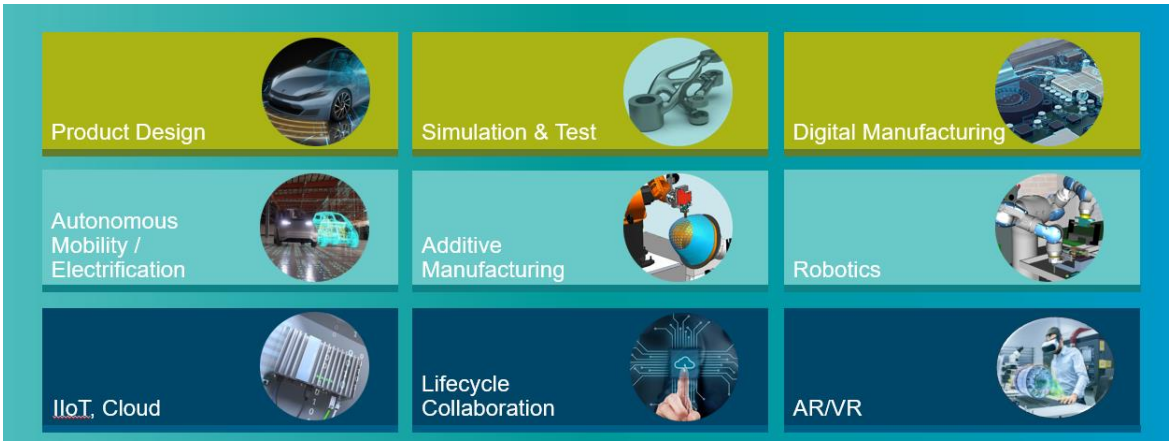
Innovation increases opportunities

Transformational force	2025 economic impact	
Internet of Things (IoT)	$36 trillion	Operating costs of key affected industries
Cloud technology	$1.7 trillion	Gross domestic product (GDP) related to the Internet
3D printing	$11 trillion	Global manufacturing GDP
Knowledge automation	$9+ trillion	Knowledge worker employment costs
Advanced robotics	$6 trillion	Manufacturing worker employment costs

The key to being able to innovate and remain competitive is to take advantage of the technology trends transforming industry and shaping the Digital Enterprise. This Digitalization Center is a platform to bring the Government, Industry, Academia, independent experts and latest technologies in Digitalization together to foster industrial research and innovation.

12.2 Digitalization

Digitalization is the process of connecting digitized information via digital twins and the digital thread to gain detailed insights that can be used to transform business processes and create new opportunities for product innovation.The data relationships between digital twins, and the ways in which they inform and influence each other, is known as the “digital thread.” Analyzing the digital thread and using the resulting insights to improve products and processes across an enterprise is digitalization in practice. Digitalization can yield a number of insights and benefits that enterprises can leverage for competitive advantages.



13 Product Design Lab

13.1 Industrial Design and Styling

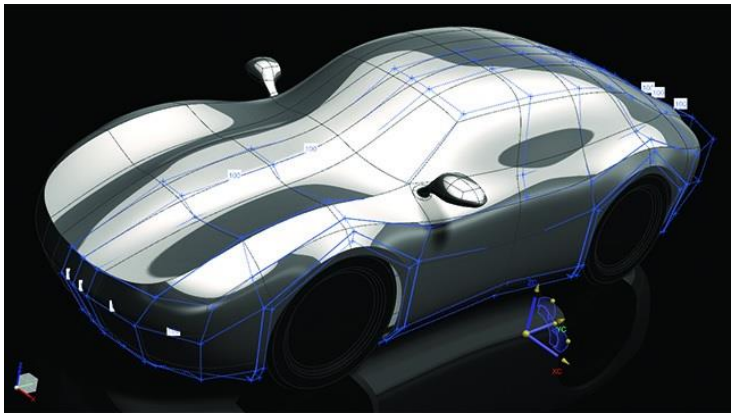
Innovative product design is a well thought-out combination of form, fit and function that leaves customers with a positive experience each time they use a product. Distinctive design and styling gives companies a competitive advantage. Design is the key differentiator in most of today's industries. Of course, the design must not only be visually appealing, but it must be functional, manufacturable and affordable to build, support and maintain.

FREEFORM SHAPE MODELING

NX features an extensive set of freeform design tools that are useful in all product development disciplines and processes, from concept through manufacturing. The freeform design tools include capabilities for creating solid models using loft, sweep and mesh techniques, surface trimming and extension, surface transitions and advanced filleting.

CLASS A

Advanced functions extend the freeform toolset to include synchronous sculpting of surfaces and solids with a unique history-based class A methods. For exterior and interior Class A surfaces, we provide pole manipulation and surface alignment tools while giving you full control and real-time analysis of surface quality.



HYBRID MODELING

With NX hybrid modeling, you can develop freeform designs using any combination of modeling techniques from a broad toolset.

- Create conceptual layouts quickly from raster images or CAD sketches, using curves and sections to extrude, loft, revolve and extend the geometry.
- Create surfaces from meshes of curves.
- Use parametric, feature-based design tools to build details, with advanced features like styled blends.
- Edit faces with synchronous freeform modeling, sculpting solids by moving iso-parameter curves and poles with push-and-pull simplicity

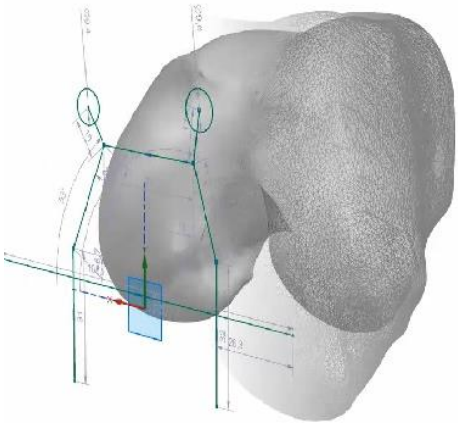
REVERSE ENGINEERING

Traditionally, many industries use scanned 3D data as part of their design processes. In the past, this has required a time-consuming, and sometimes complicated process. Irregular shapes, in particular, required

extensive reverse engineering so that they could be used for 3D printing, mold design, analysis, or other uses. NX allows you to bring the scanned data in as facets, so there's no need to map surfaces, create solids, or do any other manual shape creation. You can scan your data and immediately begin building supports for 3D printing, creating molds based on the shape, including it in an assembly, analyzing it, or performing any other operation that you would do with CAD data.

CONVERGENT TECHNOLOGY

The first technology of its kind, Convergent Modeling ™ Technology allows designers to combine facets, surfaces, and solids in one model without converting data. This allows facet data to now be an equal part of the design process



IMPORT OF SCANNED DATA

Easily import and optimize scanned data. NX directly imports polygon facet data acquired by scanning physical objects. NX allows you to bring the scanned data in as facets, so there's no need to map surfaces, create solids, or do any other manual shape creation. You can scan your data and immediately begin building supports for 3D printing.

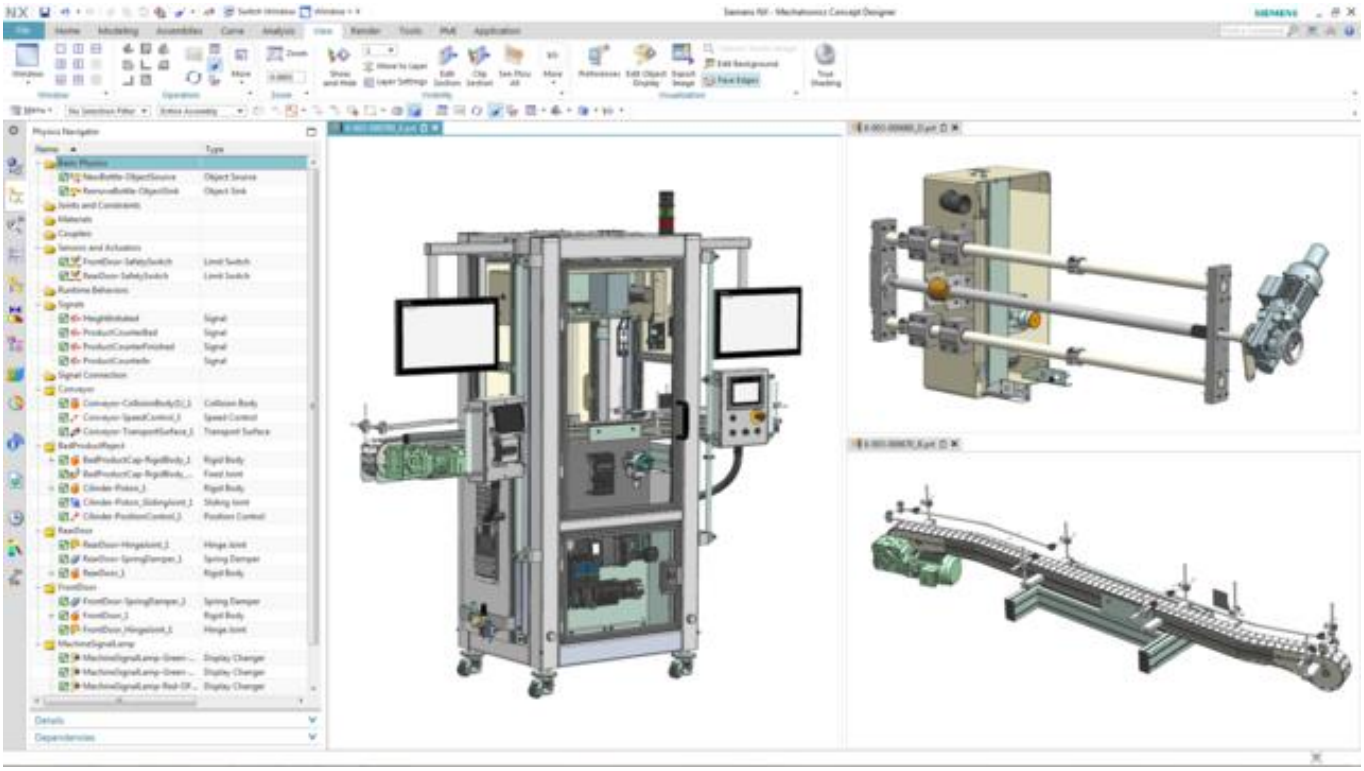
13.2 Mechatronics Concept Design

Our products enable a multi-disciplinary approach to machine design that breaks down barriers between electrical, mechanical, and automation engineers. We continue to revolutionize the machine design process by helping you design faster with higher quality. Mechatronics Concept Designer provides an end-to-end solution that enables multi-discipline collaboration, re-using of existing knowledge, reduced time-to-market, and better decision making through concept to production evaluation.

Mechatronic Concept Design is made up of powerful features that allow you to build a custom solution.

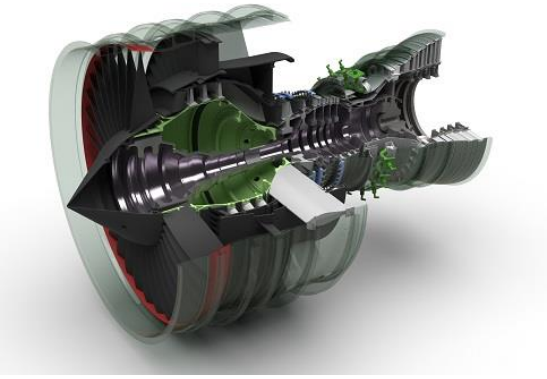
- Integrated System Engineering Approach
- Open Interfaces to Other Tools

- Physics-Based Simulation Capability



13.3 Product Modelling

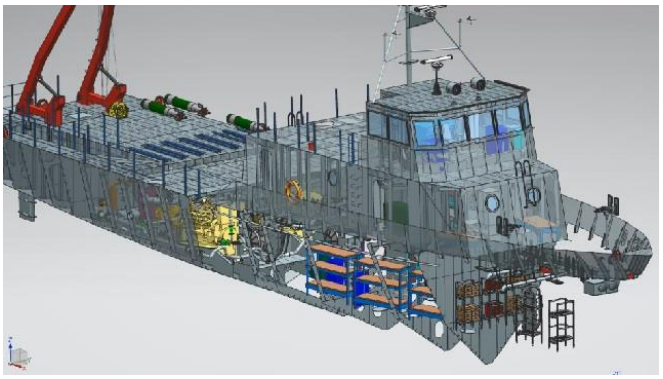
With the industry's most powerful and versatile CAD modeling tools, NX enables you to freely use any modeling approach that fits your design challenge and get innovative products to market faster.NX combines wireframe, surface, solid, parametric, and direct modeling in a single modeling software solution that allows you to choose the best tool for the task at-hand. In addition, Convergent Modeling technology in NX gives you the ability to combine these approaches with faceted-based modeling without the need for data conversion.



ASSEMBLY DESIGN

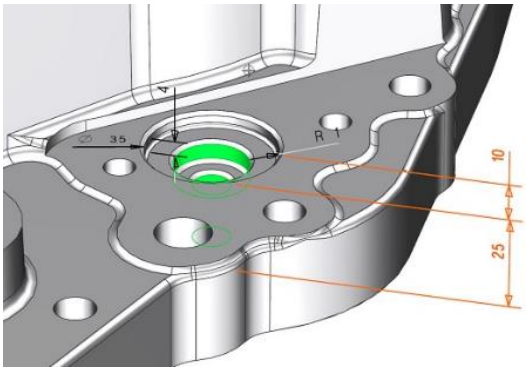
Create and manage assembly models of any size or complexity with the most powerful CAD assembly design tools available. Supporting both top-down and bottom-up techniques, NX helps you manage and navigate assembly models, and keep your team organized and on-track:

Handles the world's most complex assembly designs daily. Provides control structures and constraints for parametric assemblies that simplify design changes and accelerates modeling of configurations, options and variants. Allows you to design in the true context of your product
Supports full digital mockups to validate your designs, identify issues and resolve them.

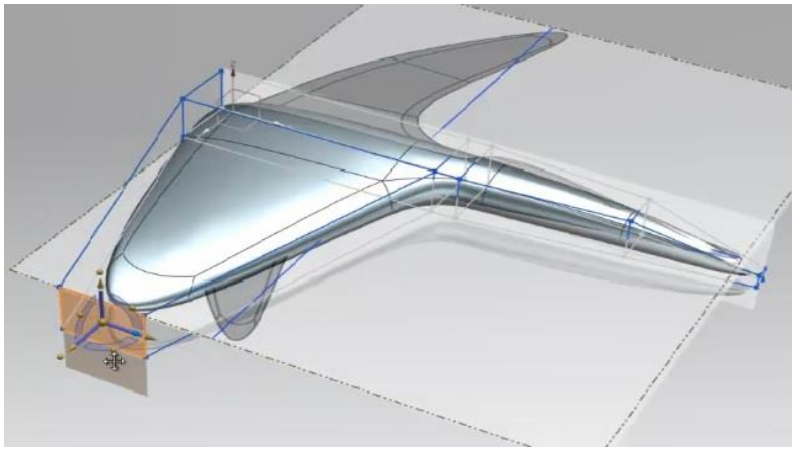


FEATURE MODELING

NX provides unparalleled power, versatility, and flexibility that enable companies to design the next generation of products faster and less expensively. NX combines comprehensive high-performance parametric wireframe, surface, solid, and facet modeling with the power of synchronous technology's direct modeling in a single modeling solution. Combining feature modeling techniques with the power of synchronous technology gives you the fastest approach to creating the designs you need.



FREE FORM DESIGN

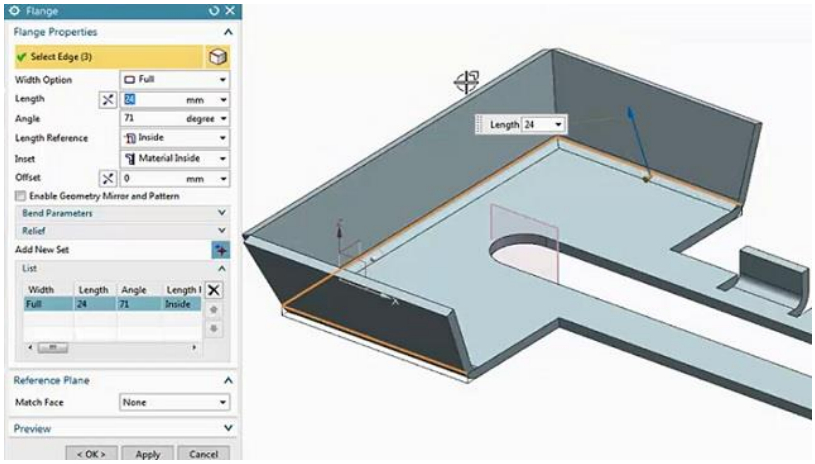


NX freeform modeling software gives you the power and creative flexibility to explore alternative design concepts quickly. A versatile, integrated toolset combines 2D, 3D, curve, surface, solid, facet, and synchronous modeling for fast and easy shape creation, evaluation and editing. With advanced freeform modeling, shape analysis rendering and visualization tools, NX delivers all the capabilities of dedicated industrial design systems, and also offers complete integration with NX design, simulation, and manufacturing to accelerate development.

SHEET METAL DESIGN

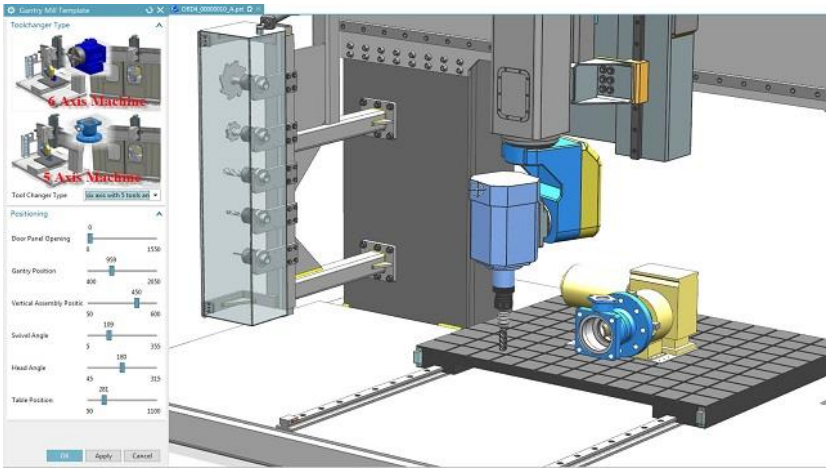
Using familiar terminology and workflows, NX helps you efficiently create sheet metal parts based on industry knowledge of material properties and manufacturing processes.

NX sheet metal design tools incorporate material and bending information, enabling the model to represent both the formed component and flattened blank shapes. You can quickly convert solid models to sheet metal components, and create sheet metal parts that enclose other components. NX Advanced Sheet Metal provides functions that enable the modeling of sheet metal parts with more complex shapes.



TEMPLATE BASED DESIGN

Reusing design information and process knowledge helps you reduce costs, increase innovation and boost efficiency in product design. Accelerate design, standardize product design processes, and maximize the time and cost savings of reuse in NX. You can quickly create templates from existing designs and easily re-use them for new designs. With simple drag-and-drop tools, you can quickly and easily create custom interfaces that control design inputs and engineering operations for templates. With NX Product Templates, you can automate much more than design modeling. To automate and standardize engineering processes, you can incorporate product and manufacturing information, drawings, motion analysis, structural simulation, and validation checking into the templates.

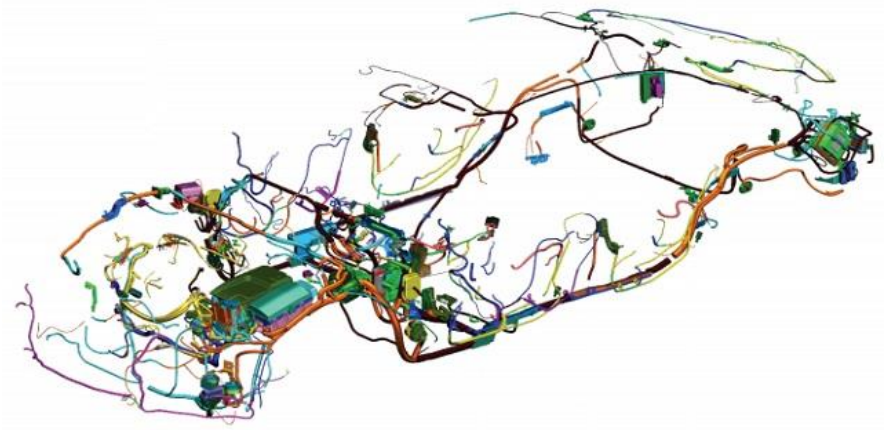


13.4 Wire harness and routing

NX digital product development solutions include an integrated suite of tools that facilitate the entire design process for routed systems, including wire harnesses, cables, piping, tubing, conduit and raceways.

NX offers a fully integrated 3D electrical routing and wire harness design application that allows you to design and route harnesses in complex assemblies. The electrical routing tools provide smart features and functions to automate the design, modification and analysis of wire harnesses.

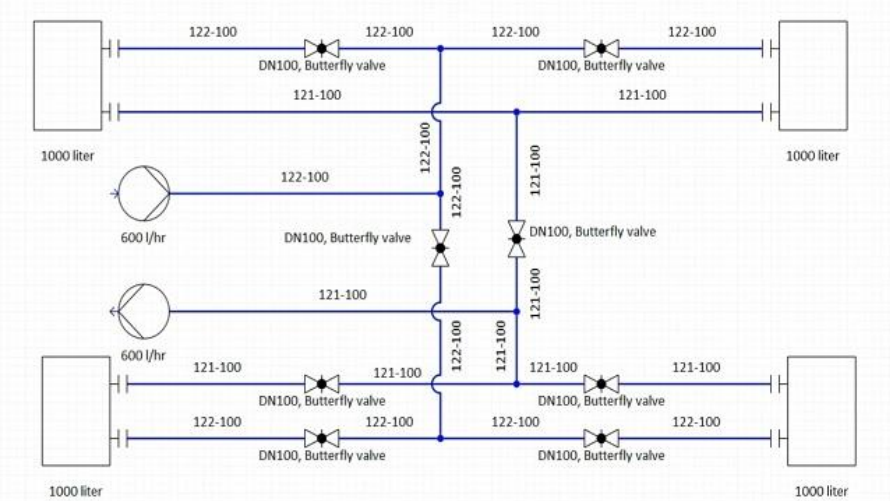
The powerful design and manufacturing capabilities available in NX electrical routing enable users to produce a wire harness directly from NX product assembly models. The need to build a physical prototype before producing the wire harnesses is eliminated, significantly reducing product development time.



2D AND 3D PIPING DESIGN

You can begin by creating a 2D schematic diagram defining the logical connections between devices, then build a 3D model of the system assembly that is driven by the schematic. Path creation tools assist you in defining paths and constraining the mechanical system to adjacent components. You can quickly define runs and spool subsections to reference in the 2D schematic, manufacturing drawings and other documentation.

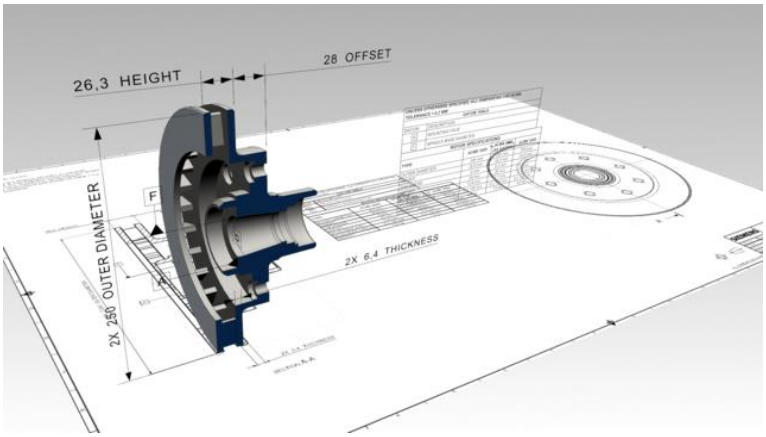
NX includes a part library that uses intelligent algorithms to automatically select components based on run characteristics and ensures proper attachment to the assembly. Template assemblies enable you to place auxiliary components such as valves, flanges and gaskets in a single step.



13.5 Model based definition

Model Based Definition enables the production of a complete digital definition of a product within a 3D model, thus replacing a traditional drawing. By empowering the model as the single source of truth product teams are able to save valuable time by incorporating product and process information and ensure that intent is completely captured and associated to the model. Compared to drawing-centric workflows, NX reduces the time spent on engineering documentation, drives downstream tools for validation and manufacturing, and reduces late changes and scrap.

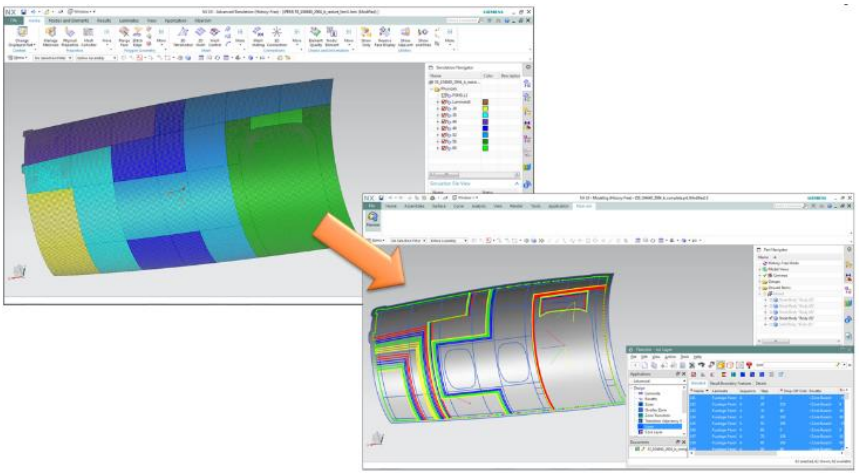
With one source of dimensional and tolerance information, there's no need to worry about drawings and models not agreeing with each other. In addition, annotated 3D models are easier to understand than complex drawings, reducing training needs and the chance for errors.



13.6 Composites engineering

The benefits of composite materials derive from the ability to truly engineer the performance of the part by varying thicknesses, fiber angles, material types, and part shapes. These myriad design variables produce inherent complexity that is unique to composite parts, and inextricably link the part geometry, material behavior and manufacturing process. Only by mastering the intersection of these three characteristics can the full potential of composites be unlocked.

Fibersim provides the key with flexible design methodologies that capture the specifications from analysis and efficiently flow them through the manufacturing process to produce an optimized composite part that can be produced on budget.

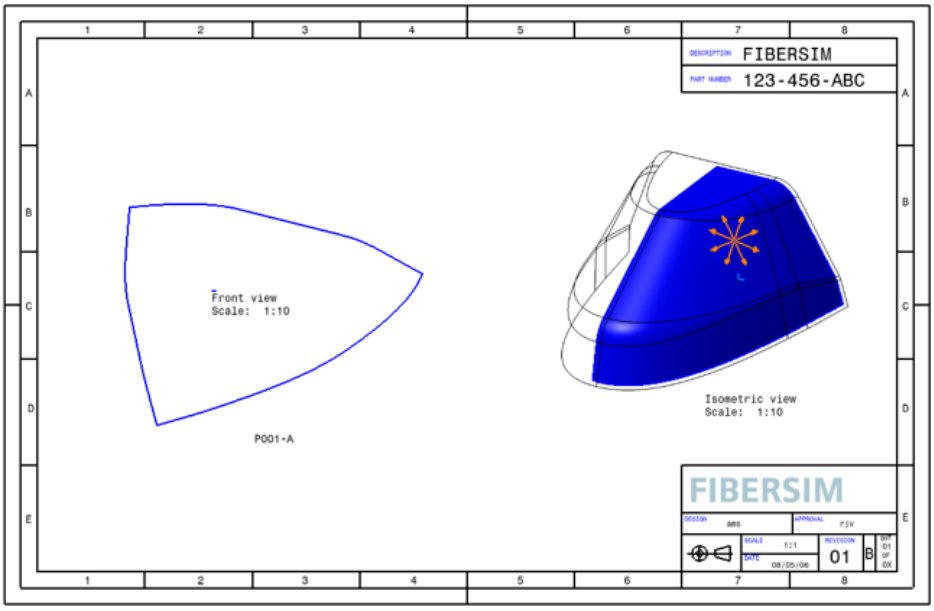


Using Fibersim as the hub for your composite part design allows for the efficient input of requirements from CAE to create a CAD digital twin that can rapidly react to changes in shape and specification, all while providing a window onto the shop floor to ensure the producibility of your design. Design rules provide powerful automation in the creation of ply boundaries from minimal geometry input. Additionally advanced sorting, filtering, and renaming capabilities provide efficient tools for navigating the complexity of modern composite parts.

Fibersim's producibility simulation is a production-proven capability to accurate flat patterns and true fiber orientations. With the complex curvature and advanced materials of modern composites, specified orientations cannot be assumed, and having a reliable simulation of the part producibility is critical to repeatable and high-performing parts. Fibersim can also provide a preliminary look at path planning challenges for automated deposition.

13.7 Composites manufacturing

The digital twin of a composite part only has value if it can be leveraged throughout the product lifecycle.

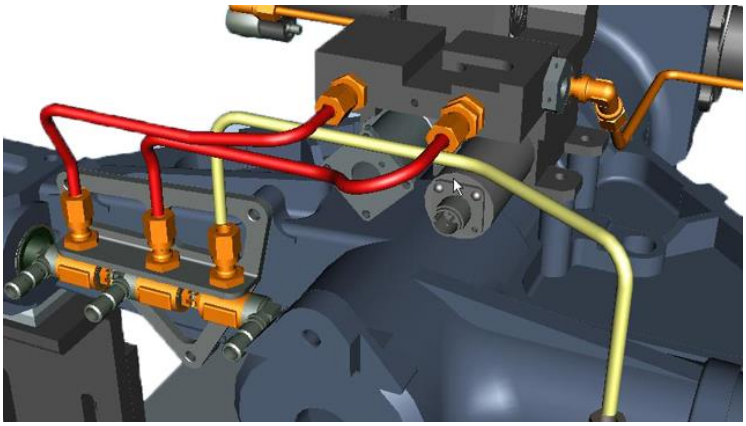


Fibersim's open architecture provides access for best-in-class industry solutions to the complete digital definition of the composite part. The HDF5-based CAE Exchange Format provides access to leading CAE tools. The Flat Pattern Export module provides optimized flat patterns for leading cutters and nesting packages. Laser Projection creates a true offset dataset that can be consumed directly by leading laser projection systems. Automated Fiber Placement and Tape Laying exports can be leveraged by leading path planning software for automated deposition.

14 Digital Manufacturing – Process Digitalisation

Tecnomatix is a comprehensive portfolio of digital manufacturing solutions that help you to digitalize manufacturing and the process of transforming innovative ideas and raw materials into real products. With Tecnomatix software, you achieve synchronization between product engineering, manufacturing engineering, production, and service operations to maximize your production efficiency.

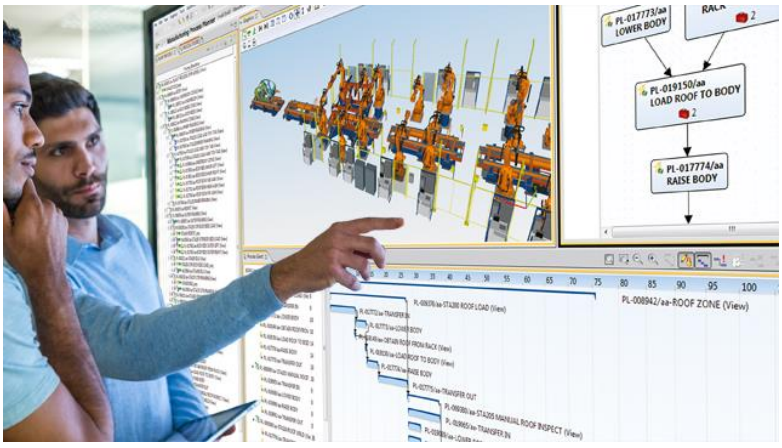
14.1 Assembly simulation



Optimizing the assembly process upfront, prior to the start of production, results in more accurate manufacturing plans and improves time-to-volume-production. You can reduce your overall planning process time, shorten production setup, achieve faster ramp-up and deliver high-quality products right the first time by using assembly simulation to virtually verify all of the process operation steps and their details.

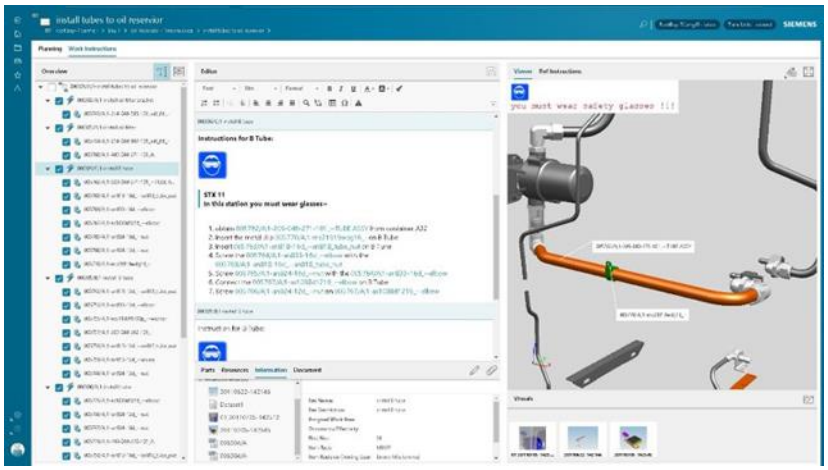
MANUFACTURING PROCESS PLANNING

Author, analyze, and manage manufacturing process plans more efficiently and communicate them throughout your organization and extended enterprise more effectively.



Teamcenter® software's Manufacturing Process Planner and Easy Plan applications allow manufacturers to create and manage the manufacturing bill of materials (MBOM) and the bill of process (BOP) to capture “what to make” and “how to make it”. These applications provide close collaboration between engineering, manufacturing and execution by leveraging Teamcenter workflow, change management and configuration capabilities. Manufacturers can use Teamcenter Manufacturing Process Planning and Easy Plan solutions to standardize and re-use assembly processes across multiple plants, capture work instructions for the shop floor, perform detailed time analysis, balance production lines, and much more.

SHOP FLOOR WORK INSTRUCTIONS



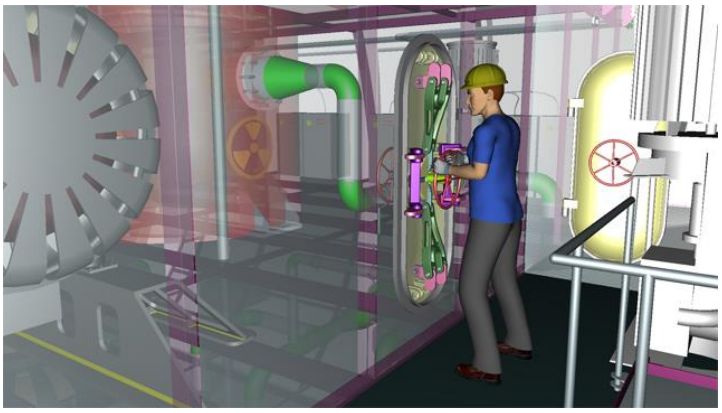
Teamcenter software's Manufacturing Process Planner and Easy Plan applications provide an easy to use environment to author the textual instructions for operations under the bill of process (BOP) and an auto-completion tool to reference parts, resources, and visual aids that users would like to document in shop floor work instructions. This eliminates user errors from manual typing and increases quality. Symbols, hazards and standard text fragments are available for textual instructions and ensure reuse of company standards. Visual aids can be created in the 3D graphics to guide shop floor operators in their daily assembly work while using the Electronics Work Instructions (EWI) application.

OPERATION TIME ESTIMATION AND LINE BALANCING

Teamcenter software's Easy Plan application provides a comprehensive set of time management and balancing solutions including time analysis capabilities using time standards, such as MTM, and application embedded integration to TiCon. Easy Plan supports lean initiatives by ensuring a clear visibility to value-added and nonvalue-added activities.

Easy Plan Line balancing displays the rolled-up times for the operations, stations, and operators as well as the cycle time and wait time in the plan. In this way, the software allows you to optimize the plan to a target Takt time, optimize the operator work in the line and evaluate alternative plans.

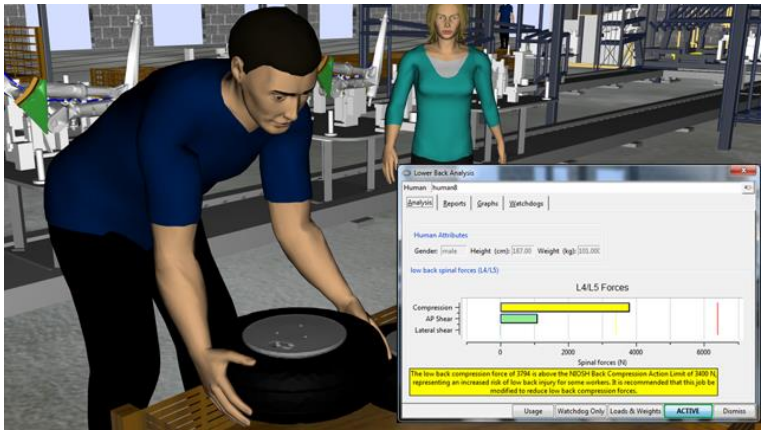
14.2 Human simulation and Ergonomics



With Tecnomatix human modeling and simulation, you can improve the safety, efficiency, and comfort of your workplace environment using Jack and Jill virtual humans. Human-centered operations can be analyzed with lifelike models that can be scaled to match different population characteristics.

You can test design and operational aspects of a wide variety of human factors, including injury risk, timing, user comfort, reach-ability, line-of-sight, energy expenditure, fatigue limits, and other important parameters. This helps you to ensure compliance with ergonomic standards during planning and to avoid the discovery of human performance and feasibility issues during production.

Consider the ergonomics of your product designs, manufacturing and service operations, and workplace layouts early in product development and process planning to ensure compliance with health and safety standards and to avoid the discovery of human performance and feasibility issues during or after production.



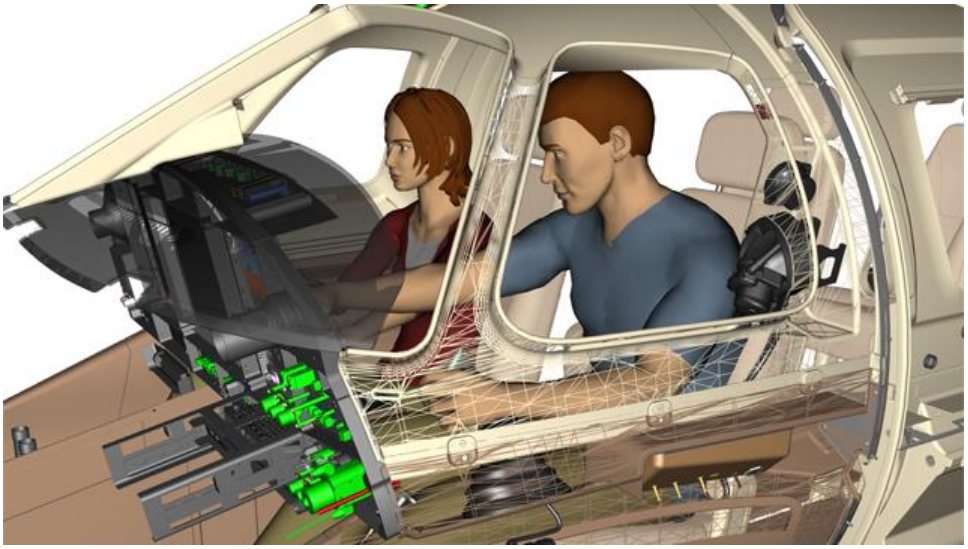
Using advanced scaling for accurate human simulation and some of the most sophisticated human factors and ergonomics analysis capabilities available, you can build safer and more ergonomic products and human operations.

HUMAN CENTERED DESIGN

Leverage human modeling and simulation during product and process design in order to perfect your designs and workplaces.

Manufacturers must address the ergonomic aspects of their products and operations during the early stages of product design and manufacturing planning. Ergonomics of products and the health and safety aspects of human assembly operations are important compliance factors, and every manufacturer needs to find the most cost-effective way to address comfort and safety in their product designs and production facilities.

Process Simulate Human and Jack enable you to improve the ergonomics of your product designs and to refine industrial tasks. The software and optional toolkits provide human-centered design tools for performing ergonomic analysis of virtual products and virtual work environments using the latest visualization and simulation technologies.



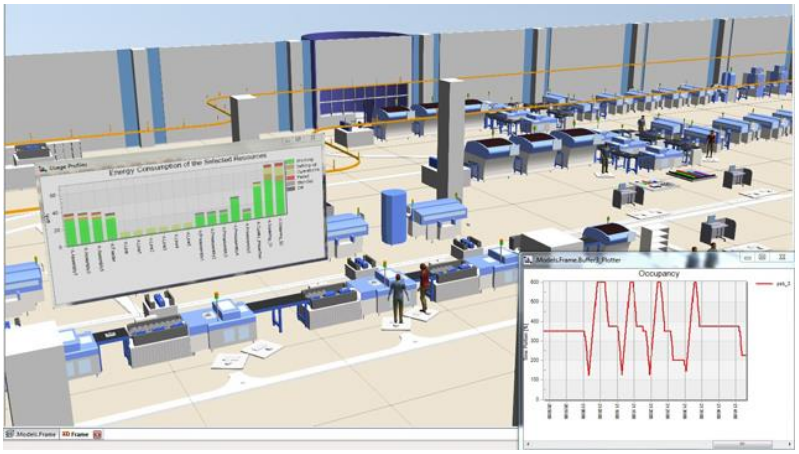
Tecnomatix® software's Occupant Packaging Toolkit helps designers and engineers analyze concept vehicle interiors for human factors and ergonomics without building physical prototypes. Designing better interior spaces for automobiles, buses, trucks, airplanes and construction equipment can be a challenge. The Occupant Packaging Toolkit addresses this challenge by providing analytical tools that help you design vehicle interiors for optimal occupant performance and comfort while reducing the need for costly physical prototypes and time consuming design revision cycles.

DESIGN FOR MAINTENANCE

Utilize Process Simulate Human and Jack software to address maintainability during product design and manufacturing planning. Evaluate if there is space to access a part for replacement, identify special tooling requirements for maintenance, and create international training material using pictures and movies. Improve service times, identify and correct ergonomics and safety hazards related to maintenance tasks, and minimize lifecycle maintenance costs. Teach service procedures without physical equipment, lowering the cost of training your service personnel.

14.3 Simulation and optimization of production and logistics

With Tecnomatix logistics and material flow simulation, you can use discrete event simulation and statistical analysis capabilities to optimize material handling, logistics, machine utilization, and labor requirements. This allows you to quickly check for bottlenecks, validate transported materials, and view resource utilization over time for multiple process alternatives. Using stochastic tools with object-oriented and 3D modeling capabilities, you can increase your manufacturing accuracy and efficiency while improving throughput and overall system performance.

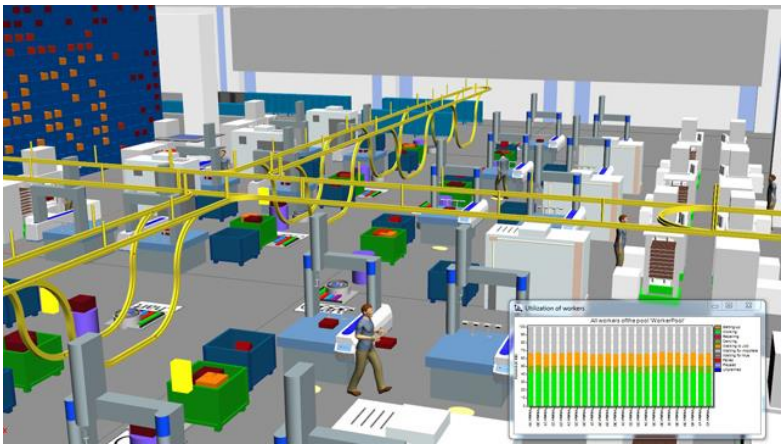


Use the power of discrete event simulation for production throughput analysis and optimization to improve your manufacturing system performance.

Tecnomatix® Plant Simulation allows you to model, simulate, explore and optimize logistics systems and their processes. These models enable analysis of material flow, resource utilization and logistics for all levels of manufacturing planning from global production facilities to local plants and specific lines, well in advance of production execution

ANALYZE PRODUCTION SYSTEMS WITH 2D AND 3D STATISTICAL SIMULATION

Tecnomatix Plant Simulation software provides discrete event simulation and statistical analysis capabilities to optimize material handling, logistics, machine utilization, and labor requirements. Using stochastic tools with object-oriented and 3D modeling capabilities, you can increase your manufacturing accuracy and efficiency while improving throughput and overall system performance. Powerful graphical visualization, charting and reporting features, genetic algorithms and experimentation tools enable you to evaluate the behavior of production systems in order to make fast, reliable manufacturing decisions.

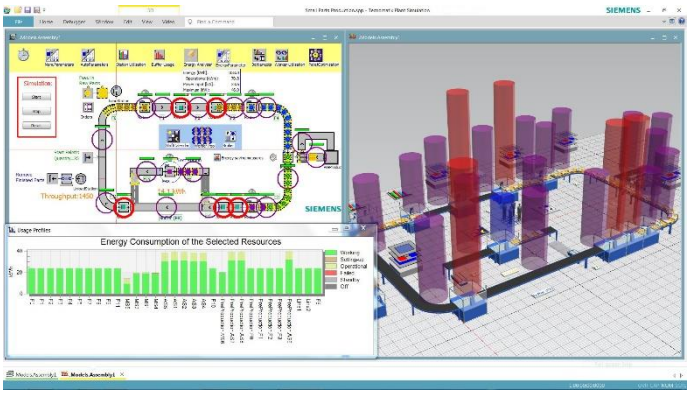


ELIMINATE BOTTLE-NECKS AND INCREASE THROUGHPUT

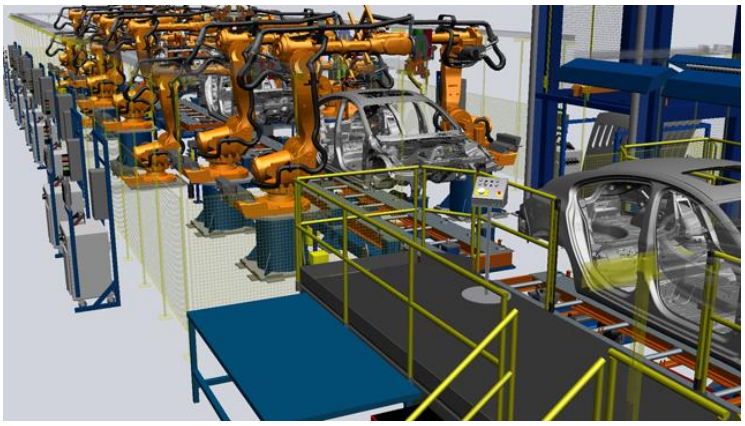
Tecnomatix Plant Simulation models are used to streamline throughput, relieve bottlenecks and minimize work-in-process. Graphical outputs for automatic bottleneck detection, analysis of throughput, utilization of machines, resources and buffers, Sankey diagrams and Gantt charts are among the many tools available to assess the performance of your production systems. The simulation models take into consideration internal and external supply chains, production resources and business processes, allowing you to dynamically analyze the impact of different production variations.

OPTIMIZE ENERGY USAGE FOR IMPROVED PERFORMANCE

Optimize the performance and energy usage of existing production systems by taking measures that have been verified with simulation models. Tecnomatix Plant Simulation includes an integrated energy analyzer that shows current, maximum and total energy consumption. An integrated energy plotter dynamically visualizes energy consumption during the simulation enabling you to see energy usage during both working time and scheduled breaks. You are able to graphically visualize energy consumption, easily identifying areas for potential energy savings.



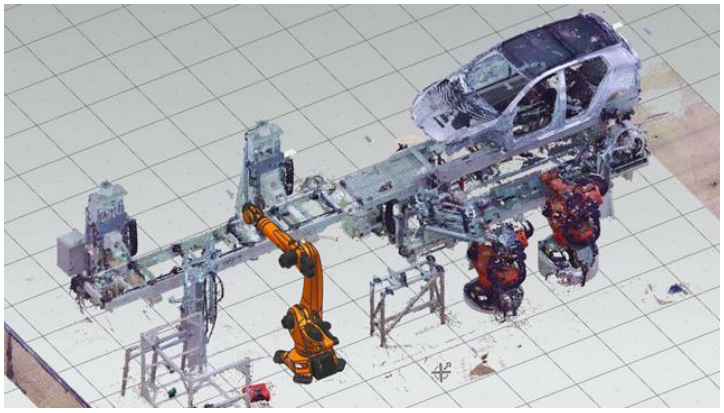
14.4 Plant layout and Line design



Design assembly lines, equipment and tool requirements in a 3D environment. Optimize factory space and maximize capital resource utilization by digitally configuring factory layouts. With Line Designer you can quickly design and visualize layouts of production lines and associate them to manufacturing planning. You can easily optimize the process by specifying each production step down to managing a single manufacturing resource, such as a robot or fixture.

Perform accurate impact analysis and drive efficient change management by using a library of parametric resources. Integrated with manufacturing planning, our solution is essential to defining optimized production processes.

LEVERAGE POINT CLOUD SCAN



Easily compare your virtual production facility layout model with your physical production facility layout. Bentley Technology digital point clouds scanned from existing brownfield environments can be used to create new factory items or modify factory models after on-site changes.

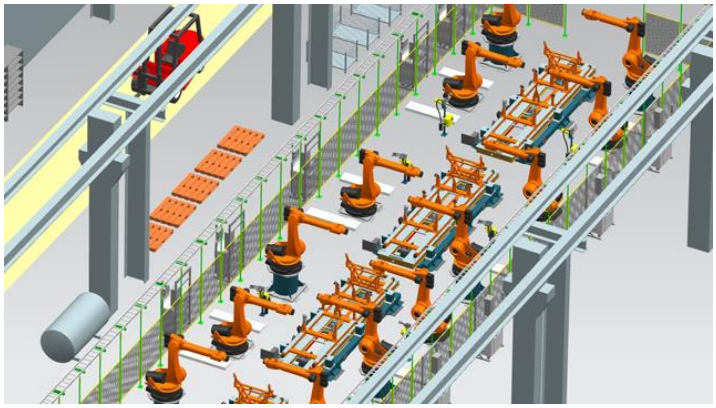
LINE LAYOUT

Line Designer is a complete production layout solution for manufacturing engineers. The parametric engine in NX enables you to efficiently work with manufacturing components and easily accommodate changes. Using the integrated system you can search, view and retrieve components across a fully classified library in Teamcenter, directly from NX.

INTEGRATE LAYOUT WITH PRODUCTION PROCESS

Siemens provides an integrated solution for production system design. The entire workflow is supported - from product and line design to commissioning. The Line Designer layout can be used to validate the manufacturing process with Tecnomatix Process Simulate, including PLC program validation in a virtual environment before use on real equipment.

With Line Designer you can quickly design and visualize layouts of production lines and associate them to manufacturing planning. You can easily optimize the process by specifying each production step down to managing a single manufacturing resource, such as a robot or fixture.



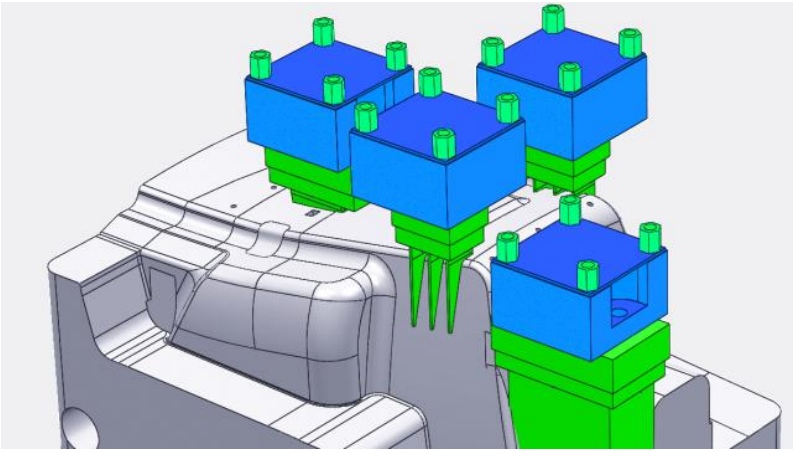
Perform accurate impact analysis and drive efficient change management by using a library of parametric resources. Integrated with manufacturing planning, our solution is essential to defining optimized production processes.

14.5 Tooling and Fixture design

Automate the entire tool development process including part design, tool assembly layout, and detailed tooling design and validation using advanced NX functionality. With step-by-step guidance and associativity to part designs, you can work with even the most challenging tooling and fixture designs.

ELECTRODE DESIGN

he electrode design software application in NX streamlines electrode modeling and design for any tool project that requires electrical discharge machining (EDM).

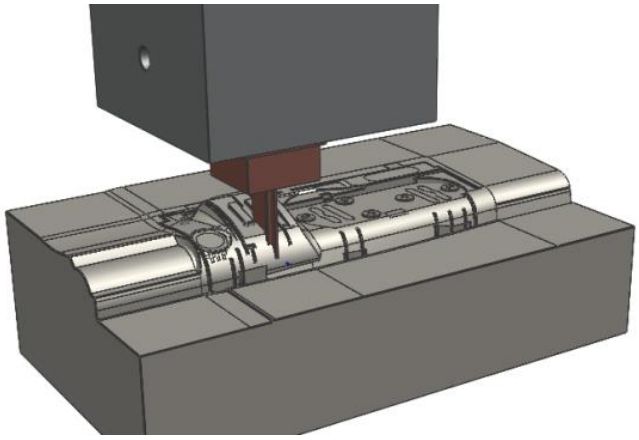


NX electrode design software provides a time-saving, step-by-step solution that automates the entire EDM process from design through production. It can help you manage even the most complex and challenging electrodes

Automate the way you specify the manufacturing processes for the core and cavity. In addition, you can automatically search, recognize, group and color faces that you want to burn and rough through EDM, WEDM, milling and grinding.

DEFINE ELECTRODE SPARKING AREAS

You can use specialized and powerful features to model the shape of the electrode head/burn area. Highly complex shapes are easily achieved and are associative – design changes made to the core and cavity seamlessly propagate to the electrode, drawing and into machining.



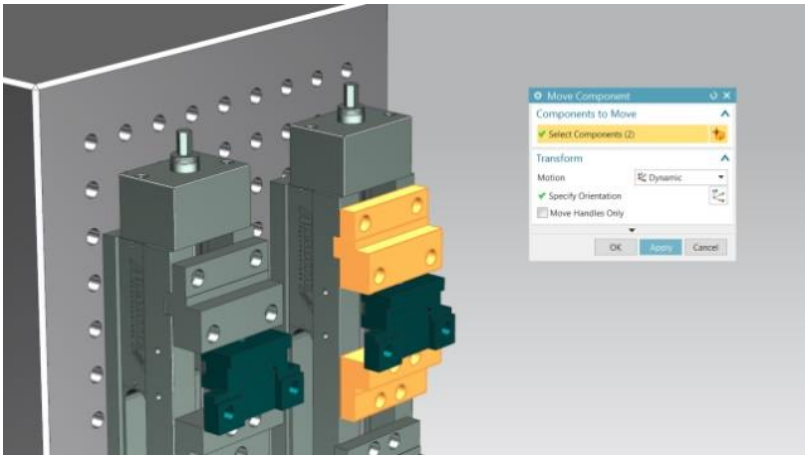
Quickly create undersized electrode geometry using NX. You can compensate for spark gap and orbital motion. Out-of-the-box orbit types include: circular, square and spherical. User-defined orbits can also be easily created.

VALIDATE ELECTRODE DESIGN

Check for interferences and calculate the sparking area; this is useful in defining downstream manufacturing operations and determining proper EDM machine settings.

FIXTURE DESIGN

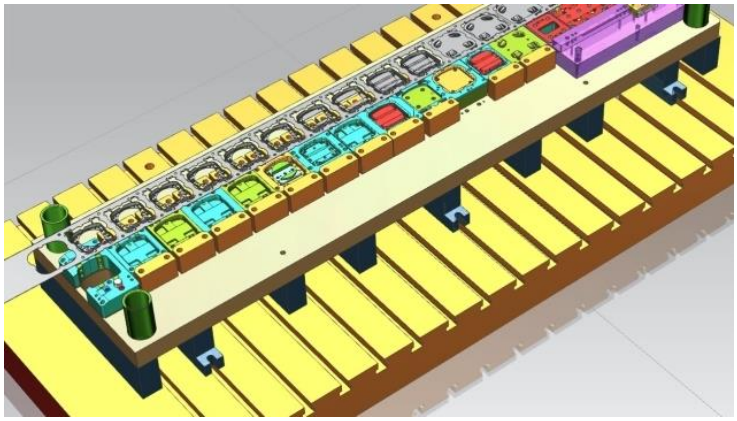
Because jig and fixture designs are fully associative to the part model, you can quickly and accurately update fixtures based on part model changes.



You can easily position and mate fixture components with the NX assembly capabilities, and then automatically create drawings and documentation for the fixture and its components. NX also allows you to simulate the kinematics of fixtures, such as opened and closed positions, and check for strength and distortion.NX offers powerful capabilities in geometric and large assembly modeling, making it ideal for all types of fixture design. You can easily position and mate fixture components with the NX assembly capabilities, and then automatically create drawings and documentation for the fixture and its components.

Easy-to-use kinematic software enables you to display and check mechanism motion. You can simulate the kinematics of fixtures, such as open and closed positions. NX also offers a wide range of tools for stress analysis to help you optimize structural performance.

PROGRESSIVE DIE DESIGN

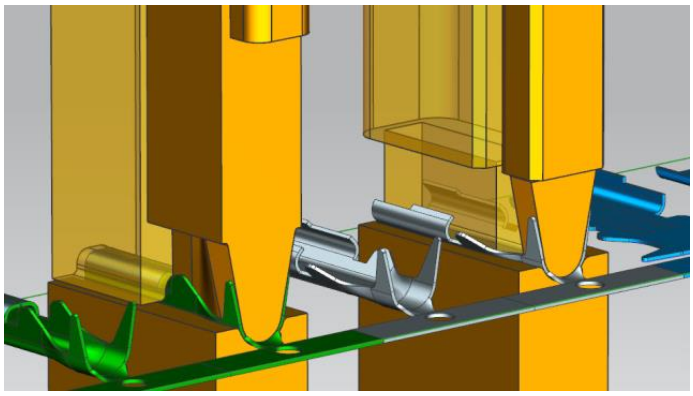


Our solution guides you through all of the stages required to design a progressive die, automating the most tedious tasks and streamlining complex processes. Our software for progressive die design is a comprehensive solution for both straight break and freeform sheet metal parts. You can design the complete die structure with associativity to the part design at every stage.

You can effectively design both straight break and freeform sheet metal parts with the broad set of sheet metal functions. Leverage feature recognition, bend table and direct unfolding capabilities to design associative intermediate stage parts with prebends and overbends.

Apply One-step Unforming and Formability Analysis technology to create intermediate forms and the flattened blank shapes for complex freeform parts.

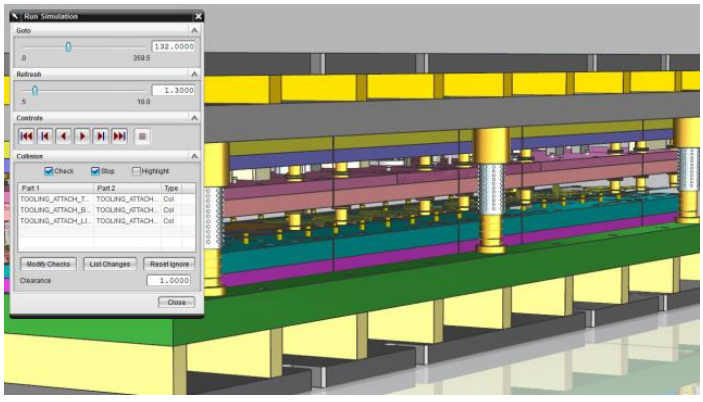
DEFINE THE COMPLETE PROCESS



Our strip layout and design tools allow you to quickly prepare the strip layout, and specify details of the strip layout and the progression of design stages using a streamlined workflow. You can simulate manufacturing of the strip to ensure proper ordering of stations.

Design die base assembly and die inserts for forming and punching operations, and efficiently and associatively design forming and punching tools. Our solution incorporates a library of standard parts, which includes the catalogs of the most important suppliers. Customizable base die libraries, standard parts, and insert groups streamline the design of the die structure.

VALIDATE THE COMPLETE DIE DESIGN



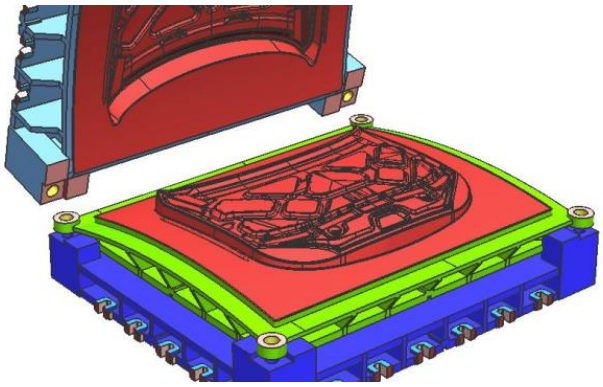
Validate the design of the progressive die within the assembly context for proper clearances and reliefs in various position stated. You can analyze material usage of the strip layout and press force balance, and simulate the strip progression. Motion simulation with dynamic collision detection helps you verify correct operation in the entire range of die movements. Our solution maintains associativity with the part design throughout the die design process, carefully controlling changes in the part design. Associativity with the part

model allows design changes to be quickly incorporated. Our solution enables management of data and processes, so you can work concurrently with your team members, searching, accessing, and reusing project data and processes.

STAMPING DIE DESIGN

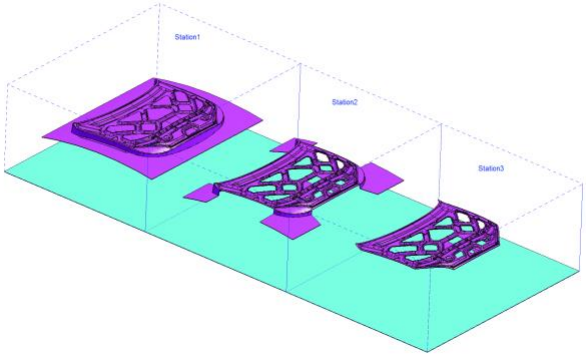
Advanced capabilities in our solution for designing automotive stamping dies include formability analysis, die planning, die face design, detailed die structure design, and die validation.

Our stamping die solution guides you in defining the process used to manufacture complex stamped sheet metal parts, producing a representation of the press line and modeling the shape of the sheet metal as it leaves each press.



Our advanced design and modeling tools allow you to rapidly create and manipulate complex vehicle body panels. In addition, you can work with data imported from other CAD systems. Quickly model sheet metal parts for high precision automotive application, easily update models to design changes, and document designs for efficient manufacturing.

PLAN THE COMPLETE DIE CUTTING OPERATION



Our stamping die design software provides a complete set of tools for defining die operation lineup (DOL) and optimizing line efficiency to ensure production targets are achieved.

Generate process models for each station of the press line, and determine which areas of the part should be formed, flanged, and trimmed. Determine the location of holes and tip the part into the position.

DIE FACE DESIGN

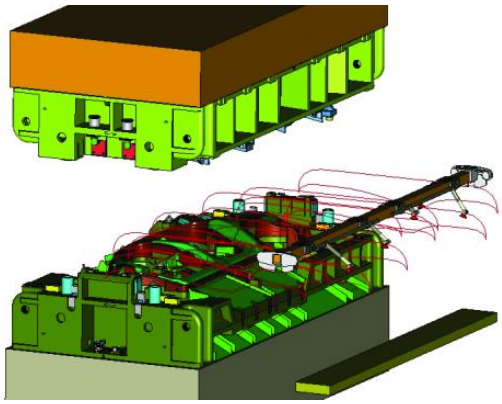
Our advanced design and analysis tools allow you to evaluate, quickly and virtually, the feasibility of forming parts for high precision die face designs. Prepare highly accurate digital models of the sheet metal that accounts for draw, trim and flange elements of the die process.

Our tools enable formability analysis early in the design process, and account for stress, strain, and thinning considerations. Predict and compensate for springbreak using surface deformation functions for overcrown, overbend, and wall deformation.

DIE STRUCTURES

Automate the design of die structures using a wide range of features for castings, trim steel, and associated scrap cutters, flange steel, draw punch, upper draw die, lower binder, upper pad, owers post and steel inserts. Predict stress, strain, and deflection under a given forming load, and evaluate the die structure for adequate stiffness.

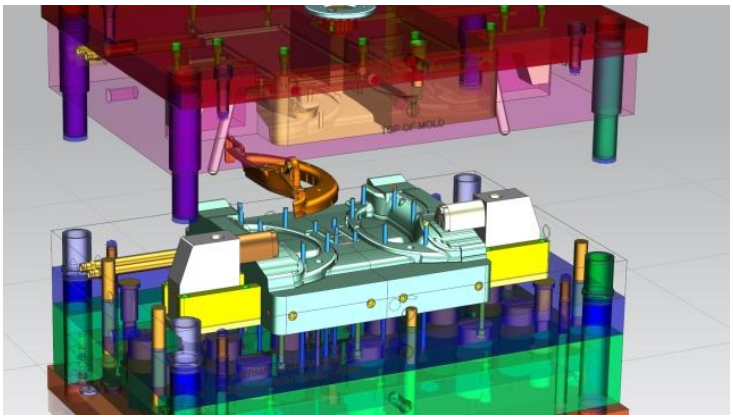
VALIDATE DIE STRUCTURES



Our stamping die design solution incorporates automated tools for virtual tests and simulations.

Predict tension, deformation, and deviation under a certain formation load, evaluate if the structure of the die has the appropriate rigidity, simulate the expected operation of the die assembly, and check internal interference and collision conditions.

MOLD DESIGN



NX Mold Design automates and streamlines the entire mold development process including part design, tool design and motion validation. You can ensure fast response to design changes and high-quality molds.

Accelerate the design of the most challenging molds using advanced functionality, step-by-step guidance and associativity with part model to ensure fast response to design changes and quality molds.

CORE AND CAVITY DEVELOPMENT

Simplify the design process of core and cavity geometry using the NX's automated functions, which enable you to: Use automated shutoffs and parting of core/cavity based on manufacturability considerations, design parting surfaces quickly and associatively, split mold to accommodate complex slider designs, automatically check the core/cavity design for interferences.

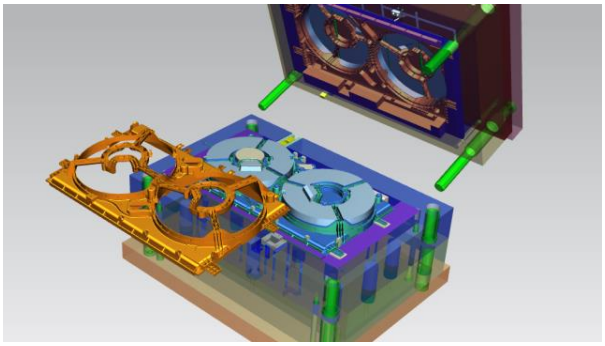
DESIGN VALIDATION

Design validation ensures that parts, tools, and manufacturing processes have been correctly defined. You can analyze the manufacturability of part designs using tools to check wall thickness, identify undercut regions, and evaluate corner radii.

To validate the mold design, you can check the distances and reliefs in various positions, as well as analyze the requirements for electrodes. You can also extend the mold life with the analysis of resistance and detection of sharp corners.

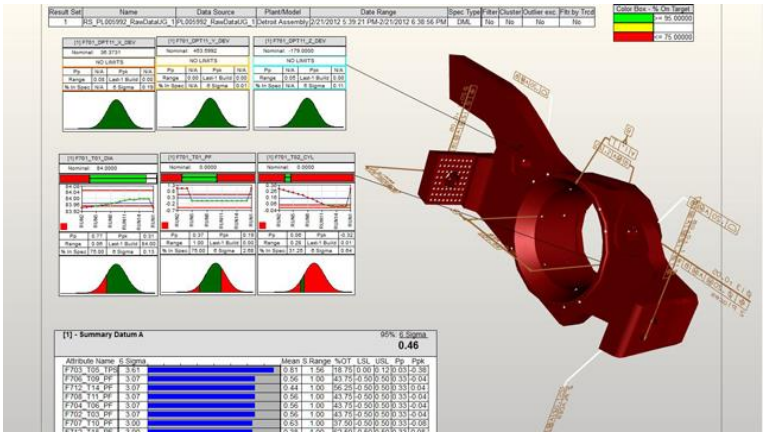
The motion simulation capabilities allow you to verify the entire range of movements of the mold, including dynamic collision detection

MOLD STRUCTURE



Layout the core, cavity, component systems, and mold base for both prototype and production-scale multi-cavity molds. Configure the mold using libraries of standard parts, component systems, and mold bases. You can design associative sliders and lifters. Quickly add and trim ejector pins and insert cooling channels with parametric patterns. Include runners, gates, screws, pins, and other standard components.

14.6 Dimensional Variation analysis



With the highly complex products of today, dimensional variation can consume enormous amounts of time and effort to control. The specified tolerances of single parts can easily lead to issues during assembly, which is a costly time to make changes. Variation Analysis can help reduce the negative impact of variation on product dimensional quality, cost and time to market.

BUILD QUALITY

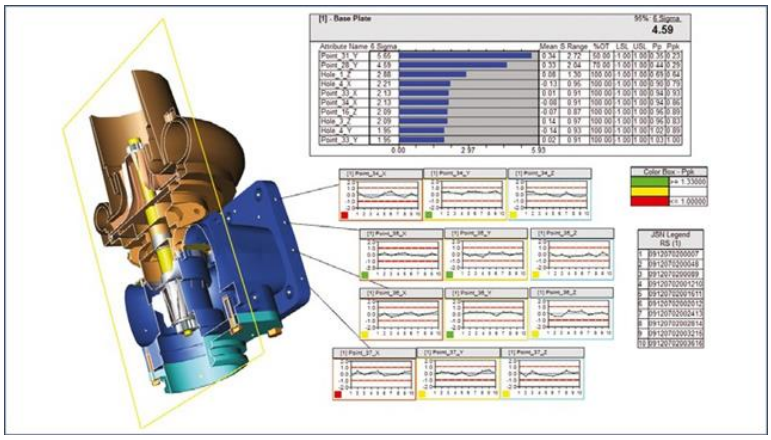
Tecnomatix® software's build quality solution helps you optimize the throughput of inspection equipment and automate manual processes for data collection, translation, analysis and reporting. Consolidate the latest inspection results and provide a consistent view of production quality so that your teams spend time solving problems instead of chasing data

AUTOMATE QUALITY DATA REPORTING

Tecnomatix Dimensional Planning and Validation (DPV) provides automated report publishing to automatically populate preconfigured report templates with collected quality measurements. You can produce historical summary reports to consolidate extremely large amounts of measurement data, enabling decision makers to quickly review this information and use it to make metrics-based design and manufacturing decisions. With access to this information you can compare processes and/or plants, understand process stability and summarize your company's performance over any time period.

MONITOR PRODUCTION QUALITY

During production you can monitor and capture measurement data from any device into Teamcenter® software's open, flexible architecture. During the loading process, you can use automated tools to proactively identify quality trends. Tecnomatix Dimensional Planning and Validation software supports any and all formats and post-processing needs, allowing you to consolidate the quality data collection from all measurement devices in your plant or throughout your enterprise into a single system for better understanding of build quality.



PERFORM STATISTICAL ROOT CAUSE ANALYSIS

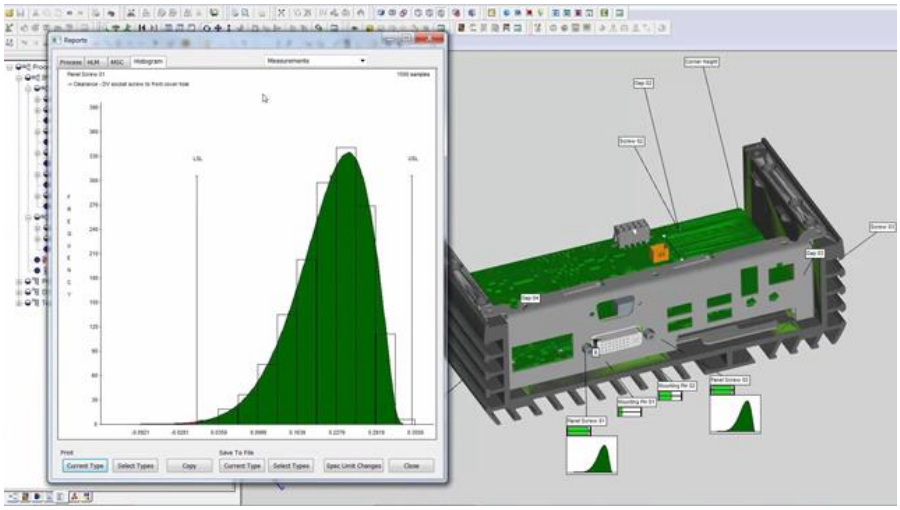
Tecnomatix Dimensional Planning and Validation (DPV) software's easy-to-use, but sophisticated statistical techniques combined with Teamcenter software's 3D geometry capabilities enable your quality teams to rapidly define the root causes to build quality issues found in production. Tecnomatix DPV goes beyond the limitations of fragmented quality solutions and closes the loop between design and production, giving you the ability to directly connect and integrate build quality knowledge into your company’s mainstream product design and manufacturing processes.

DIMENSIONAL QUALITY

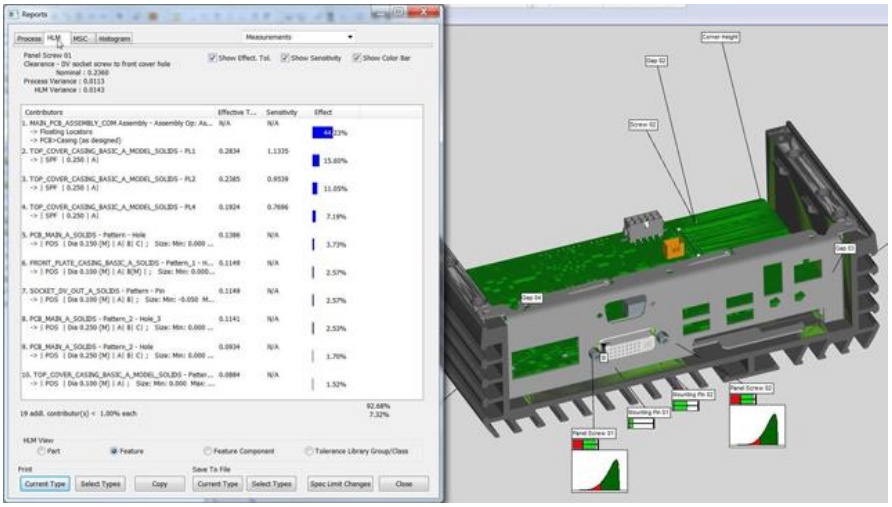
Understand the impact of dimensional variation before design release in order to ensure dimensional product quality in production.

Tecnomatix® software's dimensional quality solutions enable you to analyze the impact of manufacturing processes on design features and tolerances, highlighting the sources and amounts of dimensional variation. It helps you improve design quality and eliminate costly prototypes while reducing labor, tooling and metrology costs on the shop floor. Tecnomatix® Variation Analysis software is a powerful dimensional analysis tool used for simulation of manufacturing and assembly processes to predict and quantify the amounts and causes of variation in a robust 3D environment.

The software leverages Monte-Carlo simulation and a ConJoin assembly constraint engine for static and kinematic assembly operations within the full range of allowable constraints, and integration to finite element analysis solvers for comprehension of component flexibility due to clamping, welding and springback.



PERFORM COMPREHENSIVE ROOT CAUSE ANALYSIS



Manufacturing costs can be reduced by maximizing allowable part tolerances while still controlling critical assembly dimensional specifications. Controlling these dimensional characteristics minimizes scrap, rework and warranty defects. Tecnomatix Variation Analysis identifies critical dimensional, tolerance and assembly processes that are key contributors to variation. By adding manufacturing capability data into variation analysis you can perform real-time root-cause analysis of production build problems, helping you improve quality by ensuring that parts fit together properly the first time.

15 Simulation and Test Lab

As you innovate new, improved products, your design evolves through a large number of incremental changes. You need to be able to predict how these intended improvements influence real world performance, for better or for worse.

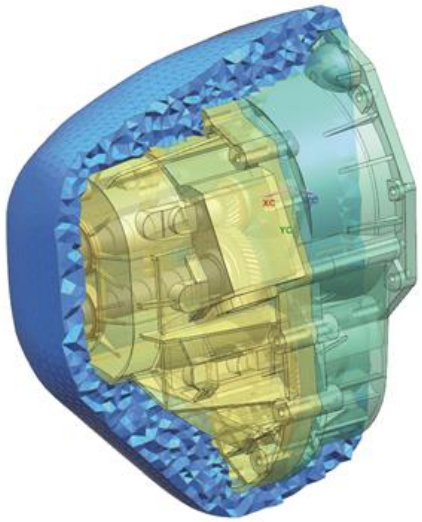
Computer aided engineering simulation allows engineers to see into the future, predicting the consequence of any design change on the real- world performance of their products. Deployed effectively, it can be used to improve your design through multiple iterations, providing data to guide the design process from its earliest stages, through to production and beyond.

15.1 Acoustic Simulation

Simcenter offers interior and exterior acoustic analysis within an integrated solution that helps you make informed decisions during the early design stages so you can optimize your product's acoustic performance. A unified and scalable modeling environment combined with efficient solvers and easy-to-interpret visualization capabilities enable you to quickly gain insight into the acoustic performance of your product.

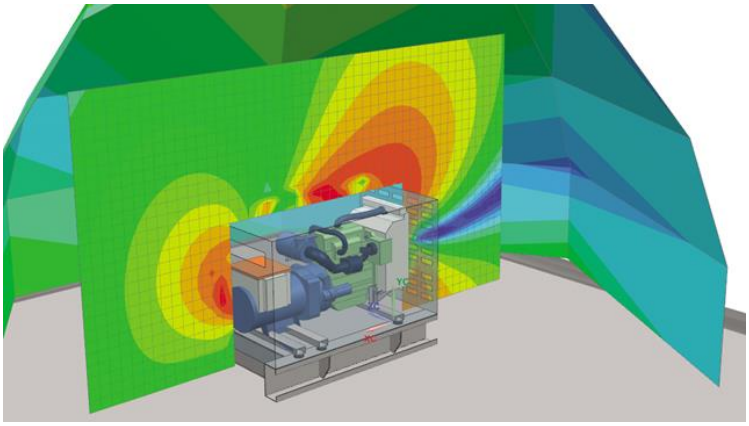
ACOUSTICS MODELING

Shorten model preparation time and enhance productivity with custom modeling tools specifically aimed at speeding interior and exterior acoustics simulation processes. Using unique capabilities such as surface wrapping for fast fluid domain creation and the ability to quickly create a convex mesh, you can conquer complex geometry and start your acoustics analysis sooner.

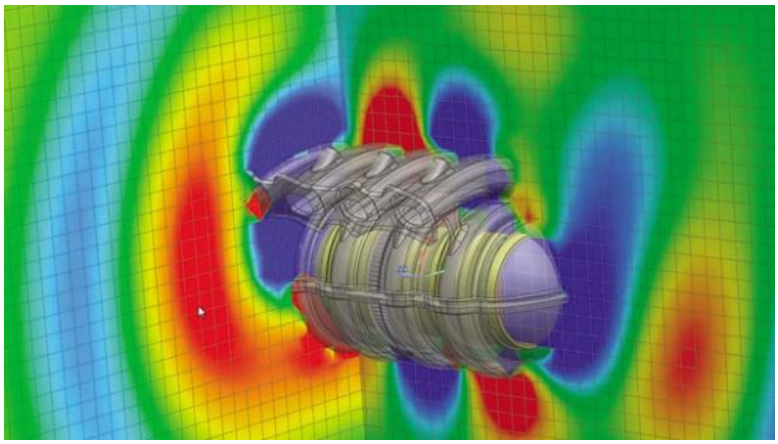


BOUNDARY ELEMENT ACOUSTICS

Often used for exterior acoustics problems, the boundary element method (BEM) is ideal for problems involving very complex geometry that may be a challenge to model for the FEM method. The BEM method helps simplify exterior acoustics simulation since only the outer surface mesh of the geometry is needed. This simplifies both the modeling process and reduces the degrees of freedom in the simulation model which will result in easier analysis.

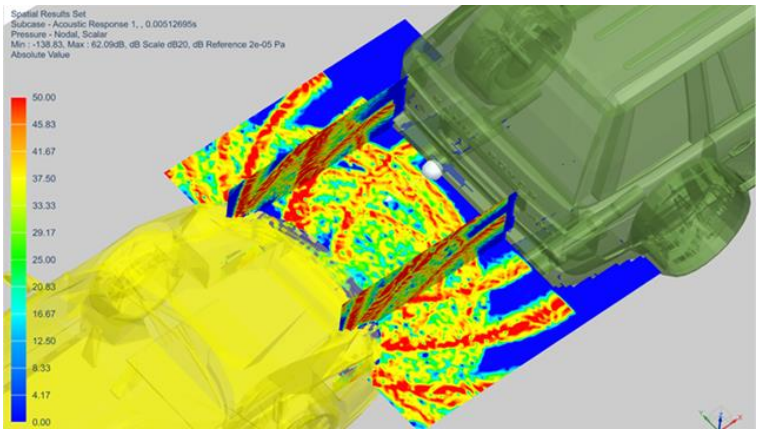


FINITE ELEMENT ACOUSTICS



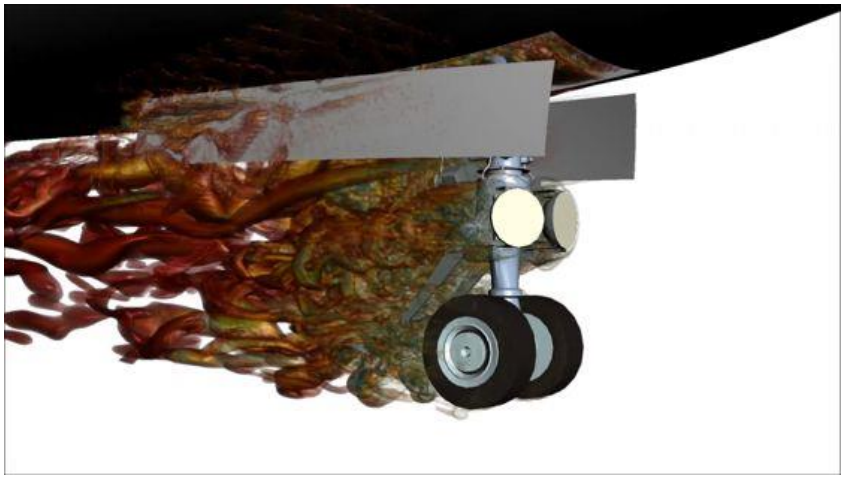
The finite element method (FEM) for acoustics analysis is ideal for simulating interior acoustics problems. In addition to FEM being the more efficient method in terms of solution speed, FEM acoustics lets you perform coupled vibro-acoustics analyses that take structural modes and soundproofing materials into consideration. FEM acoustics can be used to solve exterior acoustics problems as well, which is often used for noise analysis of air induction systems in powertrain.

RAY ACOUSTICS



The human hearing frequency extends up to about 18 kHz. Doing acoustic simulations up to this high-frequency range is not always possible with standard finite element method (FEM) and boundary element method (BEM) technologies. Ray Acoustics allows you to competently and accurately perform acoustic analysis for these high frequencies and allows you to efficiently and accurately perform various audio and in-vehicle acoustic comfort simulations, covering the entire hearing frequency range.

AERO-ACOUSTICS

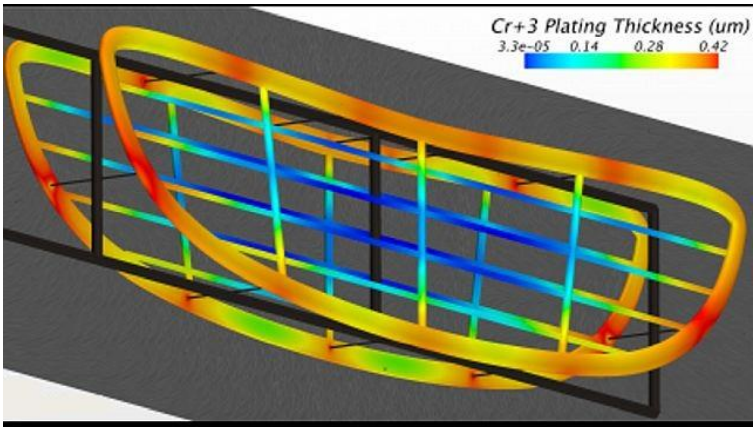


Simcenter offers an extensive library of accurate models for predicting aeroacoustics noise sources, including steady-state models, direct models (DES/LES), propagation models, and acoustic perturbation equations (APE) solver.Flow induced noise is a significant component of the acoustic signature of a vehicle or other products. Predicting and understanding noise generation mechanisms, localizing sound sources, identifying transmission paths and predicting system acoustic response is key to good acoustic design. With Simcenter, you can reduce noise, improve sound quality and gain a competitive advantage while reducing expensive physical testing and reducing flow-induced vibrations/fatigue. Either the noise-

inducing turbulent flows as well as the sound wave propagation can be resolved directly, or the flow simulation can be combined with so-called hybrid methods for sound propagation.

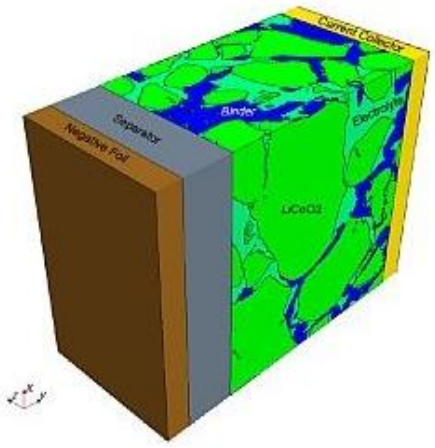
15.2 Electrochemistry simulation

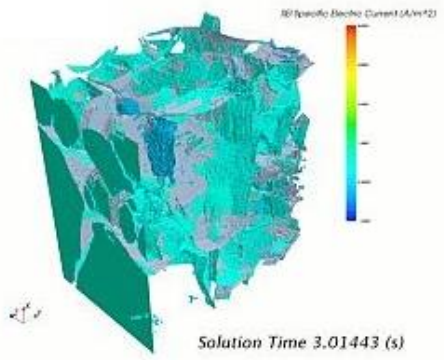
Our comprehensive electrochemistry simulation suite includes the building blocks of electrochemistry, various degrees of fidelity, tailor-made electrochemistry models, multiphase electrochemistry and design exploration capabilities.With electrochemistry simulation in Simcenter, you can achieve decreased resistances, minimize degradation and attain higher deposition/etching rates. This lowers design/operational/maintenance costs while ushering in innovative new fuel cell types, operating ranges and novel processes and materials.



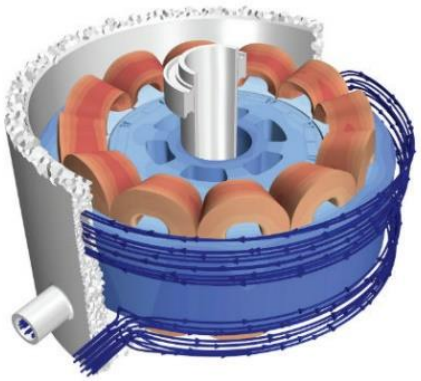
Simcenter offers the building blocks of complete electrochemistry simulation in one tool, bringing electromagnetism, electrochemical reactions and species, bulk ion chemical reactions and coupled plasma electron simulation together. Combine models to achieve required level of fidelity and understand real-world behavior of electrochemical applications including fuel cells, electroplating, wet etching, corrosion and plasma enhanced CVD (PECVD).

Simcenter includes tailor-made electrochemistry models for various applications. The electrodeposition coating model offers identification and remedying of positions with no or too thin coating in body-in-white manufacturing processes optimizing manufacturing spend and time. The Li-ion battery model helps simulate the design and analysis of microstructural topology of such batteries to understand performance factors and predict risk of dendrite growth.





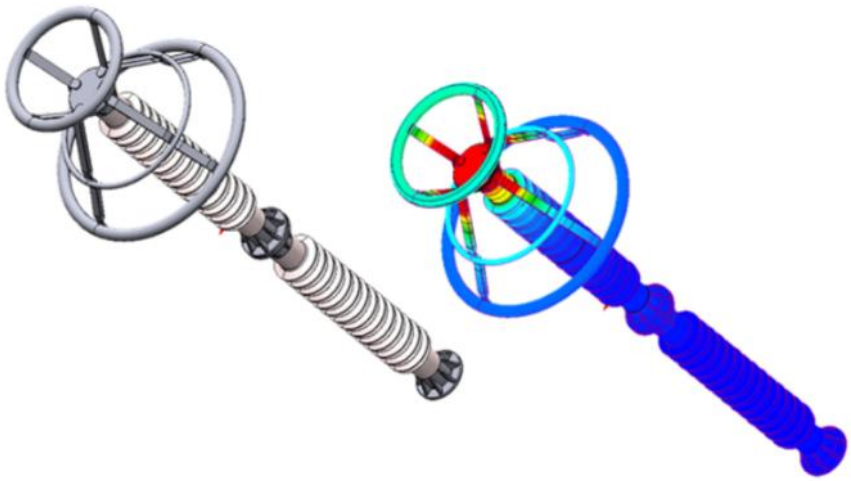
15.3 Electromagnetic Simulations



The diverse and increasingly significant role of electromagnetics in product development and design brings new challenges. In this regard, committing to deliver products that are higher in efficiency, reliability, compatibility, and durability starts with comprehending how these complex fields and waves behave and change.

Simcenter includes distinct low and high-frequency electromagnetic simulation capabilities for the unique demands in each domain. Expand your insight into the performance of electromechanical components, energy conversion, design and siting of antennas, electromagnetic compatibility (EMC) and electromagnetic interference (EMI). A range of dedicated solvers (time and frequency based, linear and nonlinear, finite and boundary element) offers a transformative CAE process, with simulations ranging from a fast, initial analysis to inherent realism for final verification.

ELECTRIC FIELD ANALYSIS



There are three electric field analysis capabilities: Static (produced by DC voltages and charge distributions), AC (produced by AC voltages) and transient (produced by voltages that vary arbitrarily in time). The electric field analysis can also simulate current flow - the static current densities produced by DC voltages on electrodes in contact with conducting material.The electric field analysis is typically used for high-voltage applications to predict insulation and winding failures, lightning impulse simulations, partial discharge analysis, and transmission tower and lines impedance analysis.

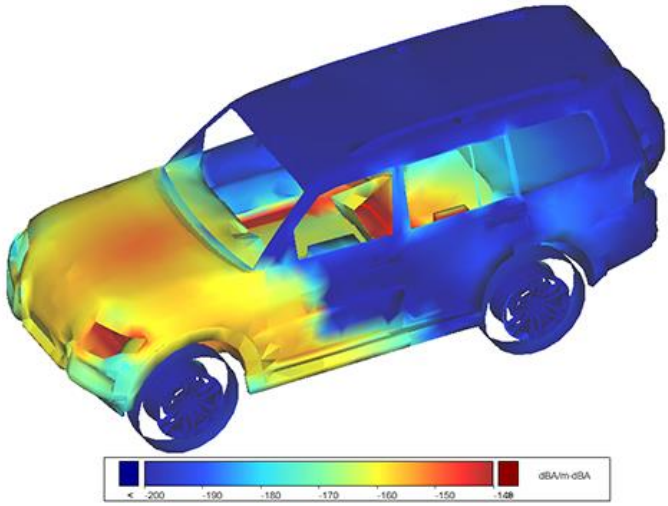
FINITE VOLUME / FINITE ELEMENT FOR ELECTROMAGNETICS

Simcenter comes with a wide range of models to address a range of electromagnetics simulations. Models include Finite Volume (FV) 2D, FV 2D axisymmetric, FV 3D and Finite Element (FE) 3D for applications ranging from magnetic valves, solenoids, actuators, transformer, electric machines. Magnetohydrodynamics (MHD) applications including plasma arc simulation, gas-blast circuit breakers and welding can also be optimized with the 2D FV MHD solver. Harmonic Balance solver expands application coverage for axisymmetric and 3D FV solvers by avoiding the need to co-simulate coupled frequency/time domain problems.

HIGH FREQUENCY ELECTROMAGNETICS

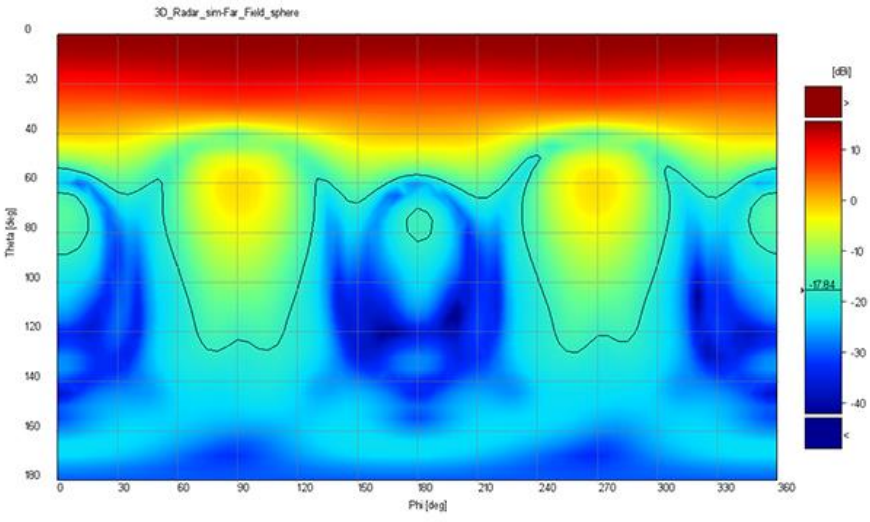
Industry 4.0 factories, incorporating wireless IIoT systems will operate within complex and noisy electromagnetic environment. There is an increasing number of electronics devices and electric cables and wires in vehicles. There is a growing number of antennas and new types of wireless devices. It is increasingly challenging to ensure a device keeps working properly by being immune and not interfering with the surrounding devices causing possible failure.

Simcenter for high-frequency electromagnetics, addresses a wide frequency spectrum to cover all prime analysis needs. Users can select the most appropriate from a range of dedicated solvers. These include full wave solvers based on integral methods for solving Maxwell's electromagnetic equations (Method of Moments) and asymptotic methods based on the uniform theory of diffraction (UTD) and iterative physical optics (IPO). Efficiently solve for 2.5D as well as for full 3D field problems. Solver acceleration options are embedded to facilitate straightforward handling of ultra-large-scale, system level models such as full aircraft, satellites, ships and cars.

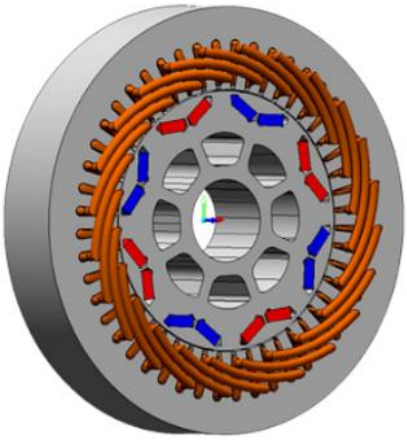


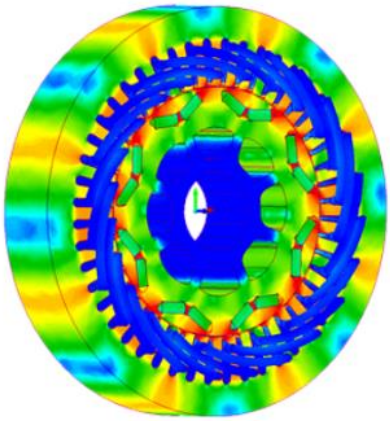
ITERATIVE PHYSICAL OPTICS

Iterative Physical Optics (IPO) is a current -based iterative high-frequency technique. IPO is applicable in the evaluation of the interaction between a radiating source and a scattering structure whose dimensions are larger than the field wavelength (e.g. antenna reflectors, radomes, vehicles, etc). The application of the equivalence theorem for the description of the scattering mechanism and the adoption of the iterative process allows the reconstruction of the interactions between objects in complex scenarios without resorting to ray-tracing. The computational capabilities are optimized by exploiting of cutting edge technologies: GPU computing, Fast Far-Field Approximation algorithm, and iterative relaxation techniques. Thin sheet and impedance boundary conditions formulations are available.



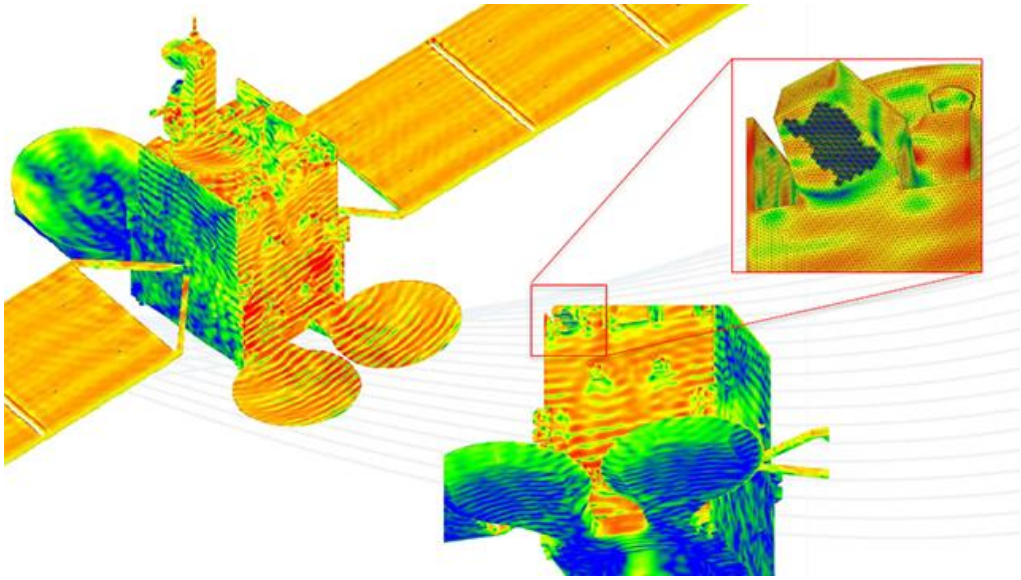
LOW FREQUENCY ELECTROMAGNETICS





Simcenter low-frequency electromagnetic solutions allow you to explore designs to meet performance, and make timely-decisions in product development, reducing the number of physical prototypes. The flexibility in our solutions, which includes finite element static, time-harmonic, transient solvers with the motion for any number of components, permits the design and analysis of electromagnetic and electromechanical devices of any complexity.As systems become more electrified, the insight of simulations on the performance of electromagnetic devices such as motors, generators, MRI, sensors, transformers, actuators, solenoids or any component with permanent magnets or coils, is priceless. Accurately replicate the test conditions including sources, loads, advanced motion and materials, with flexible efficient solvers, letting you to quickly search for a practical design that meets performance in a timely and cost-efficient manner.

METHOD OF MOMENTS



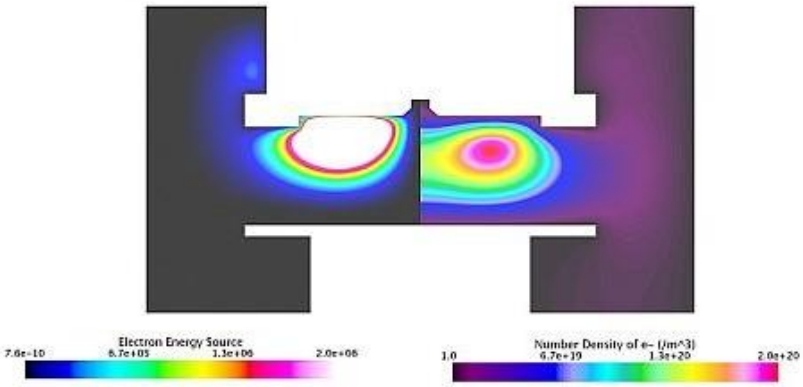
MoM solves the Maxwell equations in a discrete form without making any approximation: the problem is discretized and transformed into a system of linear equations. Both standard (direct) and fast (iterative with Multilevel Fast Multipole Algorithm) solution approach is available. Different boundary conditions are managed: Electric Field Integral Equation (EFIE), Impedance Boundary Conditions (IBC), Combined Field Integral Equation (CFIE) and, Poggio-Miller-Chang-Harrington-Wu-Tsai (PMCHWT).

Preconditioners (e.g. Multi-Resolution, SPLU, ILUT) speed up the convergence of the iterative solution approach. Low-frequency stabilization methods (S-PEEC formulation) solves the Low-Frequency Breakdown problem (very ill-conditioned linear system). The multi-port approach minimizes the computational burden for the evaluation of active solutions. MoM is suitable in case accuracy is needed

for complex problems (in terms of geometries and materials) and when the interaction between the radiation source and the scattering structure is strong.

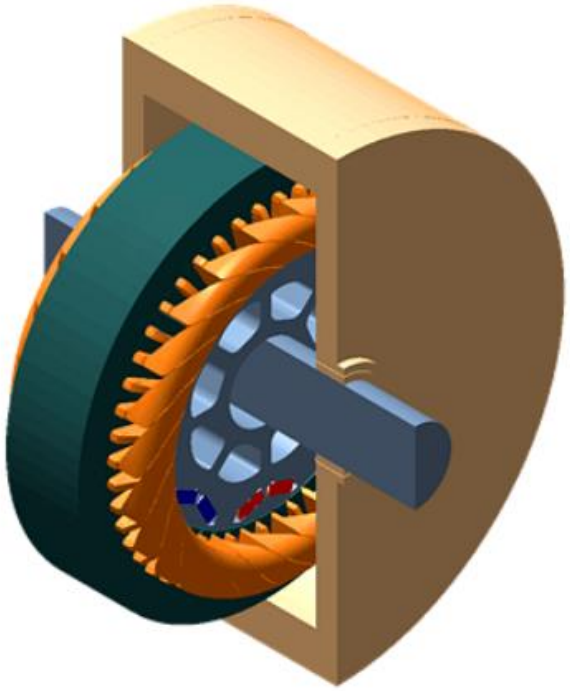
PLASMA MODELING

Plasma modeling in Simcenter can be used to optimize design of various kinds of circuit breakers including gas/self-blast, molded case, high and low voltage.



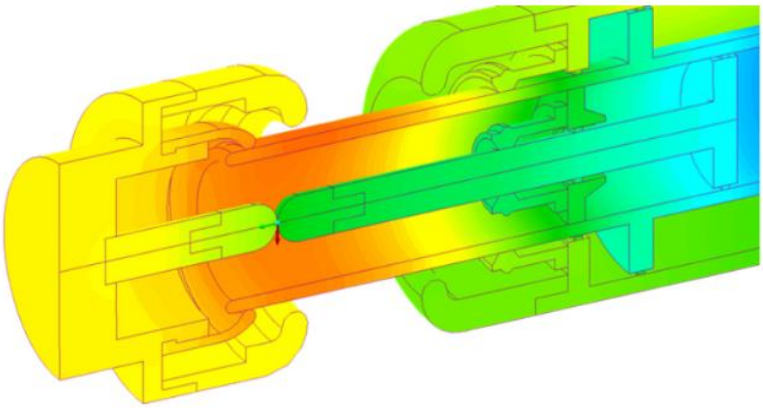
ELECTRIC MACHINE DESIGN

Complete design and analysis software for permanent magnet, induction, synchronous, electronically and brush-commutated machines. Leverage the fast nature of equivalent circuits and the accuracy of FEA, with the synergy of automating the nonproductive tasks for rapid and accurate analysis of electric machines.Using template-based interface makes it easy to use and flexible enough to handle practically any motor topology, with provision for custom rotors and stators. Typical FEA operations such as mesh and solver refinements, winding design, motion, and post-processing including the export of 1D models, are not required as the software handles these for the user. Performance parameters, waveforms and field plots are available with just a click.



THERMAL ANALYSIS

Coupled thermal finite element analysis simulates the temperature distribution as a result of heat rise or cooling in the electromechanical device. It seamlessly couples to electromagnetic and electric field simulations, and uses their power loss data as a heat source, and then determines the overall performance due to the impact of temperature changes. This analysis determines the non-linear steady-state or time-varying temperature distributions caused by the specified heat sources.Using this analysis, you



can predict the temperature distribution caused by ohmic, eddy-current, core and dielectric power losses, and the corresponding temperature effects on material properties and electromagnetic and electric fields. Hence, you can accurately predict the demagnetization of permanent magnets, and hotspots to determine the loading capacity and service life of your device.

UNIFORM THEORY OF DIFFRACTION

The Uniform Theory of Diffraction (UTD) is a "ray" method, based on an asymptotic solution of the Maxwell equations. UTD is applicable when a radiating source interacts with a scattering structure whose dimensions are much larger than the field wavelength (e.g. ships, vehicles or scenario configurations, like airports, factories, cities, etc.). Under these hypotheses, similarly to the optics case, the electromagnetic scattering can be described as the combination of discrete contributions (reflections and diffractions of different orders) from a number of "hot points" distributed on the structure (edge, wedge, vertex) according to relatively simple geometric laws relating to the propagation of rays. UTD manages real materials characterized through transmission and reflection coefficients.

15.3.1 **Fluid dynamics Simulation**

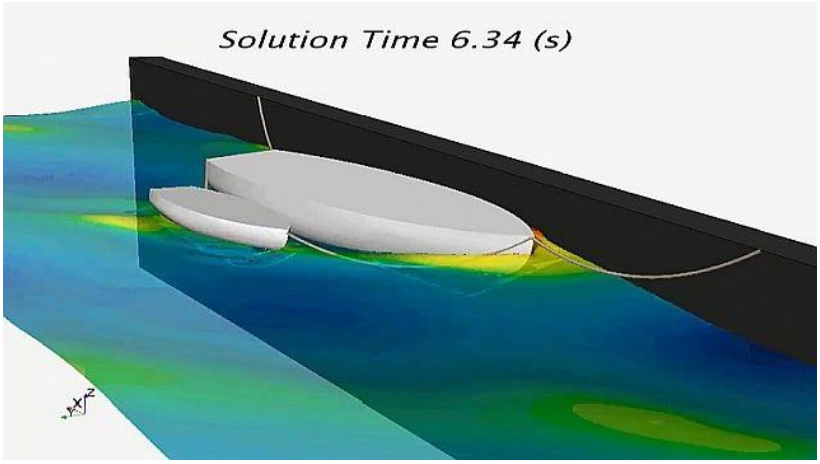
Since the real-world performance of your product depends on how it interacts with fluids, either gases, liquids or a combination of both, you need to predict how those fluids behave, and to be able to turn their influence to your product's advantage.

Simcenter provides industry leading computational fluid dynamics software that allows you to simulate almost any engineering problem that involves the fluids, structures and all of the associated physics

DYNAMIC FLUID BODY INTERACTION

With Simcenter, you can understand a body's behavior in any flow field by creating bodies that can move due to fluid forces and constraining them in any direction.

Addition of external forces and connecting bodies ensures greater accuracy in simulating fluid-induced motion. Applications include propulsive devices, bearings, moorings, hinges, joints, springs, ships, and rotating machinery.



MOTION DEFINITION AND NESTING

With the ability to specify both simple and sophisticated user-defined motions and nest them, users can now simulate applications such as painting, vehicle flooding, rudders, harbor drives and azi-pods.

RIGID BODY MOTION FOR CFD

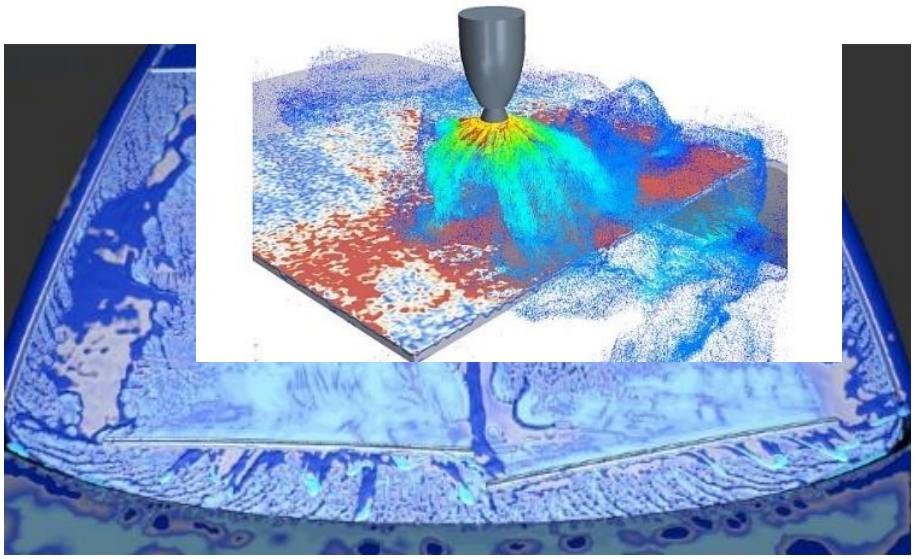
Simulate translation and/or rotation of a mesh region defined as a constant rate or a user function in this unsteady approach for monolithic region motion to simulate fans, pumps, propellers, mixers, and automotive applications.

SLIDING AND NON-CONFORMAL MESHES

Simulate a broad range of translating/rotating devices from pumps to trains with sliding and non-conformal meshing in Simcenter using accurate and scalable solution interpolation across non-conformal, moving interfaces.

MULTI-PHASE FLOW

Real-world engineering problems cover multiple flow regimes across stratified, dispersed, discrete, films, etc. To date, there is no single multiphase model that can cover all regimes, however, Simcenter provides a comprehensive range of models which can be used together to cover many flow regimes including the transitions between them. Predict and understand real-world behavior of your products by simulating multi-regime, multi-scale multiphase flows.



CAVITATION

Cavitation occurs where rapid changes of pressure in a liquid lead to the formation of vapor-filled bubbles in regions of low pressure. When subjected to higher pressures, these bubbles can collapse forming shock-waves that can deteriorate performance or damage equipment. Simcenter STAR-CCM+ allows you to predict the occurrence of cavitation in liquid systems and either mitigate it or turn it to your advantage.

DISCRETE ELEMENT METHOD

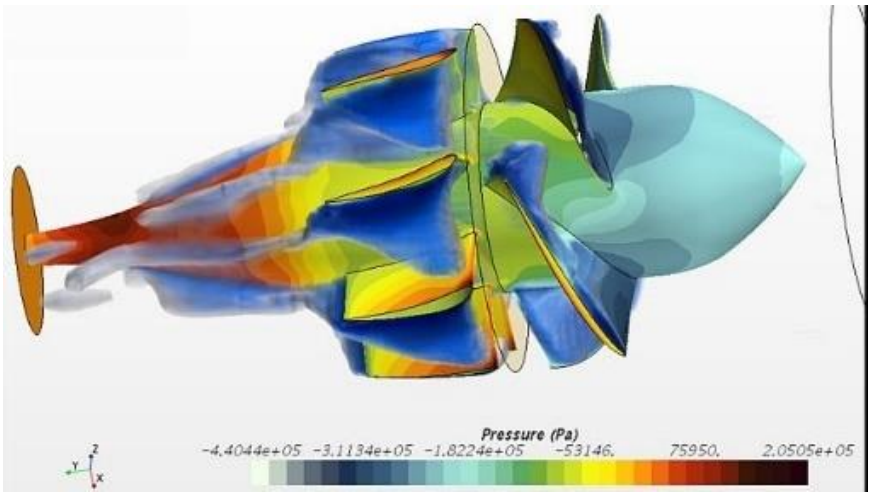
Simcenter offers industry-leading Discrete Element Method (DEM) capability to model non-spherical particle behavior. Unlike most codes, the particle behavior can be coupled with flow and moving bodies in a single package, eliminating the need for expensive multiple software tools and reducing time and cost. The DEM model is widely used to simulate fluidized beds, rock mechanics, conveyors, tablet coating, plugging fissures in oil wells, crop harvesting, and lawn mowers.

DISPERSED MULTIPHASE

The DMP model is a lightweight Eulerian model suitable for modeling low loadings of small droplets/particles where the dispersed phases to not contribute to the volume fraction. This model is efficient in automotive soiling and aircraft icing applications.

EULERIAN MULTIPHASE

A core model for simulating continuous, interpenetrating and reacting fluids. Model phase change, crystal growth and bubbles/droplets. Applications include bubble columns, fluidized beds, settling tanks and mixing vessels.



FLUID FILM

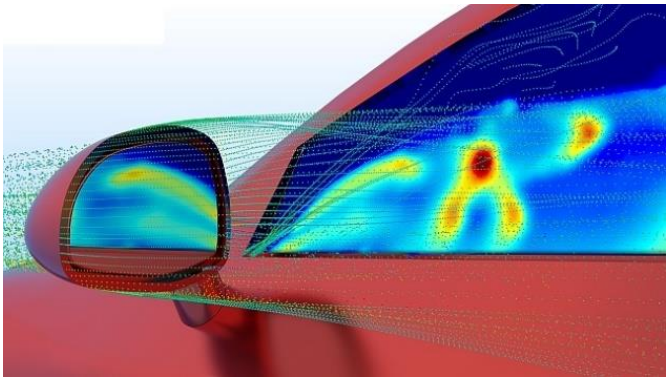
Model thin layer of fluid on surfaces and capture rivulets and surface tension effects with this model. Include phase-change effects like evaporation, condensation, melting and solidification to accurately simulate your physics. Applications include vehicle rainwater management, selective catalytic reduction (SCR), fuel sprays, spray coating/deposition and aircraft ice protection.

LAGRANGIAN MULTI-PHASE

Accurate solve the path of discrete droplets or particles in dilute dispersed phases. Include droplet splashing, rebounding, atomization and breakup, evaporation, condensation and reactions to fully model the exact physics. Applications include vehicle water management, selective catalytic reduction (SCR), spray coating, erosion and liquid fuel combustion.

MIXTURE MULTI-PHASE

Utilize this lightweight model that is faster than EMP by solving one set of transport equations and assuming phases to be miscible. Applications include phase changes in fuel cells, nuclear steam generators, and boilers.



MULTI-PHASE INTERACTION MODELS

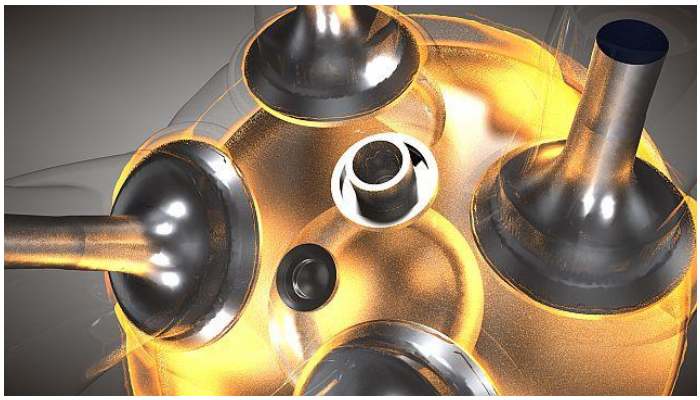
Multiphase flows are never occurring in isolation and hence accurately capturing the interaction between different phases is key to minimize computational cost. Simcenter offers the use of all multiphase models together in a single simulation to capture real-world multiphase flows. Use the highest fidelity model or combine several models to cover all regimes, in addition to expanding the applicability of a standard model.

VOLUME OF FLUID

Accurately track the motion of the interfaces between immiscible fluids and model phase change effects like boiling, evaporation, condensation, cavitation, solidification and melting with the VOF model. Suited for engine cooling, oil and gas flow assurance problems, fuel tank sloshing and marine hydrodynamics and seakeeping (with predefined VOF waves.)

PARTICLE BOUNDARY TYPES MOTION

The dissipative nature of particles often requires moving boundaries. With Simcenter, motion can be applied to particle problems across the whole region, boundary tangential velocity, unsteady sliding mesh interface, overset boundary, DFBI body boundaries, and periodic boundaries. Fully capture particle interaction with multiple boundaries including baffles, porous walls, phase impermeable and thermal scenarios.

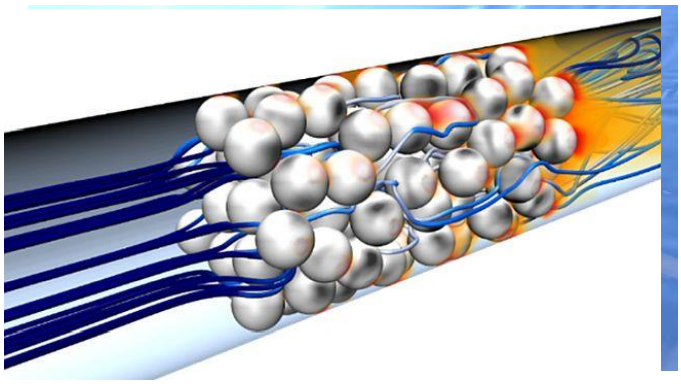


REACTING FLOW

Simcenter delivers a comprehensive suite of reacting flow and emission models, covering a wide range of applications. It enables tight coupling between reacting flow models and heat transfer, radiation, multiphase reactions, and surface chemistry. Our reacting flow models help understand and optimize flame shape and location, minimize solid component temperatures, reduce emissions and maximize performance efficiency. You can predict and understand flame dynamics, heat transfer, thermal wear, emissions, yield, conversion, selectivity, and undesirable conditions to accurately capture real-world physics of your designs.

FLAMELET MODELS

Reduce computational expense by approximating combustion chemistry using a 0D/1D laminar flamelet. Utilize accurate flamelet generated manifold through inclusion of heat loss effects on species composition, accurate combustion table generation and accurate flame location by combining with propagation models.

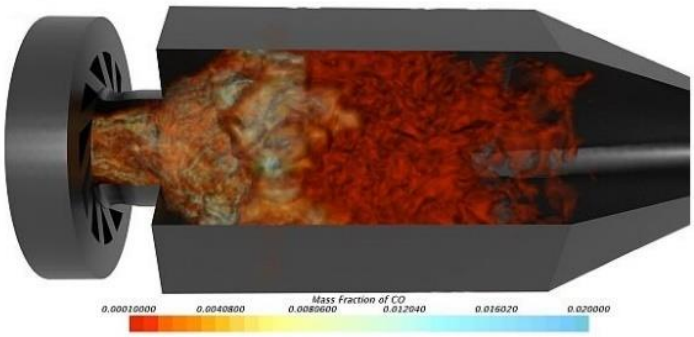


MULTI-PHASE SURFACE REACTIONS

Tight coupling between reacting flow models and flow, heat transfer, radiation and multiphase models ensures engineers are always simulating accurate physics. Multiphase reactions work with eulerian multiphase and VOF models for bubble columns, metallurgy, trickle bed reactors and fluidized beds. Surface reactions extend applicability to CVD, catalytic reactions in

aftertreatment and methane formation while particle reactions are used to model coal and biomass combustion.

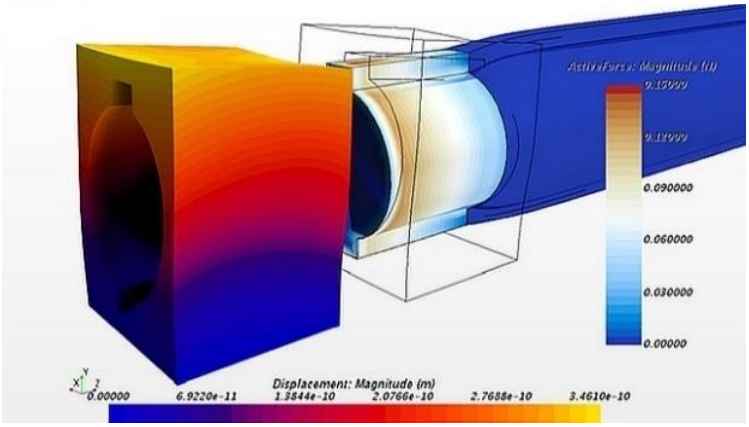
REACTION AND COMBUSTION MODELS



Simcenter offers a wide range of industry-relevant models for Reynolds Averaged Navier-Stokes (RANS) and Large Eddy Simulation (LES) scenarios for modeling reaction and combustion. Use the appropriate model for accurate species prediction through complex chemistry, accurate and fast flame location prediction and higher-order methods for LES combustion.

Simcenter offers specialized models to accurately simulate emissions like NOx, soot, CO and HC, ignition and re-light in gas turbines, furnaces, burners, and steady-state combustion and also reacting channel models for process heaters, cracking furnaces and steam reformers.

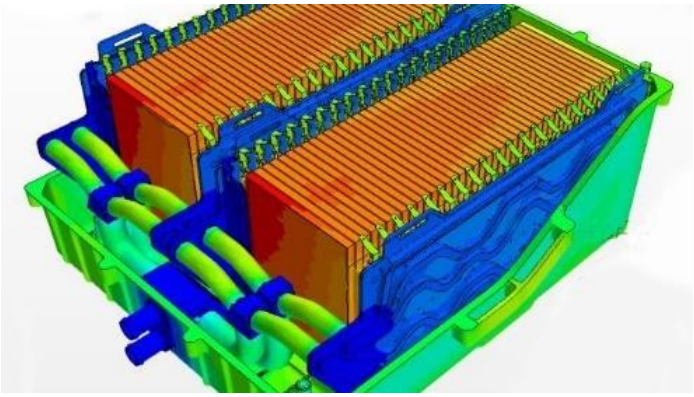
RHEOLOGY



With the addition of computational rheology in Simcenter at no extra cost, engineers can now simulate fluids dominated by diffusion and viscous or viscoelastic behavior. Modeling these simulations is possible thanks to the added finite element solver. This method is useful to engineers in consumer product, waste processing, and food and beverage industries who work with mixers, flow containers, slurries, extrusions, and material processing.
Simulating rheology accurately is the key to reducing power consumption, emissions and raw material usage while improving product reliability, user experience and liability costs

Center offers a comprehensive suite of models including solvers for free surface, partial fill, viscous energy, film casting, and short fiber. These rheology solvers extend simulation applicability to a whole new category of flow/energy problems and is based on the Finite Element (FE) solver technology to truly model viscoelastic problems.

BATTERY SIMULATION

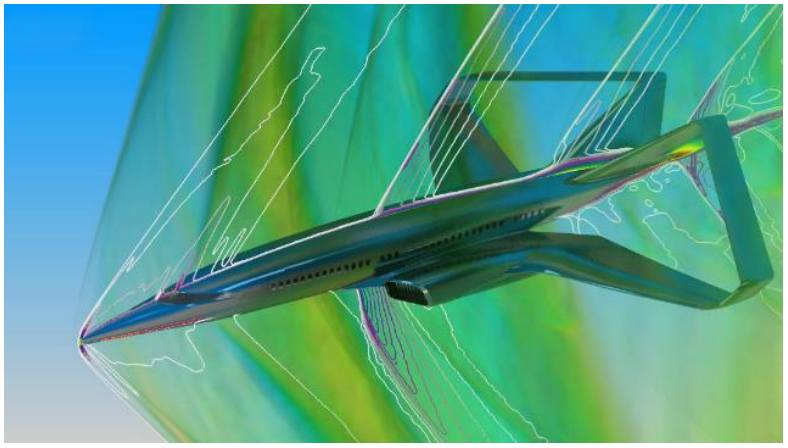


Digitally validate Li-ion cell design including geometrical cell specifications and cell performance. Extensive components of a battery cell are available, as well as a material database to support the user in its model development.

ENGINE SIMULATION

Engine simulations involve moving components, multiphase flow, combustion and heat transfer. You no longer have to be an expert user to simulate internal combustion engines: using an application-specific workflow and simplified interface allows you to set up engine simulations quickly and easily. Expert users can use those simulations as the starting point for performing more complicated multiphysics engine simulations that exploit the full range of Simcenter STAR-CCM+ simulation capabilities.

FLUID DYNAMICS

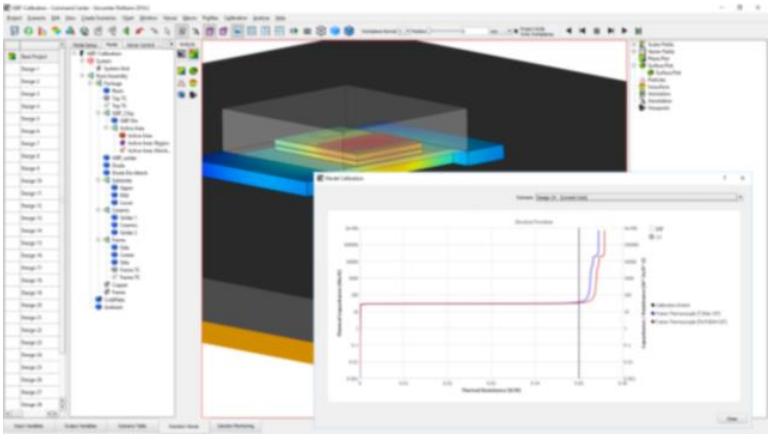


he computational fluid dynamics (CFD) capability in Simcenter offers an efficient and accurate set of fluid dynamics models and solvers with excellent parallel performance and scalability. It provides a solid foundation for multidisciplinary design exploration.

POWER ELECTRONICS THERMAL MANAGEMENT

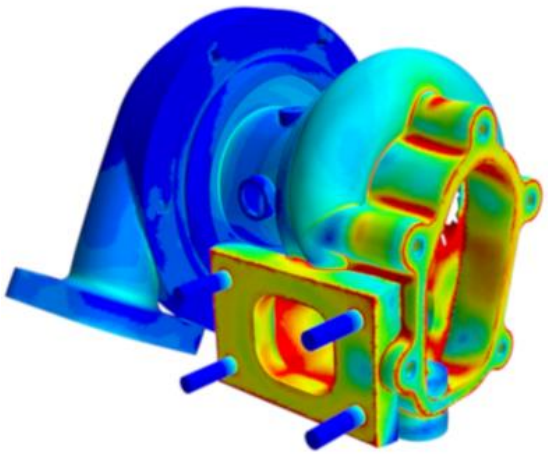
Power Electronics play a central role in many of today's most prevalent technologies, in the most demanding environments. The operational and lifetime reliability of power electronics is key to any successful integration. Reliability is effected by peak operating temperatures, temperature cycling, and temperature gradients within the device.

Simcenter software and thermal measurement hardware provide the most comprehensive and unique technologies to address the needs of Power Electronics Thermal Management. Power Electronics thermal models that are calibrated against Simcenter T3STER measurements through an automated process allow prediction of temperature response to a known accuracy. Thermal engineers can optimize system level thermal designs early in the development process with calibrated device models.



SOLID MECHANICS

Almost all real-world engineering problems ultimately depend on the interaction between fluids and solid structures. Simcenter STAR-CCM+ offers both finite volume (FV)-based computational fluid dynamics and finite element (FE)-based computational solid mechanics (CSM) in an easy-to-use single integrated user interface. Using this approach you can solve static, quasi-static, and dynamic problems including those with nonlinear geometry and multiple parts using bonded and small sliding contacts.

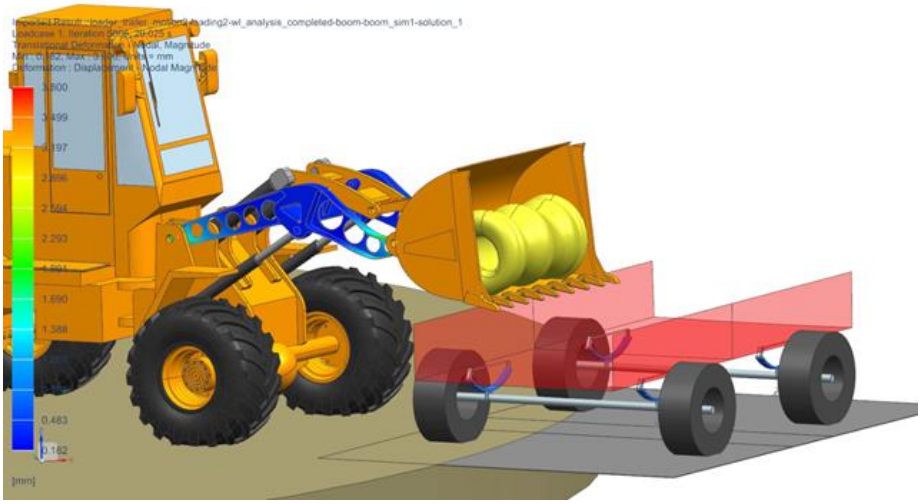


15.3.2 **Motion simulation**

Understanding the operating environments for intricate mechanical systems – like in wing flaps or landing gear, sliding sunroofs or suspensions, or photocopiers and other mechanisms – can be challenging. Motion simulation calculates the reaction forces, torques, velocities, acceleration and more for mechanical systems. You can directly convert CAD geometry and assembly constraints into an accurate motion model or create your own motion model from scratch, and the embedded motion solver and robust postprocessing capabilities allow you to study of a broad range of product behaviors.

CO-SIMULATION WITH CONTROL SYSTEMS

Today's products often have various controllers that include electronics, hydraulics and software components. The behavior of the control system impacts the hardware mechanical system, and vice-versa, and so it's critical for mechanical and controls engineers to understand these effects as they develop their systems.



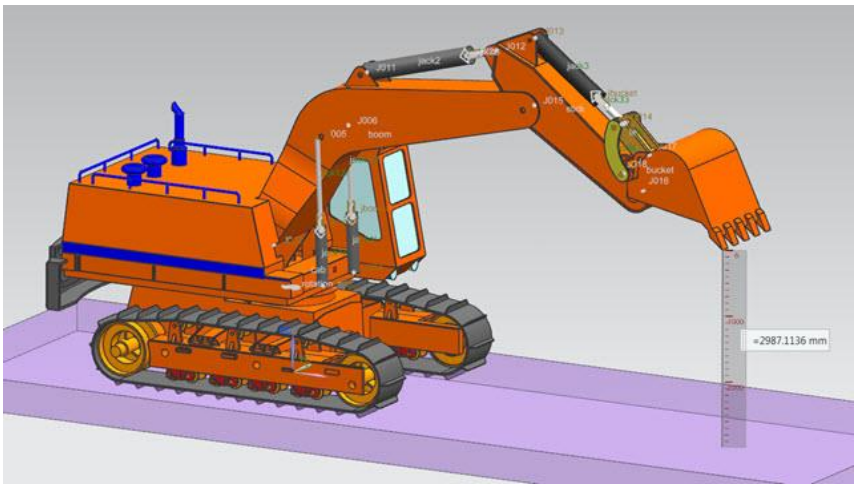
You can increase engineering productivity by simulating and optimizing both the mechanical and control systems concurrently. Simcenter gives you the ability to co-simulate mechanical designs coupled with control systems to verify whether the control system design is robust enough to control the dynamic mechanism, and help eliminate costly changes later in development.

INTERFERENCE CHECKING

When designing new assemblies, you need to consider the package space the assembly operates in and whether components will interfere with surrounding geometry. Simcenter can help you solve these this problem by providing a true multibody dynamic solver that can compute the displacement and position of assembly components connected to springs, bushings, and flexible bodies. By using your geometry directly, you can determine whether you need to make design changes to avoid interference issues.

RIGID BODIES

Basic multibody dynamics begins with rigid body motion, which is the fastest way to develop a critical understanding of your product's motion characteristics. Simcenter gives you the right tools to perform detailed rigid body dynamics analyses. It's easy to create your motion model directly from your CAD assembly through an automated conversion process based on your assembly constraints, or you can create your own model by scratch. You can also easily model and simulate contact between your rigid bodies.

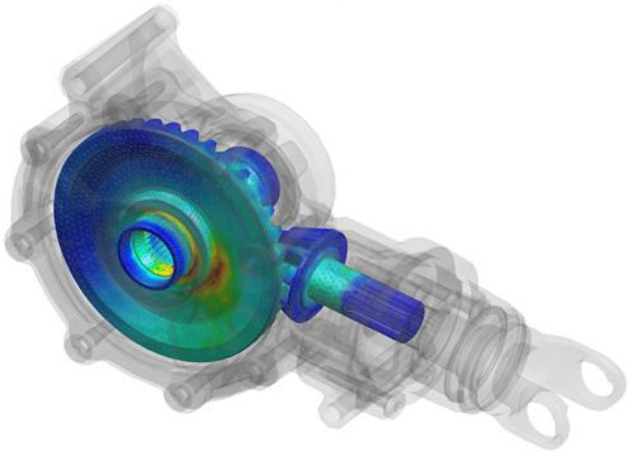


15.3.3 **Structural simulation**

Understanding how a component or product assembly reacts under stress or vibration is critical in any industry, but as products and materials become increasingly complex, engineers need tools that go beyond linear statics analyses. Simcenter includes the structural solutions you need for a wide range of structural analysis problems within a single user environment. You no longer need one tool for linear statics, another to study fatigue, and yet another for nonlinear analysis. As a result, engineering departments can consolidate analysis tools, and you only need to know a single user interface.

LINEAR ANALYSIS

Linear analysis is used to solve static problems, such as determining if a structure will fail under a prescribed load, and can also be used to solve transient problems where loads change over time. Simcenter features a complete range of integrated linear analysis functionality, including analysis for linear statics, normal modes and buckling. You can use these capabilities to evaluate structural performance for applications in a variety of industries.

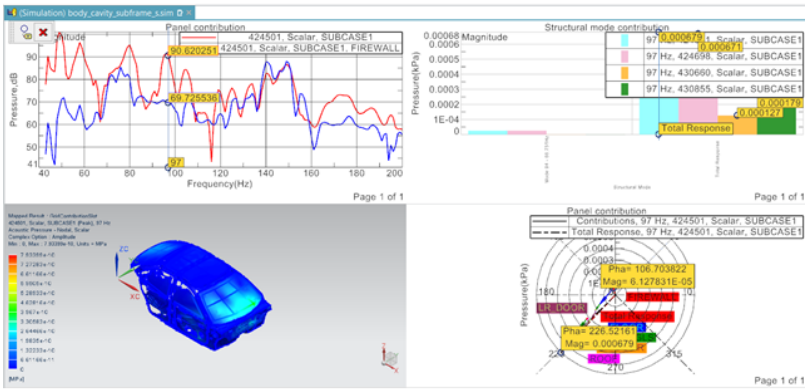


NON-LINEAR ANALYSIS

f deformations are large, if linear material assumptions are invalid, or if contact is a factor, then nonlinear analysis is the appropriate simulation choice. Simcenter solves a wide range of nonlinear analysis problems. Nonlinear implicit and explicit analysis solvers enable engineers to address problems as simple as a plastic catch, or as complex as a car body roof crush analysis. Integrated explicit dynamic capabilities let you perform metal forming analysis or evaluate electronic hardware performance during a high impact drop test simulation.

STRUCTURAL DYNAMICS

Evaluating dynamic response is a key role of various engineering applications, such as assessing passenger comfort in aircraft and automobiles under varying operating conditions, or evaluating the effect of vibrations on the performance of consumer products and electronic devices.



15.3.4 Thermal Simulation

Thermal management is a major consideration for a wide range of products, including industrial machinery, automobiles and consumer electronics. The objective of any thermal management solution is to maintain a product's temperature within a range that is optimal for performance. Accomplishing this may require the removal or addition of heat, either passively or in an actively managed fashion, and this can be evaluated using thermal simulation software

BOILING

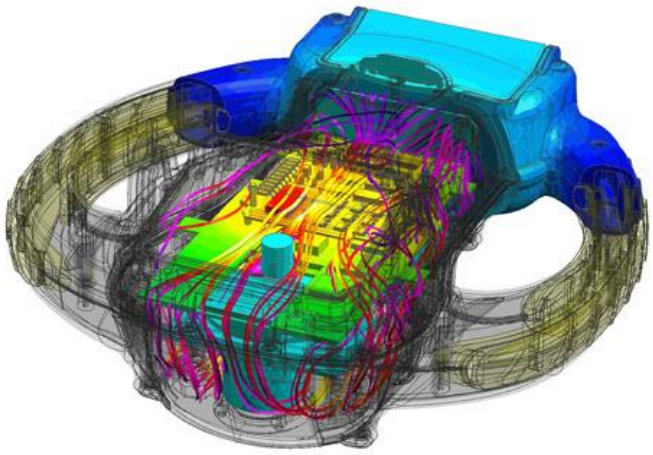
Consider boiling phenomena in your heat transfer applications with wall and bulk boiling models, improving accuracy of heat transfer and phase-change simulation in your application.

CONDUCTION HEAT TRANSFER

Thermal conduction occurs when heat transfers through a solid, from the higher-temperature to lower-temperature regions. This happens spontaneously, and continues until a state of thermal equilibrium is attained. Typical examples of conduction in everyday life include the handle of a pot of boiling water getting hot, the increase in temperature of the outer wall of a copper pipe as hot water passes through it, or the spontaneous chill you experience when you consume a spoonful of ice cream.

CONVECTION HEAT TRANSFER

Convection is a major heat transfer pathway that is present in a wide range of applications, processes and natural phenomena. Many products rely on a robust heat management strategy for optimal performance and durability. Optimizing convective heat transfer in these devices, either by strategic placement of components or the use of other working fluids, is a complex problem. Simcenter offers robust capabilities for addressing convection in the design of products.



ENERGY IN SOLIDS

The comprehensive heat transfer models in Simcenter extend to solid energy models including conduction in solid shells and exothermic solids.

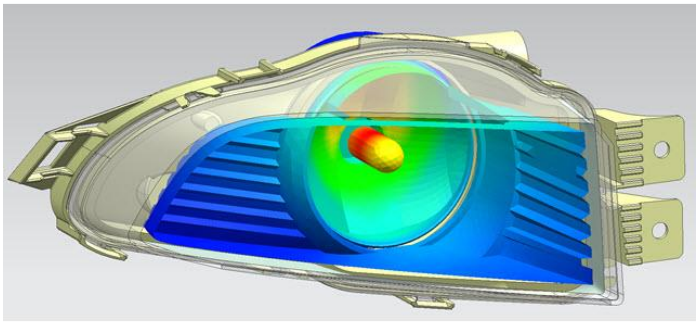
HEAT EXCHANGERS

Simcenter offers single and dual stream heat exchanger models to model the heat transfer between two fluid streams

PHASE CHANGE

Some types of thermal simulation involve a change in state of materials. Examples include freezing of water on a cold windshield, de-fogging of interior volumes, and condensation and boiling that may occur where a fluid meets a structural boundary. Simcenter provides advanced capabilities to account for phase change in thermal and fluid-thermal simulations.

RADIATION HEAT TRANSFER



Radiative heat transfer occurs when objects radiate electromagnetic energy due to temperature. This energy, typically located in the infra-red region of the wave spectrum, is also known as thermal radiation.

Simcenter provides you with capabilities to solve most complex problems involving radiative heat transfer.

THERMAL STRESS

Thermal loads will usually result in stresses in components that add to the stresses resulting from other types of loads such as contact, force, and pressure. Thermal stresses are caused by changes in temperature in a structure where expansion or contraction is constrained. Simcenter includes advanced capabilities for evaluating thermo-mechanical stress in structures.

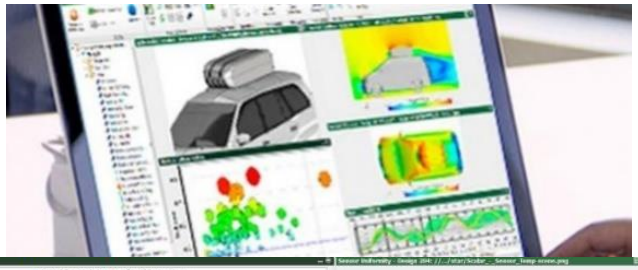
THIN FILM: DE-ICING & DE FOGGING

A simplified approach for simulating ice or fog layer formation, thickness and distribution, offering quick results with minimal turnaround time. Applications include deicing and defogging.

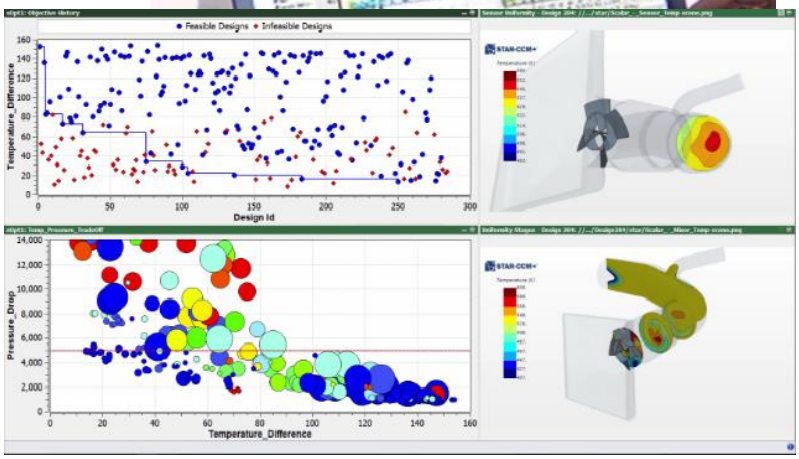
15.4 Optimization

How can I reduce material in a component or change its properties while ensuring it continues to meet performance targets? Simcenter delivers engineering optimization techniques that can help you answer these this question by systematically searching for the best design that satisfies certain criteria. Reduce component weight or find the right combination of parameters to improve product performance through comprehensive topology, geometry, and parameter optimization capabilities.

DESIGN EXPLORATION



Rather than just simulating a single operating point, explore how your product performs over the full range of operating conditions that it will face during its working life, and employ intelligent design exploration to discover better designs faster.



To stay ahead in the innovation race, engineers need to be able to quickly predict the outcome of design changes on the real-world performance of their product. Engineering simulation provides an excellent way for designers and engineers to cost-effectively evaluate how their products will perform under expected operating conditions.

Design exploration software takes simulation to the next level by allowing users to determine appropriate values of variables that yield product designs that result in exceptional performance.

EFFICIENT SEARCH

As opposed to most traditional optimization tools that require highly specialized technical expertise and simplification of models to allow for efficient search, all designers and engineers can use HEEDS to unlock innovation. HEEDS includes proprietary Design Space Exploration functionality to efficiently find design concepts that meet or exceed performance requirements. HEEDS automatically adapts its search strategy as it learns more about the design space to find the best possible solution within the allotted timeframe. It is easy to use, designed to meet deadlines, and capable of providing significant value!

15.5 System Simulation

Using Simcenter system simulation solutions, you can evaluate and balance potentially conflicting performance attributes (such as thermal management, operability, drivability or fuel efficiency) from the early development stages until the final performance validation and controls calibration. To deal with an increased number of requirements, use cases and architectural variants, you can rapidly create heterogeneous system simulation architectures and share your models with the global engineering team. In addition, to help you bring more successful products to the market rapidly, the concept of digital twin has been extended to on-board software engineering.

OPTIMIZE SYSTEM PERFORMANCE FROM EARLY DESIGN STAGES

Innovate products without compromising time-to-market and quality by using the leading integrated, scalable system simulation platform. Simcenter Amesim allows system simulation engineers to virtually assess and optimize the performance of mechatronic systems. This will boost overall systems engineering productivity from the early development stages until the final performance validation and controls calibration.

Simcenter Amesim includes ready-to-use multi-physics libraries combined with application and industry-oriented solutions that are supported by powerful platform capabilities, to let you rapidly create models and accurately perform analysis. It is an open environment that can be integrated into your enterprise processes. You can easily couple the software with major computer-aided engineering (CAE), computer-aided design (CAD) and controls software packages, interoperate it with the Functional Mock-up Interface (FMI), Modelica®, and connect it with other Simcenter solutions, Teamcenter and Excel.

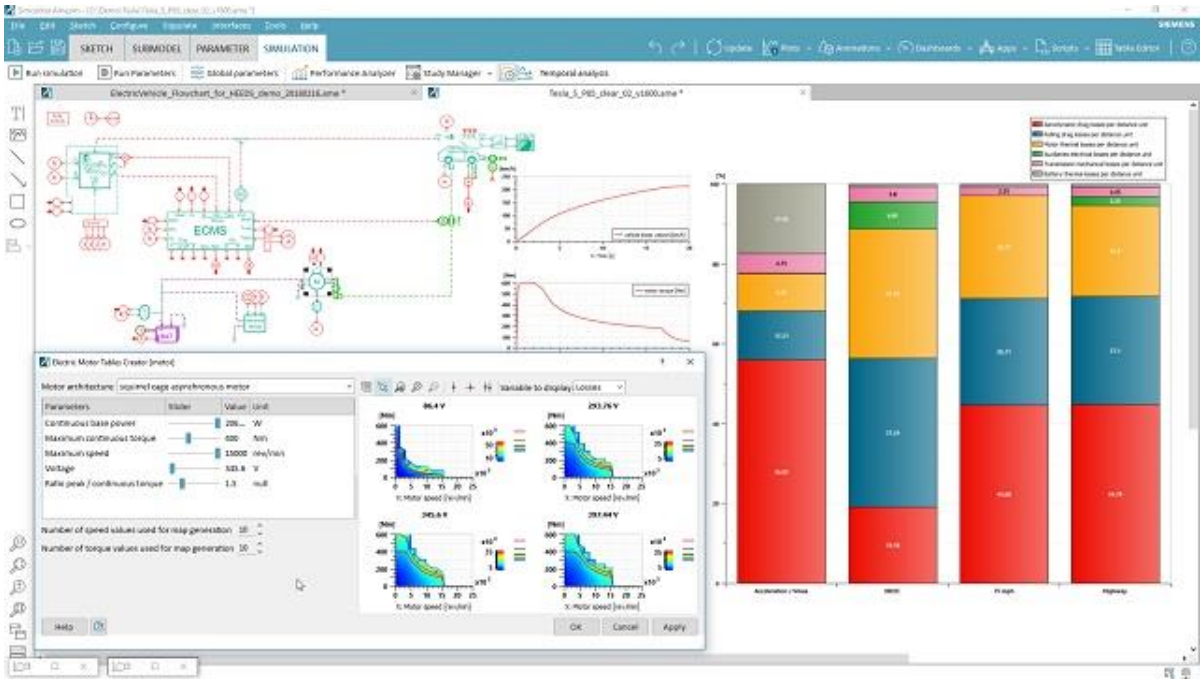
Simulate electrical and electromechanical systems from concept design to control validation. Simcenter Amesim helps optimize the dynamic performance of mechatronic systems, analyze power consumption, design and validate control laws for electrical devices for the automotive, aerospace, industrial machinery and heavy equipment industries. Using Simcenter Amesim, you can investigate various electrification architectures of conventional vehicles, and virtually assess the impact of electric subsystems on the global performance of electric and hybrid electric vehicles. You can also address the challenge of developing more electric aircraft and future electrified propulsion systems.

ELECTRIFIED VEHICLE SIMULATION

Master the engineering complexity of vehicle electrification. Simcenter Amesim offers the required modeling level to simulate all critical subsystems. Whether you deal with battery sizing or electric machine design, you can benefit from efficient modeling workflows to support your engineering effort from architecture creation to integration, including detailed design.

Meet strict emission regulations while ensuring a high-level of vehicle performance and comfort. Simcenter Amesim helps you win the electrification race by providing you the appropriate tools to embrace this technology evolution.

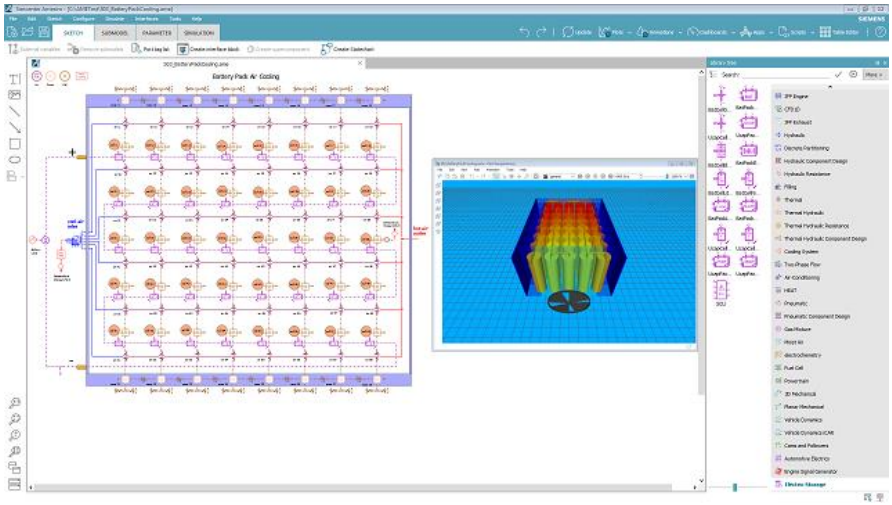
Simcenter Amesim allows you to answer design questions that matter on vehicle, engine, transmission and thermal integration. It also offers the required modeling level to simulate all critical electric subsystems. Whether you deal with battery sizing or electric machine design, you will benefit from efficient modeling workflows to support your engineering effort from architecture creation to integration, including detailed design.



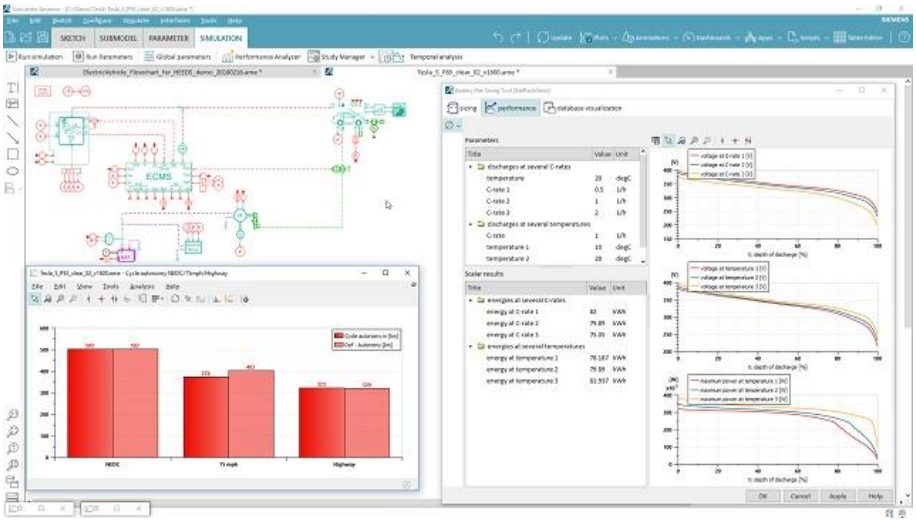
Simcenter Amesim gives you decisive advantage in the innovation race by offering you all the necessary tools to investigate powertrain architectures.

BATTERY & FUEL CELL

Virtually assess the energy performance of electrochemical storage systems when integrated in hybrid or battery electric vehicles. Simcenter Amesim offers a scalable and flexible platform combined with a battery identification tool to characterize and simulate accurately the electro-thermal behavior of storage devices. You can easily size a pack, design a cooling subsystem, optimize a control strategy, reduce the fuel consumption or maximize the range.



HYBRID & ELECTRIC VEHICLE



Manage the complexity that comes with introducing a new energy source into the vehicle. Simcenter Amesim offers state-of-the-art multi-level modeling for all the critical subsystems (internal combustion engine, electric machine, battery or transmission). On top of that, it supports your integration processes to deliver the best-balanced design in terms of energy efficiency, performance and drivability, for any kind of powertrain architecture.

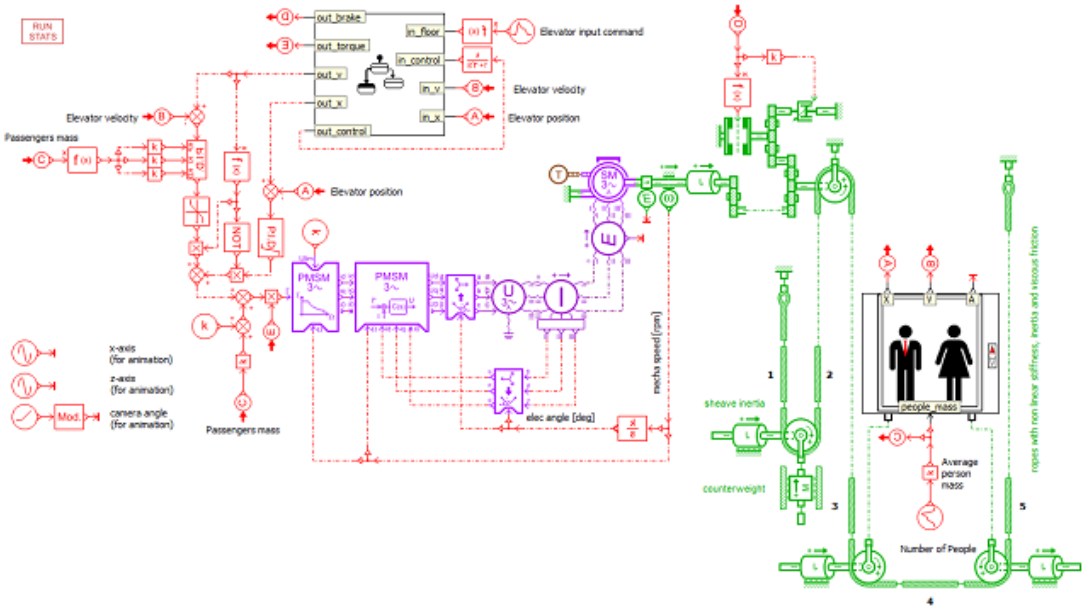
AIRCRAFT ELECTRICAL SYSTEM SIMULATION

Create a more electric aircraft by optimizing its electrical network and accounting for thermal integration. Simcenter Amesim helps you design reliable generators, electromechanical and electrohydrostatic actuators, and analyze the impact of network

reconfiguration in case of failure. Using cosimulation with Simulink®, you can integrate generator control units with high-fidelity multi-physics models. Preprocessing and post processing tools, like EHA and EMA parameter optimization, fast Fourier transform (FFT) and linear analysis features, help succeed in certification tests.

ELECTRICAL SYSTEM MODELING

Benefit from off-the-shelves models for batteries, fuel cells, power converters, linear actuators and electric motors to build any kind of electrical device architecture. Using the Simcenter Amesim multi-physics, multi-level, scalable and flexible approach, you can address many engineering issues like the design of the thermal management system, the assessment of the system performance or efficiency with realistic mechanical or hydraulic loads, as well as the design and validation of your control.



BOOST ENERGY EFFICIENCY AND PERFORMANCE OF YOUR FLUID SYSTEMS : FLUID SYSTEM SIMULATION

Optimize the dynamic behavior of hydraulic and pneumatic components while limiting physical prototyping to the strict necessary. With a wide choice of components, features and application-oriented tools, Simcenter Amesim allows you to model fluid systems for a wide range of applications such as mobile hydraulic actuation systems, powertrain systems or aircraft fuel and environmental control systems.

Simcenter Amesim provides you with comprehensive component libraries to support occasional and expert users when modeling fluid systems, from functional to detailed models. The seamless communication between libraries and the accurate modeling of physical phenomena enable the design of any fluid system and the coupling with controls and other related systems in a single platform.

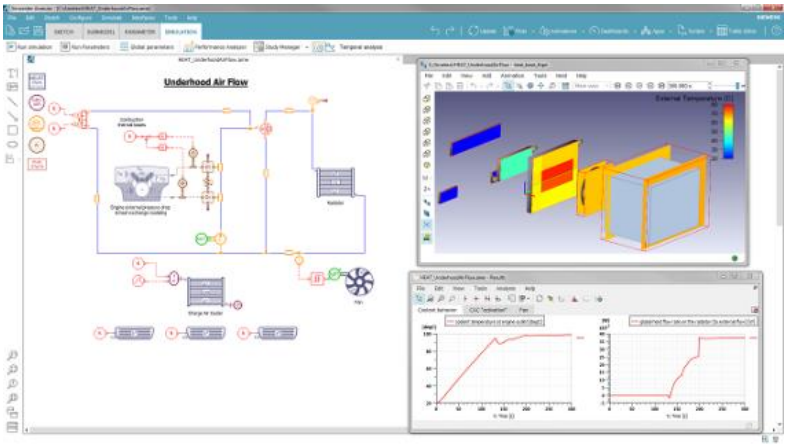
ENHANCE THE DESIGN OF YOUR POWERTRAIN SUBSYSTEMS: POWERTRAIN SUBSYSTEM SIMULATION

Accelerate the design of your powertrain subsystems, including valvetrain, cranktrain, fuel injection as well as lubrication and cooling loops. Simcenter Amesim provides you with the right modeling capabilities at any design phase with the appropriate level of detail and accuracy. You can study the performance of your subsystem and run different types of analysis, ranging from flow balancing, to transient behavior including thermal aspects, or even high-frequency response.

Simcenter Amesim allows you to size your components, assess and optimize your system efficiency as well as design and validate your control strategies. You will be able to prepare the integration of your components within the powertrain environment by evaluating the interaction between the different subsystems, and with the combustion chamber. By analyzing the impact of your subsystem design on engine performance, fuel economy, emissions or even passenger comfort, you can define the best compromise to meet your initial objectives.

Simcenter Amesim offers all the capabilities to size your powertrain components, optimize the efficiency of your powertrain systems and validate your control strategies.

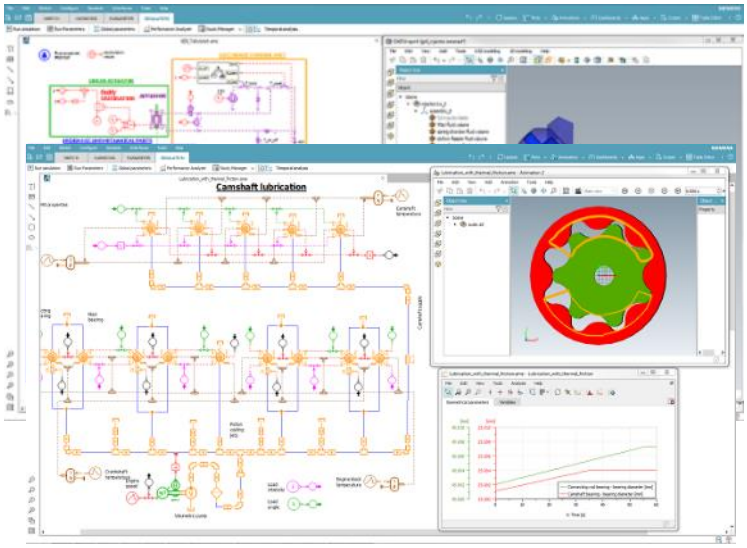
COOLING SYSTEMS



Improve your cooling system design and study its interactions with connected subsystems and the underhood environment. With Simcenter Amesim, you can model engine warmup and associated key criteria (fuel consumption, cabin heating) while taking into account all thermal interactions with the different subsystems in a single environment. You will then be able to rapidly study the influence of topological modifications or alternative components (split cooling, materials changes or integration of an electric pump).

FUEL INJECTION SYSTEMS

Enhance the injector geometry to minimize the activation energy and perform the proper needle lift. Simcenter Amesim helps you optimize the pump geometry and the cam profile to reduce hydraulic losses, pressure oscillations, noise and vibrations. You can improve the stability of hydraulic valves and analyze the effect of the injector body deformation. By representing the dynamics of electromechanical actuators, you will be able to evaluate component performance with different types of actuating technologies.

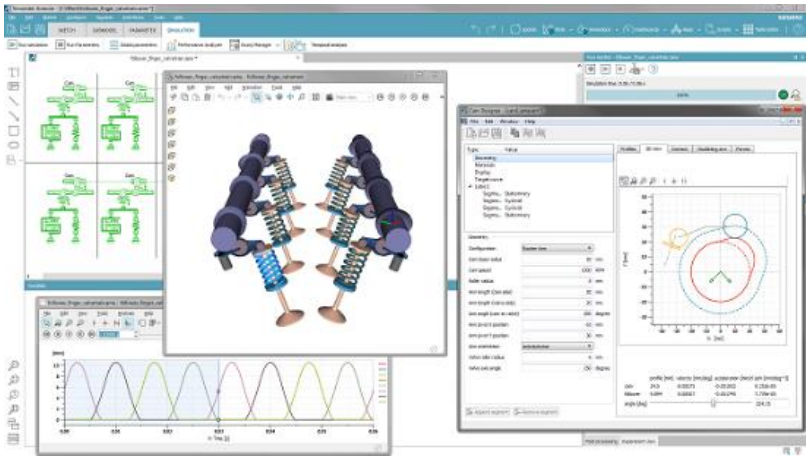


LUBRICATION SYSTEMS

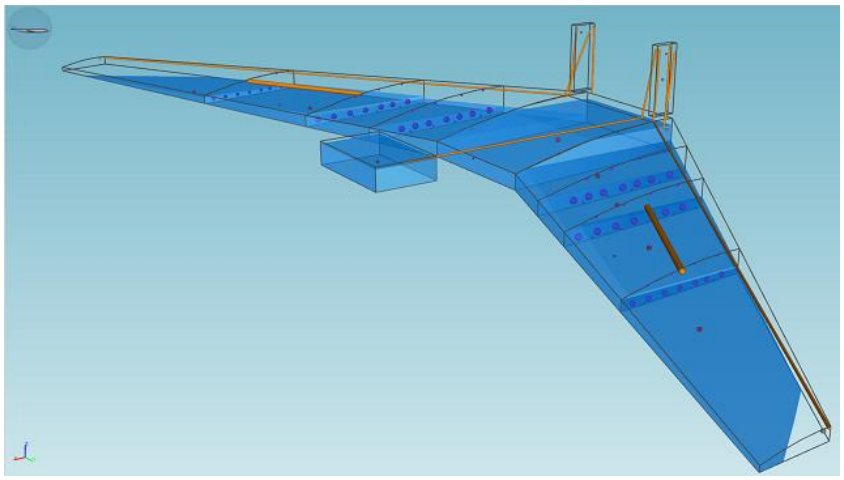
Design lubrication systems by simulating the integration of hydraulics components (pumps, oil network and bearings) with mechanical systems (a crankshaft or a camshaft), in order to compute flow rates and energy loss distribution. Simcenter Amesim helps you analyze pressure dynamics using detailed subsystem models (variable displacement pumps or a cam phaser), to accurately control your system. You can also take into account the thermal aspects relative to the heat release of oil cooling and bearings.

VALVETRAIN & CRANKTRAIN

Optimize the performance of your valvetrain and cranktrain by accurately simulating their dynamic behavior. Simcenter Amesim enables precise computation of the engine subsystem losses (mechanical, thermal, hydraulic) to evaluate their impact on the global engine efficiency, estimate fuel consumption and pollutant emission levels, and to quickly find the best subsystem design with maximum engine efficiency on real driving environment cycles.

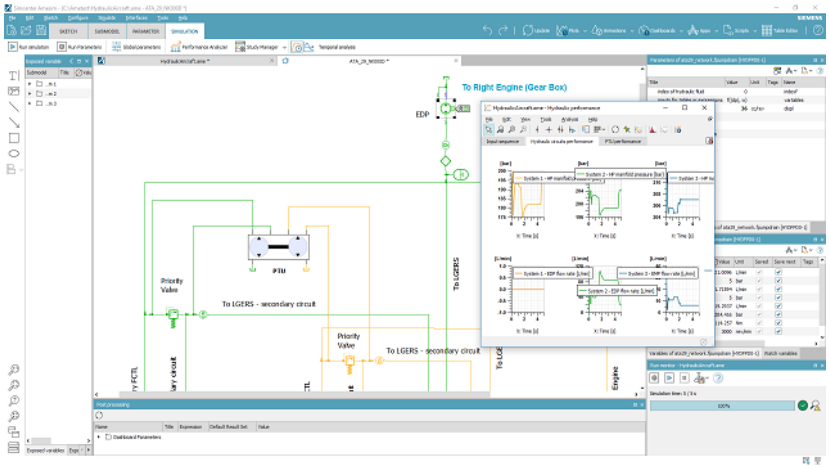


AIRCRAFT FUEL SYSTEM SIMULATION



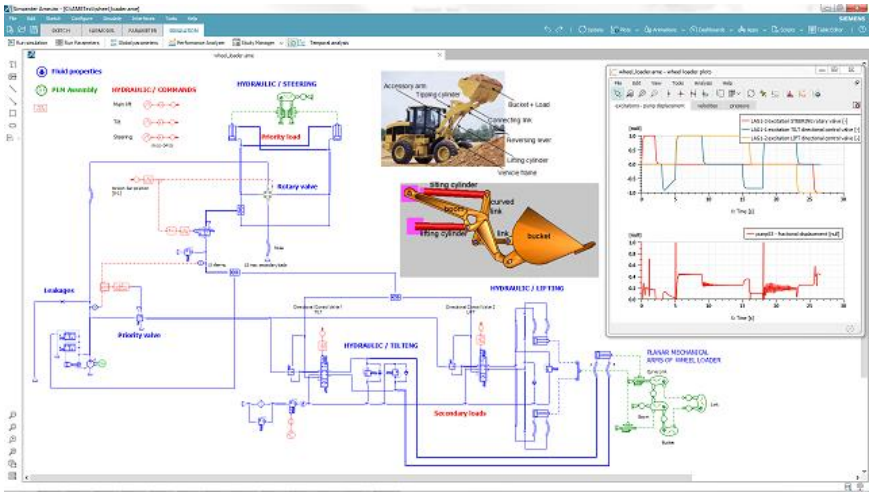
Handle the challenging task of optimizing fuel pressurization, fueling, refueling and defueling of reservoirs with complex shapes while accounting for aircraft attitude, acceleration, wing bending or twisting. The software helps you model the venting, on-board inert gas generation system (OBIGGS), the fuel distribution network and the global energy management system in order to predict potential issues. You can improve efficiency, reduce weight, volume and energy consumption of your fuel systems while satisfying certification requirements.

AIRCRAFT HYDRAULIC SYSTEM SIMULATION



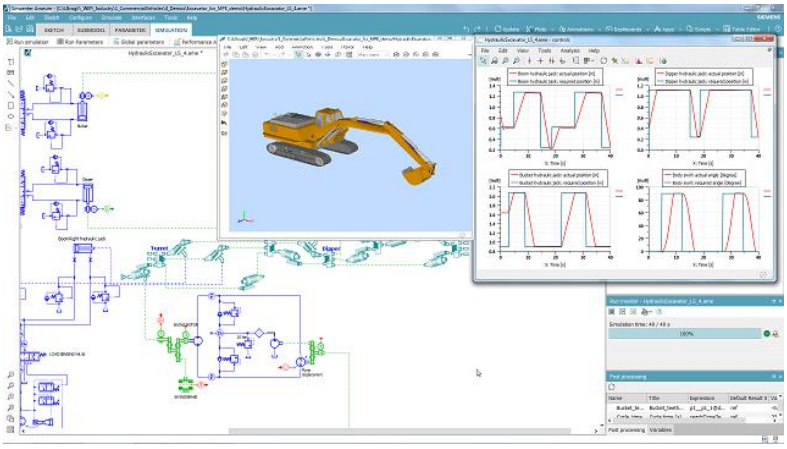
Improve the performance of aircraft hydraulic systems by simulating their behavior for different sizing scenarios and flight missions. Simcenter Amesim provides a scalable approach to tackle engineering challenges ranging from low- to high-frequency dynamics. It allows you to integrate your hydraulic system models with those representing interfaced systems, such as electrical system, landing systems, and flight controls, to assess the aircraft performance at large. You can then estimate the system's degraded performance by simulating how it responds to failures and find alternative designs to meet certification requirements.

FLUID POWER SYSTEM MODELING



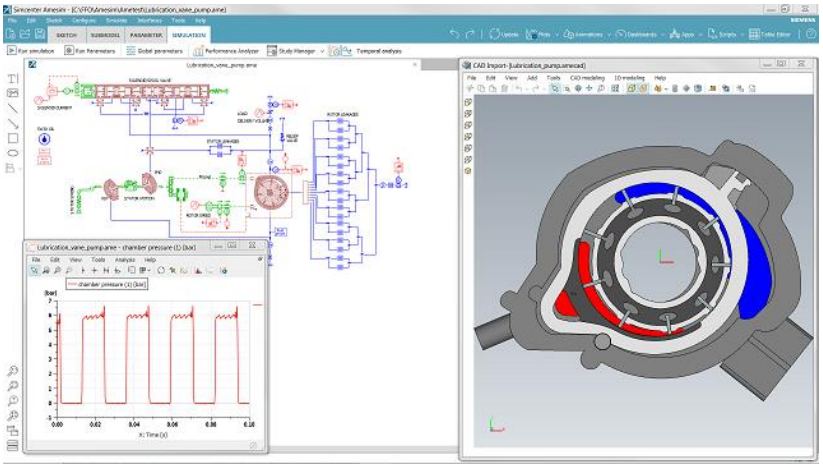
Assess the overall behavior of hydraulic or pneumatic systems and components. Simcenter Amesim comes with a set of predefined functional components for pumps, compressors, valves and actuators, as well as with a series of detailed geometry-based components. You can study the evolution of pressures, flow rates and temperatures in the complete system, and analyze the performance of specific components (valves or pumps), taking into account compressible flow, mixtures of gases, thermal effects, aeration and cavitation.

HEAVY EQUIPMENT ACTUATION SYSTEM SIMULATION



Design robust, reliable fluid power actuation systems for earthmoving, crane, crawler, mining equipment and more. Simcenter Amesim enables you to reduce power generation (such as variable displacement pumps and load sensing), develop new functions (such as self-leveling and control strategies) and improve product quality, robustness and reliability. The software enables you to consider every subsystem, and predict the dynamic behavior of the global fluid power system.

PUMP AND VALVE SYSTEM SIMULATION



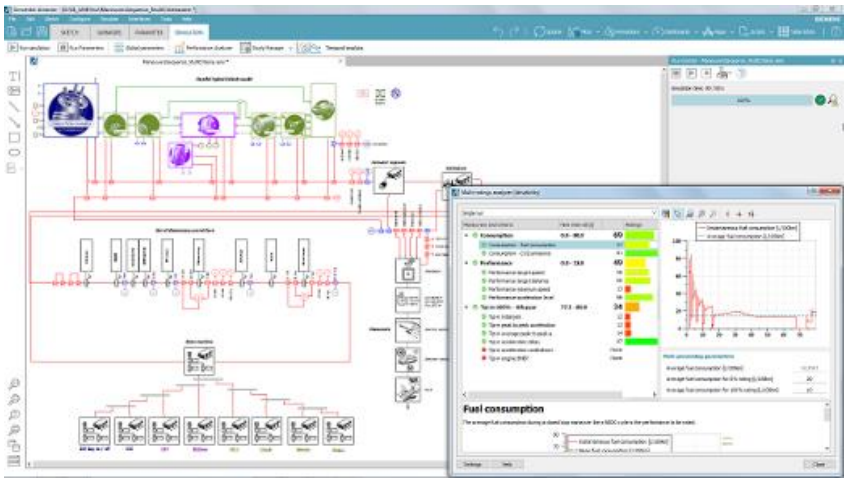
Boost the performance of your compressors and hydraulic pumps with Simcenter Amesim. CAD import capabilities enable you to easily create a high-fidelity model from the detailed geometry. It helps you meet the increasing demand for high performance: flow characteristics, reduced pressure ripple and precise regulation of pump displacement. In addition, you can solve integration issues earlier in the design cycle, and optimize control strategies to adapt the pump flow according to the actual actuators' request.

DESIGN COMPLEX MECHANICAL SYSTEMS RIGHT FROM THE FIRST TIME : MECHANICAL SYSTEM SIMULATION

Manage the increasing engineering complexity of mechanical systems. Simcenter Amesim includes state-of-the-art modeling techniques that allow multi-dimensional (1D, 2D and 3D) dynamic simulations.It enables you to study rigid or flexible bodies and complex non-linear frictions by analyzing low- or high-frequency phenomena. It takes into account contacts between complex geometries to increase reliability and robustness of developed kinematics. And it comes with multi-physics actuator models for accurate analysis of the coupling between mechanical structures and electric or hydraulic motion.

Simcenter Amesim allows you to frontload architecture and design decisions. The software comes with powerful modeling, analysis and optimization tools that help you virtually explore a large number of possible system architectures, predict performance, energy balance, noise and vibration behavior, and validate early in the design cycle the configuration that meet requirements. It also features connection between plant models and control models or code, to support the development of best-in-class mechatronic systems.

POWERTRAIN TRANSMISSION SYSTEM SIMULATION



Optimize the integration of any kind of transmission and vehicle to balance performance, fuel economy, drivability, comfort and reliability from the early design stages. Simcenter Amesim helps you improve fuel consumption by predicting losses, as well as reduce vibrations by detecting and modifying natural modes contributors, and reducing contact force variations, clutch judder, booming and clunk noise.

TRANSMISSION DESIGN

Rapidly model your driveline, engine and gearbox, including their components such as synchronizers, planetary gear trains, clutches and dual mass flywheels. With Simcenter Amesim, you can easily model the entire transmission, including all actuators and controllers, and evaluate their interactions during the powertrain and driveline integration in the chassis. You can reproduce all physical phenomena in order to optimize your design, and in this way shorten the calibration phase.

TRANSMISSION DRIVABILITY

Maximize driver comfort by delivering optimal shift transmission quality and engine torque delivery transients. Using Simcenter Amesim, you can study the entire physics and controls strategies of gear shifting for every kind of transmission architecture in order to avoid severe oscillations. By simulating tip-in, tip-out, takeoff, engine stop-and-start scenarios, you can virtually evaluate vehicle drivability and balance it with fuel economy and performance.

TRANSMISSION NOISE AND VIBRATION

Understand the root causes of noise and vibration generated by a combination of linear and nonlinear powertrain systems. Simcenter Amesim helps you address engineering challenges related to engine torque oscillations, gear rattle, driveline modes excitation, friction self-excitation, hydraulic dynamics and controls strategies. You can analyze phenomena such as booming, clunk, clutch judder or shuffle, and then optimize components, subsystems and overall system architecture.

TRANSMISSION PERFORMANCE AND LOSSES

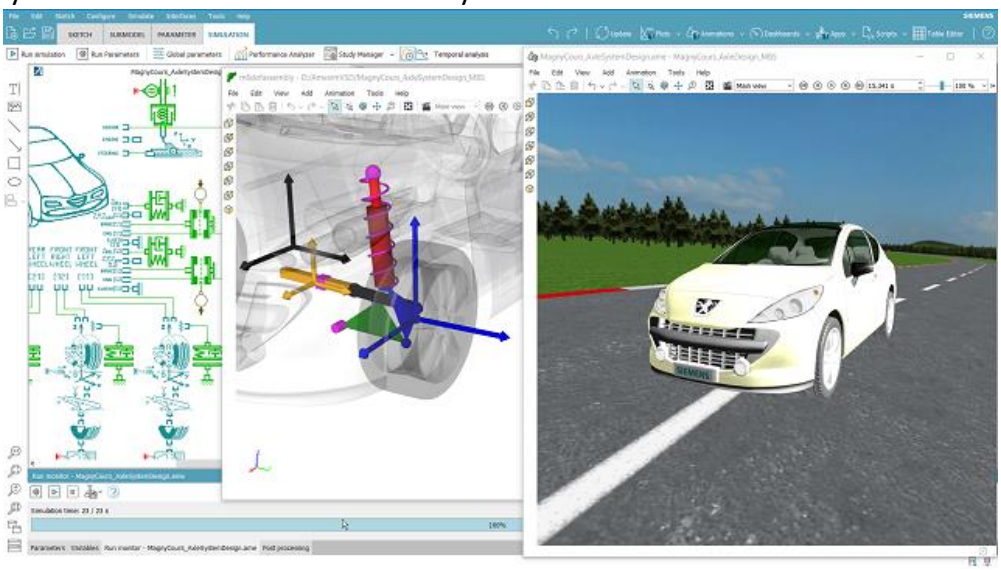
Optimize gear shifting as well as hybrid strategies to reduce fuel consumption while still providing a consistent output power curve within the engine's best operating range and reduce mechanical losses. Advanced Simcenter Amesim models for loss estimation in gears and bearings allow you to identify the main sources of loss in your transmission at any operating point and to point out the components that have to be optimized.

OPTIMIZE THE DYNAMICS OF VEHICLE SYSTEMS, CHASSIS COMPONENTS AND CONTROLLERS:

VEHICLE SYSTEM DYNAMICS SIMULATION

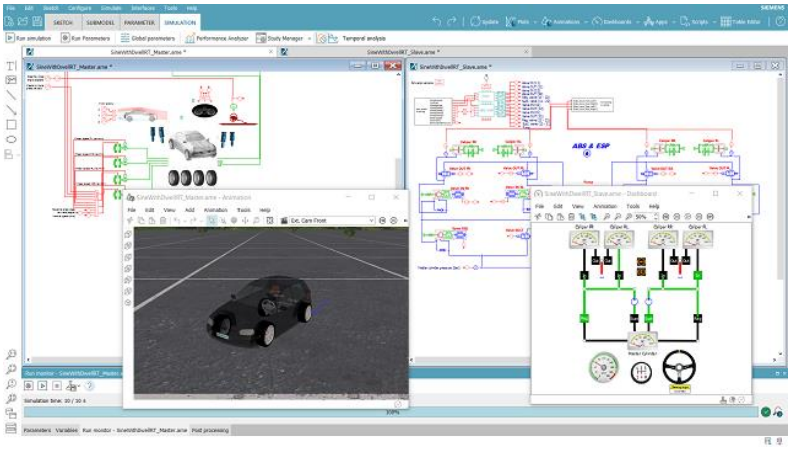
Balance conflicting performance characteristics like comfort and handling, but also stability, agility, drivability and fuel economy. The increasing integration of active controls, together with the use of electrified chassis systems makes engineering activities even more complex.

Simcenter Amesim provides an integrated approach for developing vehicle and its chassis components, that addresses the multi-disciplinary nature of all these mechatronic systems thanks to seamless integration and co-simulation capabilities with the controller models. The system simulation approach enables engineers to frontload design decisions for chassis components and their layouts, and provides scalable solutions all along the design and validation process, from model-in-the-loop (MiL), software-in-the-loop (SiL) to hardware-in-the-loop (HiL). This helps you reach vehicle dynamics and chassis component performance targets faster while maintaining (or even improving) your engineering brand values.

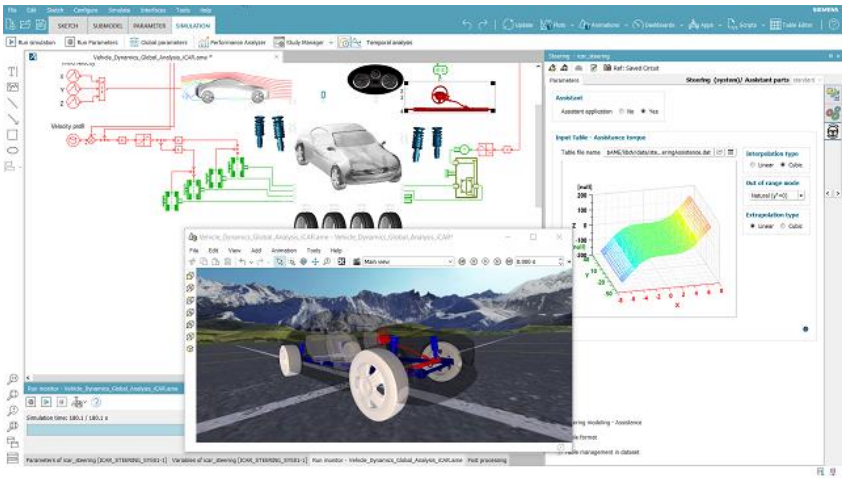


INTELLIGENT CHASSIS SUBSYSTEMS

Accelerate the design of robust chassis components and subsystems like steering and braking, shock absorbers, active roll stabilizer bars and any mechatronic system related to chassis. Our scalable, multi-disciplinary modeling platform and its off-the-shelve templates help you assess technology risks that result from chassis electrification, and use the most appropriate level of detail according to your simulation needs and available parameters. Simcenter Amesim helps you integrate these systems within the vehicle, and validate control strategies.

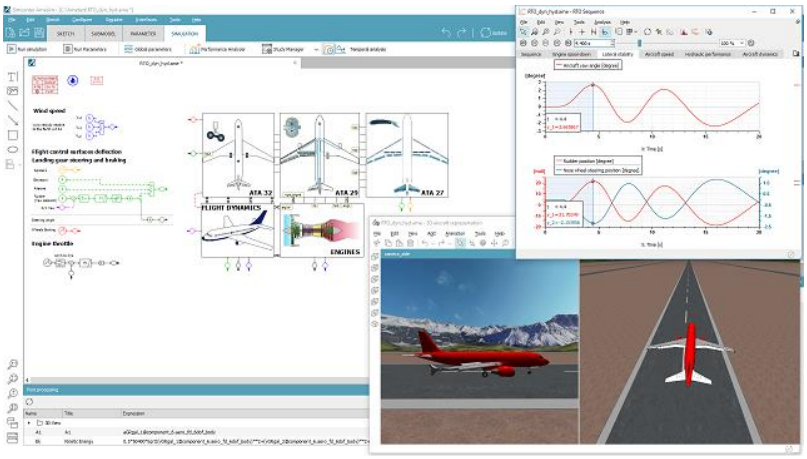


RIDE AND HANDLING



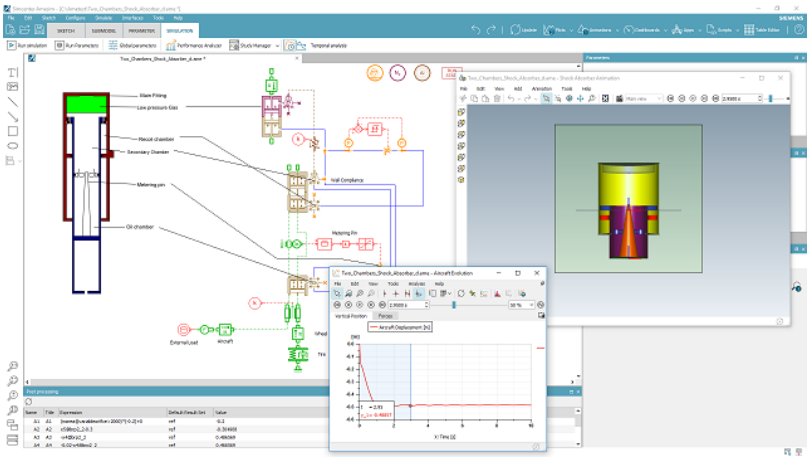
Effectively predict vehicle dynamics performance and accelerate decision-making on vehicle layout using a modular and scalable approach that provides increased modeling relevance for early phases of vehicle design. A template-based, easy-to-use modeling approach enables you to run simulations faster than real time for controls validation. This modeling continuity closes the gap between vehicle mechanical engineering and controls engineering, increasing system quality and avoiding late problems that impact time-to-market.

FLIGHT CONTROL SYSTEM SIMULATION



Handle the multi-physics aspects of the entire flight control system for various actuation technologies, such as mechanical, direct drive, electromechanical or electro-hydrostatic. Simcenter Amesim covers the entire development process from predesign, to detailed dynamic analysis, and to real-time validation that considers the overall flight envelope. You can also integrate flight controls with interdependent systems to assess interactions earlier in the design phase.

LANDING SYSTEM SIMULATION



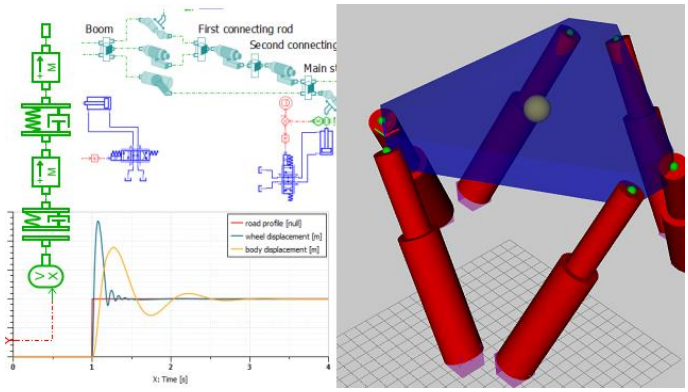
Design eco-friendly and cost-efficient landing gear systems, by reducing fuel consumption and carbon emissions during ground maneuvers. By using Simcenter Amesim from the early development stages to detailed analysis, system integration and validation, you can improve the reliability of landing gear systems, even for hard landing conditions, you can make the braking system more robust, even for a rejected take-off, and you can do a proper structural integration of extension and retraction systems.

MECHANICAL SYSTEM MODELING

Accurately model the kinematic and dynamic behavior of multi-body systems (from 1D to 3D) by using mechanical Simcenter Amesim components.

Ready-to-use rigid or flexible bodies connected by functional junctions allow you to rapidly analyze a large number of effects, such as elastic collision, dry and viscous friction, worm gear, screw/nut, rack and pinion mechanisms, ropes and sheaves.

Validated models of cams and followers help you seamlessly compare the performance of different hydromechanical valvetrain architectures.



INNOVATE PROPULSION ARCHITECTURES: PROPULSION SYSTEM SIMULATION

Develop the next generation of propulsion systems. The success of your future design will be critically influenced by propulsion technologies onboard. The increasing needs for performance, safety and efficiency cannot be met without integrating innovative propulsion architectures.

The multi-physics system simulation approach enables you to address the great variety of architectures and technologies. Powertrain electrification in automotive, reusable launch systems for the space industry or the use of alternative fuels (LNG) for ships are examples of technology implementation that modeling capabilities of Simcenter Amesim can support. You will be able to design and assess the impact of the propulsion system on various metrics such as onboard power generation or vehicle pollutant emissions, by performing a complete analysis of cross-system influences in a single platform.

DEVELOP INTERNAL COMBUSTION ENGINE SYSTEMS AND CONTROLS

Internal Combustion Engine System Simulation

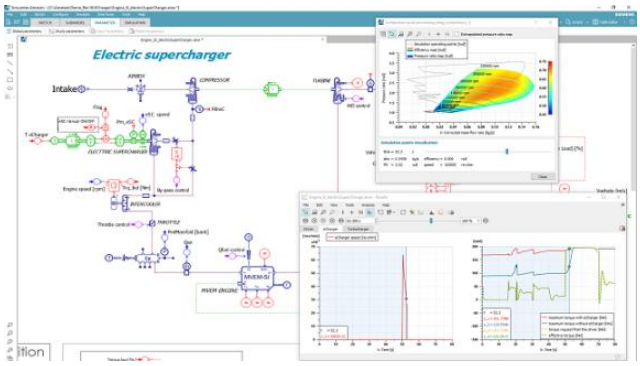
Evaluate, design and optimize complete internal combustion engine systems, from air management and combustion to exhaust after-treatment and engine controls, by using accurate physical engine and component models. The capabilities for internal combustion engine simulation are developed in close collaboration with IFP Energies nouvelles.

By applying a system simulation approach using Simcenter Amesim, you can now study

integration with fuel injection subsystems, engine thermal management, electrical devices, powertrain and various other components, as well as adapt model definitions to a wide range of scenarios. Simcenter Amesim allows you to analyze the impact of advanced technology choices and gives you a powerful toolset to investigate alternative engine architectures and concepts.

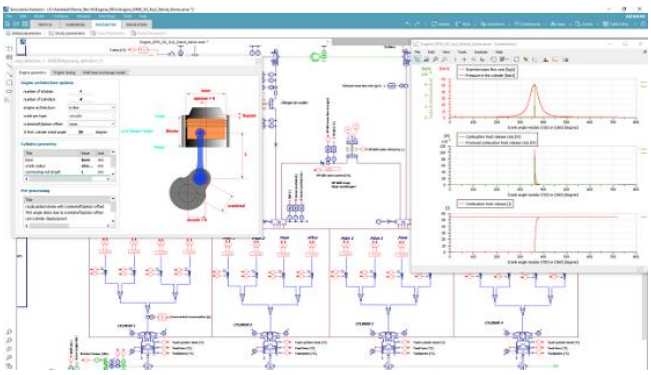
Simcenter Amesim includes all the required tools to design and optimize the complete internal combustion engine, including controls.

AIR PATH & CHARGING



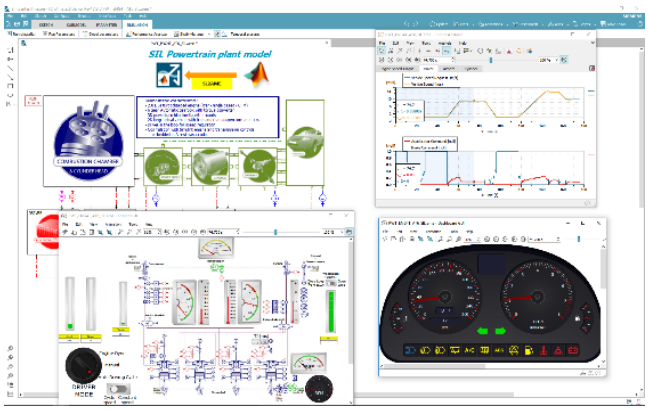
Develop innovative air path architectures including actuators, charging and cooling systems, and rapidly analyze their impact on gas management, combustion and emissions. In addition to a broad set of component models that enable you to design advanced air path systems and study the engine performance, Simcenter Amesim provides powerful application-oriented analysis tools, a Simulink interface, and generic co-simulation to allow integration with computational fluid dynamics (CFD) software.

COMBUSTION



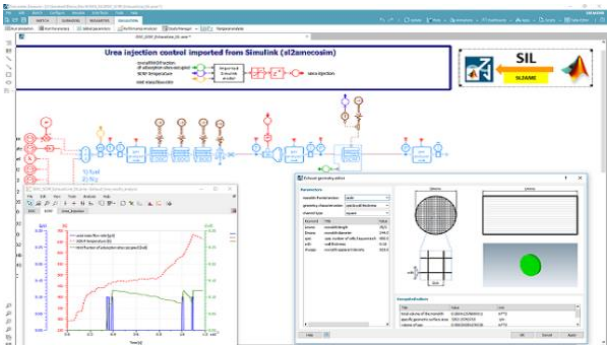
Offer your customers better engine response and lower fuel consumption. Simcenter Amesim supports the design and optimization of conventional and innovative combustion processes as well as the adoption of alternative fuels. You can optimize engine parameters, such as spark advance, turbulence, lambda control or injection split for different fuel types and assess the benefits in terms of efficiency, torque production and emissions.

ENGINE CONTROLS



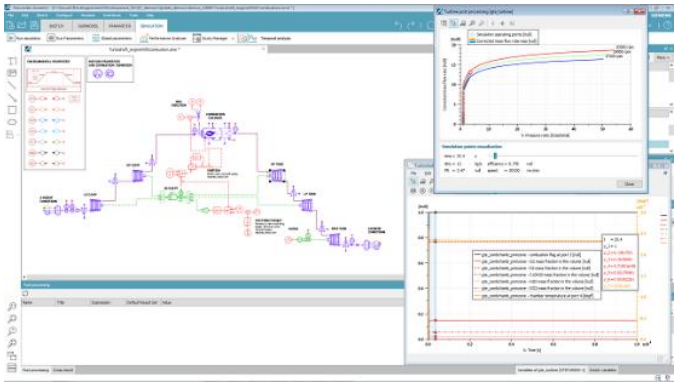
Address the growing complexity of engine control strategies using multi-physics plant modeling capabilities of Simcenter Amesim. Engine control engineers in charge of controls design, validation (offline or real time) and calibration can use state-of-the-art Simcenter Amesim engine, after-treatment and powertrain models at every development stage. An efficient Simulink interface and straightforward export workflows ease the integration of the models in your processes.

EXHAUST AFTER-TREATMENT



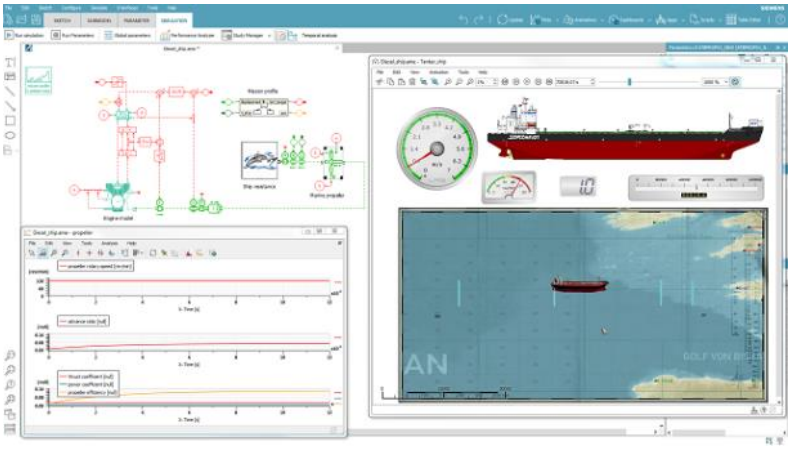
Meet emission standards including Real Driving Emissions (RDE) by optimizing exhaust systems and associated control strategies. Simcenter Amesim allows you to accurately model and analyze the conversion of nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbons (HC) and soot filtration. You can work on exhaust system components and controls, integrate the after-treatment system in a vehicle configuration in order to evaluate the emissions for driving cycles.

AIRCRAFT ENGINE & EQUIPMENT SYSTEM SIMULATION



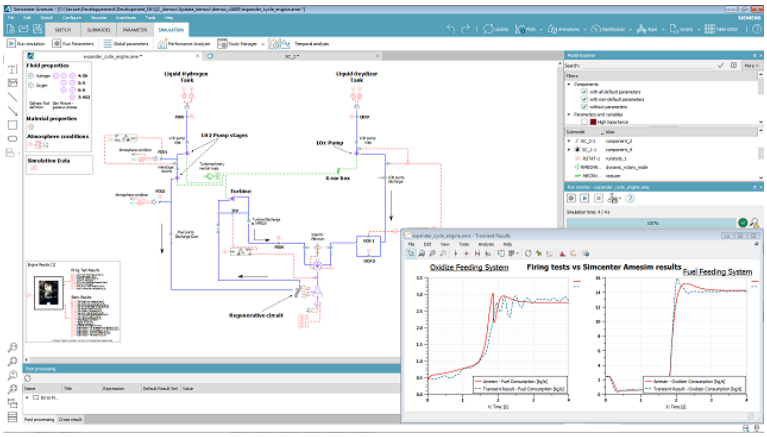
Develop and balance the performance of conventional and innovative aircraft engine architectures by modeling and simulating their complete thermodynamic cycles in various operational conditions, accounting for environmental conditions, degradation of compressors and turbines, and by integrating their equipment and consumers. Simcenter Amesim enables you to integrate the best concepts early in the design cycle to assess the overall performance and to derive best fit-to-purpose engines. You can easily assess and realize your innovative ideas.

MARINE PROPULSION SYSTEM SIMULATION



Optimize the hydrodynamic performance of your ship propulsion system by simulating multiple powertrain configurations, such as conventional, hybrid or electric battery, under different scenarios. Integrate your engine model and controls into the full ship architecture to estimate fuel consumption and NOx emissions for different load cases. Find the right compromise between accuracy and simulation time by coupling your Simcenter Amesim system simulation model with data from CFD calculations.

SPACE PROPULSION & SUBSYSTEM SIMULATION



Challenge the performance of your space propulsion system by analyzing its transient behavior, during start-up and shut-down for instance. Simcenter Amesim enables you to optimize the engine performance by assessing different architectures of the complete engine and by evaluating various technologies for the different subsystems, like actuators, or their electrification. You can develop advanced controllers relying on predictive engine models, and evaluate the performance along missions by coupling the propulsion system with flight dynamics.

Deploy model-based design for components and entire systems
System Integration

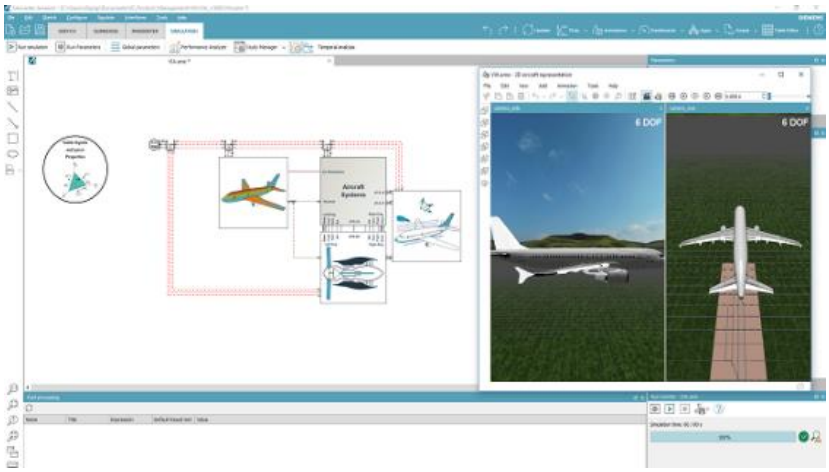
Remove development silos and effectively handle increasing system complexity. If you want to successfully adopt model-based design (MBD), you need to apply a continuous modeling approach from early architecture design to the calibration stage. To support you in this engineering transformation, Simcenter Amesim offers a multi-level philosophy that allows you to gain efficiency by streamlining the user experience.

Versatility in terms of physical modeling, combined with dedicated unique features will help you set up the most effective engineering design process for a car, a plane, an excavator, a ship or any other industrial application. From components to the entire system, we offer you the tool that enables you to focus on your engineering challenge and address it as fast as possible with available data.

Simcenter Amesim helps you bring model-based engineering to the next level for many challenging applications.

VIRTUAL INTEGRATED AIRCRAFT

Increase the efficiency of your aircraft program by addressing the complexity of aircraft systems, and investigating system interactions from the early design phases. Simcenter system simulation solutions enable the virtual integrated aircraft (VIA) approach to support your model-based systems engineering, modeling and simulation, verification and validation processes. The approach can be tuned to the structure of your organization, and helps your engineering team collaborate, instead of work in silos.



Various scripting and customization capabilities provide seamless integration of Simcenter Amesim

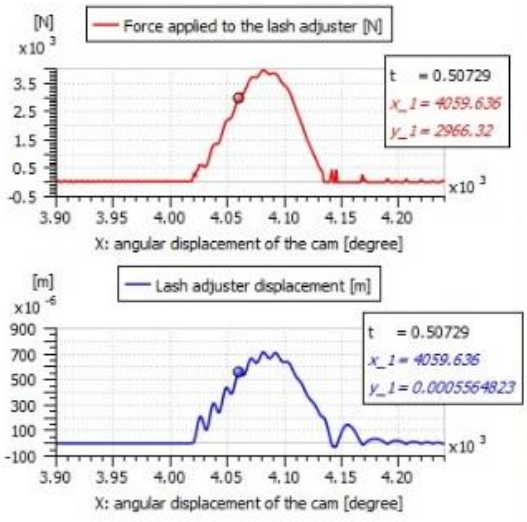
within your existing design processes. Being open and flexible, the Simcenter Amesim platform efficiently interfaces with many 1D and 3D computer-aided engineering (CAE) software solutions and helps you quickly derive and export models for standard real-time targets by providing a consistent and continuous model-in-the-loop (MiL), software-in-the-loop (SiL) and hardware-in-the-loop (HiL) capable framework.

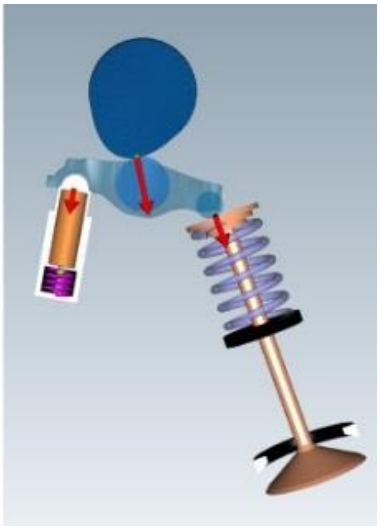
Simcenter Amesim includes a broad set of capabilities to accelerate the learning curve and improve system simulation productivity through better integration in overall design processes.

Simcenter Amesim productivity features make it possible to rapidly acquire intricate knowledge of systems using advanced analysis, optimization and automation capabilities.

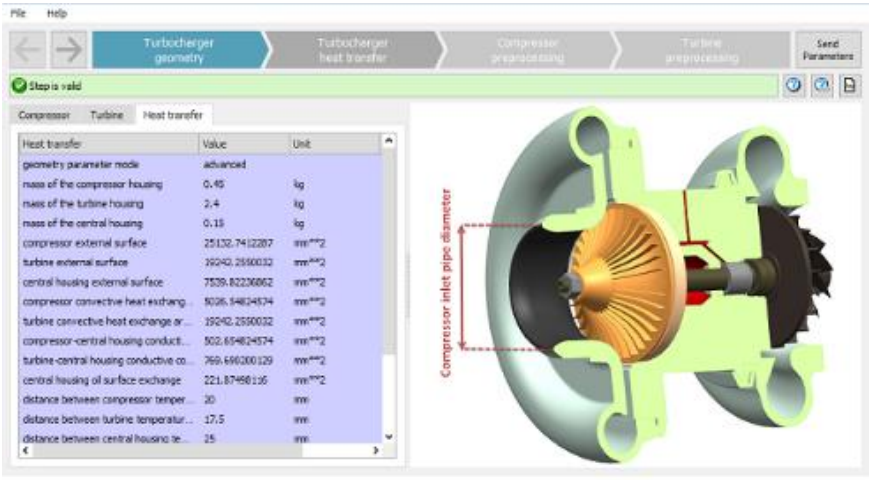
ANALYSIS TOOLS

Virtually evaluate the design of your product and frontload decisions using fully integrated analysis tools and methods within Simcenter Amesim. Advanced plotting facilities help you accurately understand the performance of your system in both time and frequency domains. You can use built-in graphs to conduct studies such as transient simulation, linear analysis, spectral analysis and energy distribution. You can also complete your understanding thanks to the use of our 2D and 3D animation tools.



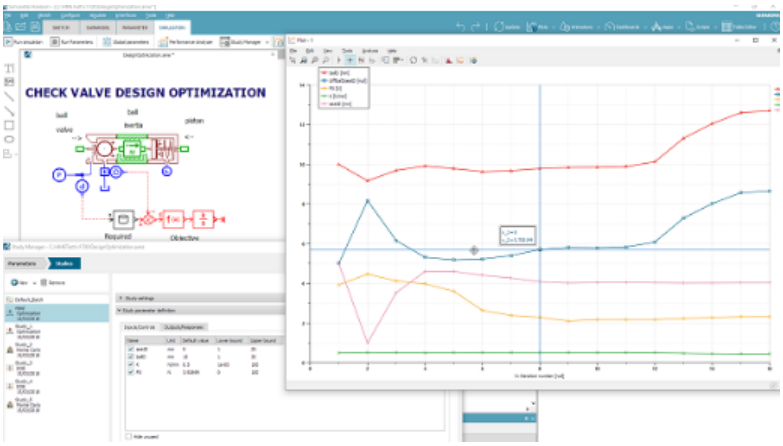


CUSTOMIZATION



Leverage the use of your models across departments from CAE specialists and application experts to transverse project engineers and global analysts. Simcenter Amesim enables you to quickly create custom applications that ease the use of in-house engineering expertise for dedicated components and systems. In addition, our software enables you to enhance your model by adding metadata such as model history or modelling assumptions for instance.

OPTIMIZATION, ROBUSTNESS AND DESIGN OF EXPERIMENTS (DOE)



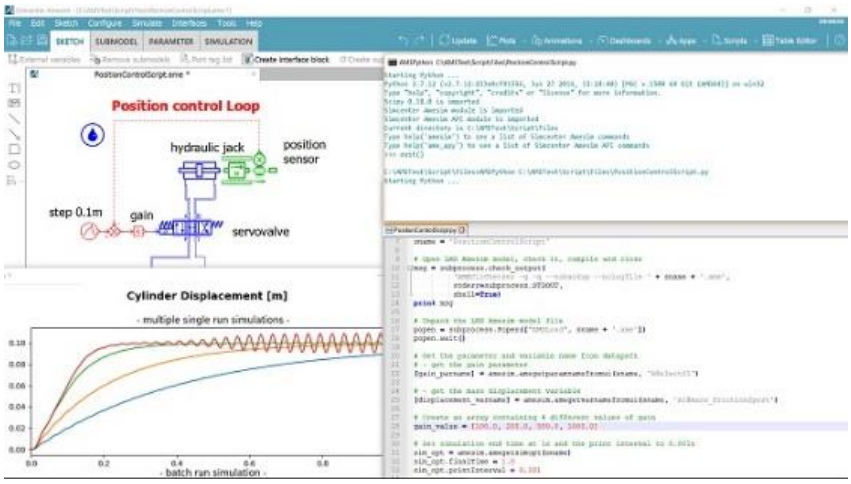
Optimize your multi-physics system simulation effectively and easily. Whether used for design or validation, system models can give you access to global parameters that directly influence overall behavior. Simcenter Amesim integrates tools for design exploration, optimization and robustness analysis. The models can be processed within HEEDS and other well established third-party process integration and design optimization tools for advanced studies and better process integration.

PLATFORM FACILITIES

Benefit from a modern user interface designed with the best user experience in mind, and optimized for scalability. Simcenter Amesim includes a set of features aimed at simplifying the everyday life of users, such as supercomponents, experiments, the batch run capability, and many other usability-oriented functionalities. In addition, you can implement complex logic into models with the help of statecharts, which allow users to define and control model states via conditional transitions.

SIMULATOR SCRIPTING

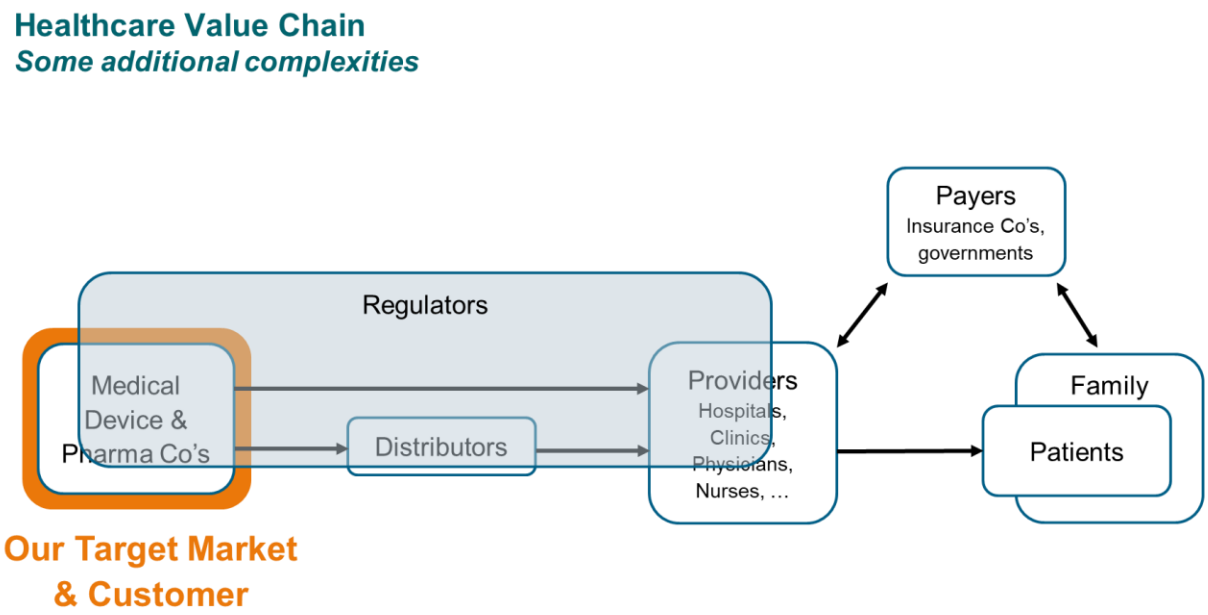
Automate simulations and build Simcenter Amesim-based applications to meet your specific needs. The software provides a complete set of scripts that support application programming in popular programing languages like Python, MATLAB, Scilab and Visual Basic for Applications (VBA). It enables you to automate interaction with models: set up batch runs, perform complex pre-processing and post-processing, carry out parameter studies or integrate a Simcenter Amesim model within an external application.



COMBINE VARIOUS CUTTING-EDGE SIMULATION TECHNOLOGIES IN A SINGLE PLATFORM : TECHNOLOGIES

Leverage best-in-class simulation technologies with Simcenter Amesim. The platform has several numerical capabilities, including a recognized solver, in-depth performance analysis functionalities, as well as powerful discrete partitioning and parallel processing features. Moreover, Simcenter Amesim allows covering all the model-in-the-loop (MiL), software-in-the-loop (SiL) and hardware-in-the-loop (HiL) phases, thanks to its real-time compatible libraries, and streamlined by numerous model simplification tools. Simcenter Amesim models can be exported to no less than a dozen of real-time targets.

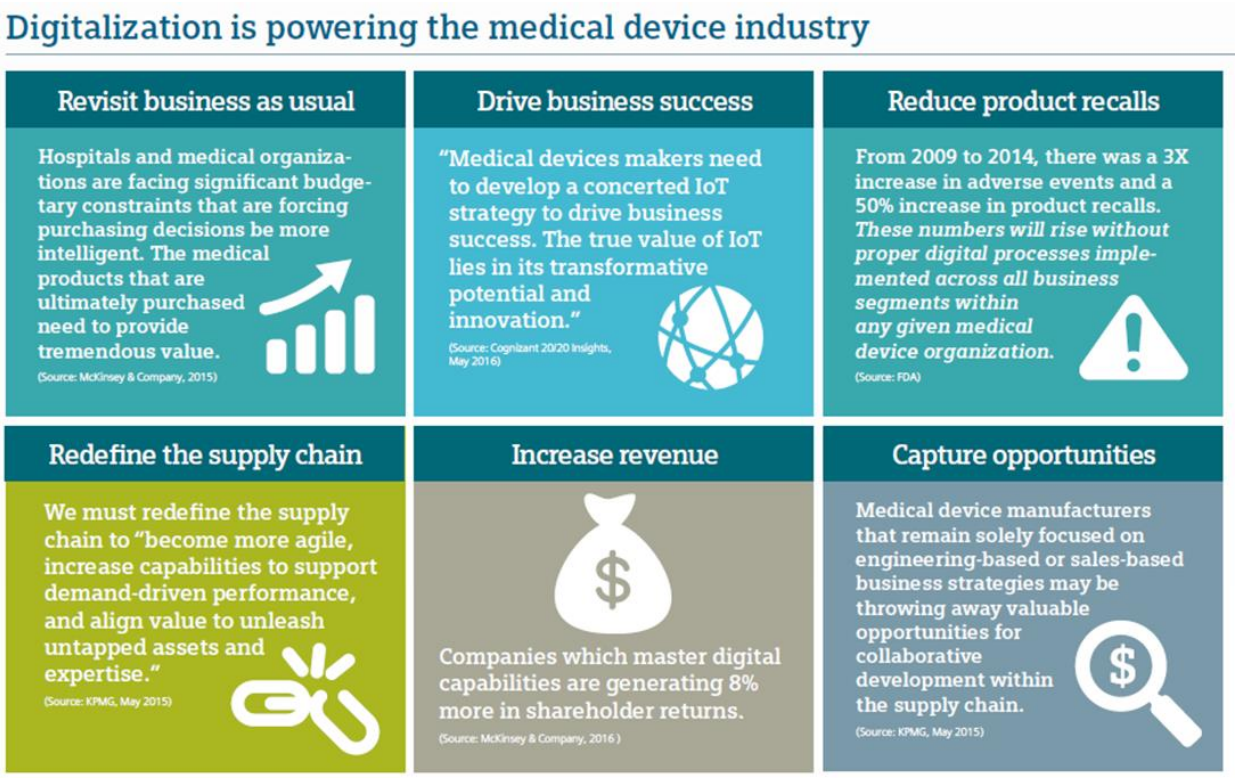
16 BIO Technology Specialised Lab



16.1 Medical Devices & Pharmaceuticals

16.1.1 Digitalization for the Medical Devices and Pharmaceuticals Industry

Siemens Digital Industries Software offers solutions for leading companies in the medical device and pharmaceutical industries that recognize the need for a product lifecycle management (PLM) platform to answer product development challenges. Our proven, flexible solutions help speed up innovation in the pharmaceutical and medical device development, ensure quality, reduce costs and maintain adherence to ever-changing global regulations, including FDA compliance.



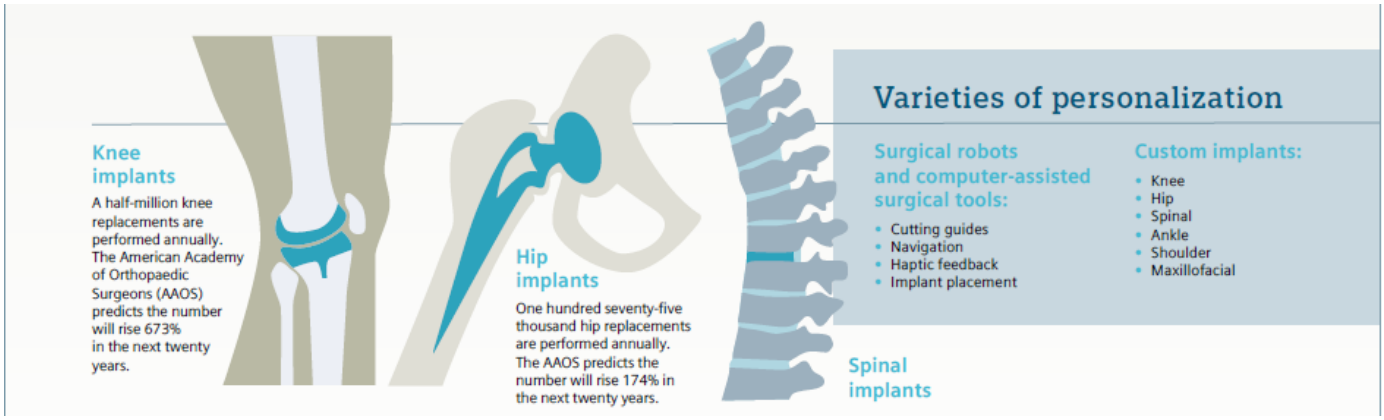
Digitalization is affecting every industry, displacing market leaders and creating new business opportunities. Surviving and thriving in an age of disruption demands that manufacturers rethink every aspect of their business, become digital enterprises, and take advantage of the new and disruptive technology drivers across each phase of their operation to reduce cycle time, increase yield and create new business opportunities.

In the medical device industry, new technologies present new opportunities for real innovation in the way medical devices are designed, manufactured and serviced. Digitalization is the only way that companies can harness new technologies while meeting the continuing challenges posed by increasing product complexity, regulatory compliance and geographically disparate engineering and manufacturing departments.

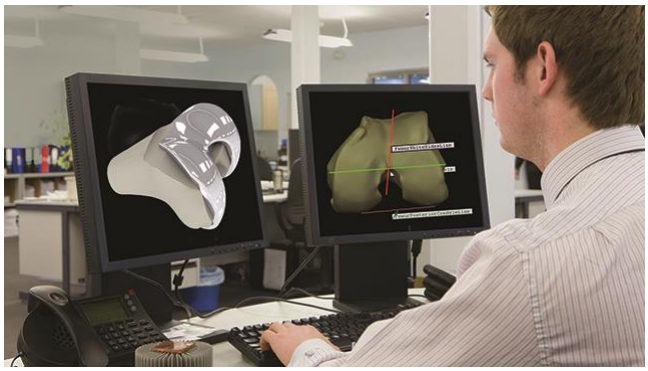
At Siemens, the drive to deliver best-in-class solutions to support digitalization and regulatory compliance in the medical device and pharmaceutical industries is driven by a single purpose: helping our customers improve the quality of life, by turning ideas into reality. With digitalization solutions spanning every step of the design, development and manufacturing processes, Siemens Digital Industries Software brings new hope--for discovery, innovation, and most importantly, for better treatments and better outcomes for patients.

16.1.2 Design Excellence

Innovation that enables smart, interconnected devices, along with the coupling of therapy and diagnostics, promises more effective disease treatments. The key to success, enabled by our Design Excellence Solutions, is a multidisciplinary development of systems that integrate hardware, electronics, software, and formulated components. Tie off risks and requirements and discover issues earlier by leveraging digital simulation to predict performance and optimize devices. Manage the complexity of change at every phase with agility, efficiency, speed and accuracy.

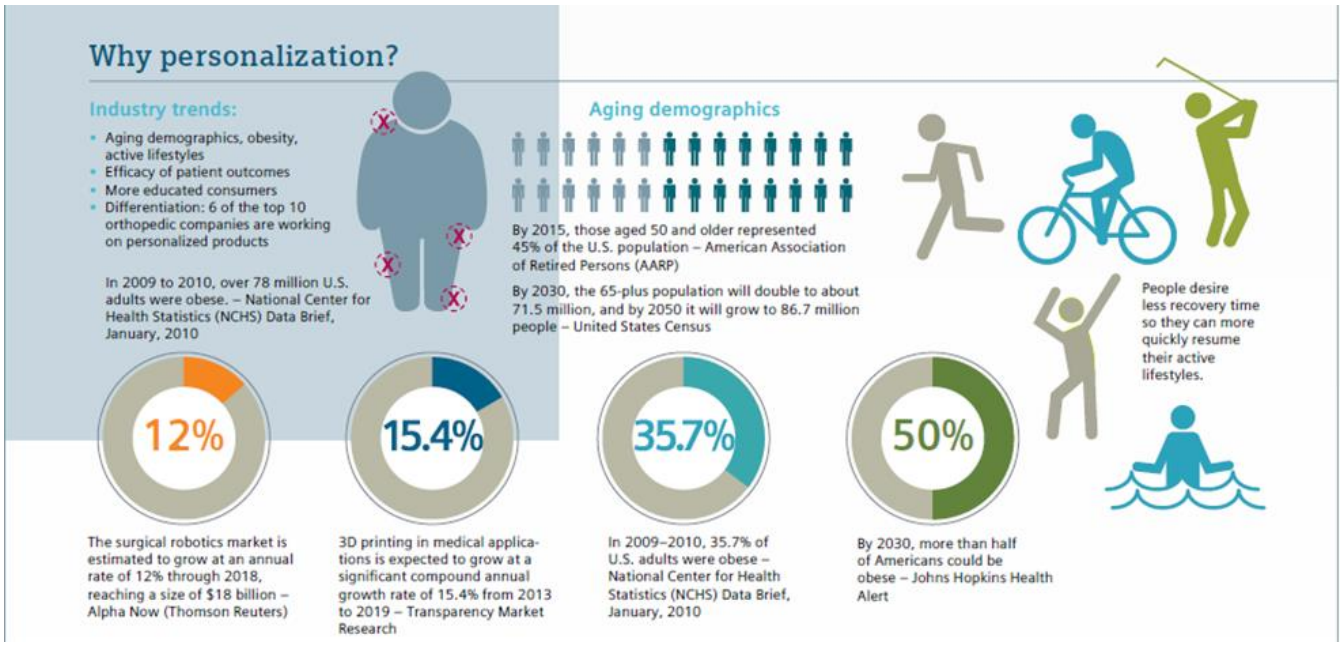


There has never been greater opportunity to innovate in the design of medical devices. Advances in software and electronics enable smart, interconnected devices that promise improved user experience and effectiveness. Combined biochemistry and imaging advances that couple therapy, diagnostics, doctors, and patients increasingly rely on med-tech for better disease treatments.



The key to success, given these tailwinds, is to recognize that fundamentally new approaches to innovative development are needed. Rooted in decades of systems and model-driven engineering experience, our Design Excellence Solutions enable the multidisciplinary development of devices that are systems of systems – integrating hardware, electronics, software and formulated components.

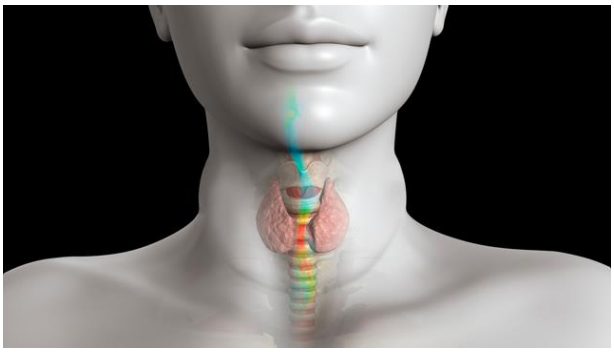
Our solutions help organizations avoid overlooking common problems by guiding the tie off of all risks and requirements, at all levels of detail, across all disciplines. You can discover new issues earlier, leveraging digital simulation to predict performance and better understand the intrinsic physics of your devices. Our solutions enable you to respond to issues and resultant changes, managing complexity at each phase of the development process with agility, efficiency, speed and accuracy.

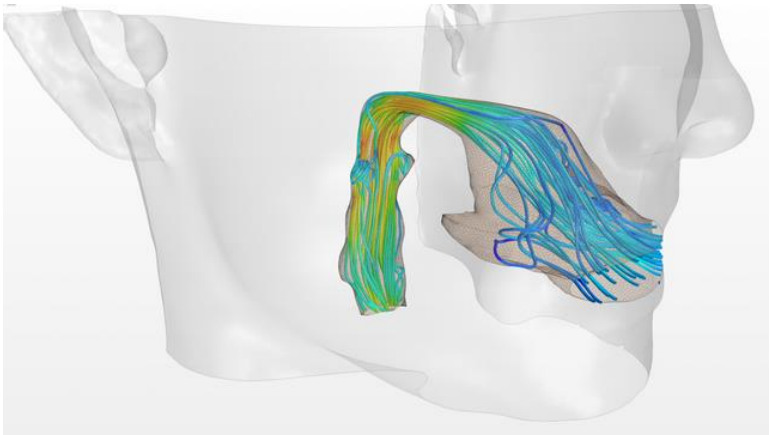


16.1.3 Simulation & Testing for Medical Devices

Simulation is playing an increasingly significant role in the development of medical devices, saving development costs by optimizing device performance and reliability, reducing benchtop tests and clinical trials, and helping to speed the regulatory approval process.

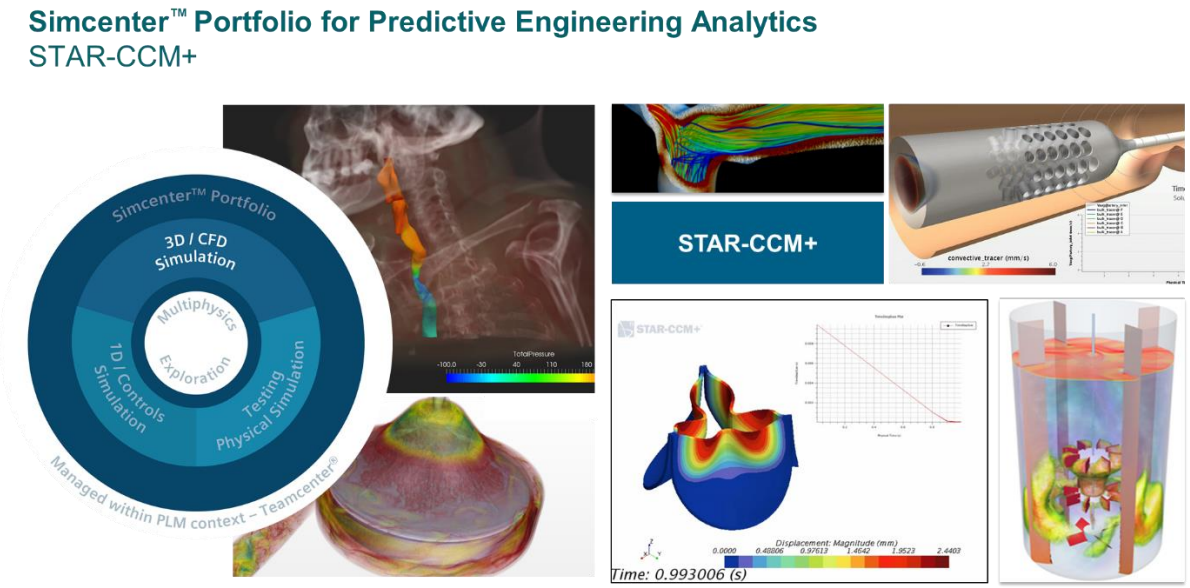
Developing increasingly complex medical devices requires increasingly capable tools for simulation and testing. Our deep portfolio of simulation and testing solutions allows medical device developers to generate digital evidence of device performance across a range of engineering disciplines, throughout the product life cycle.

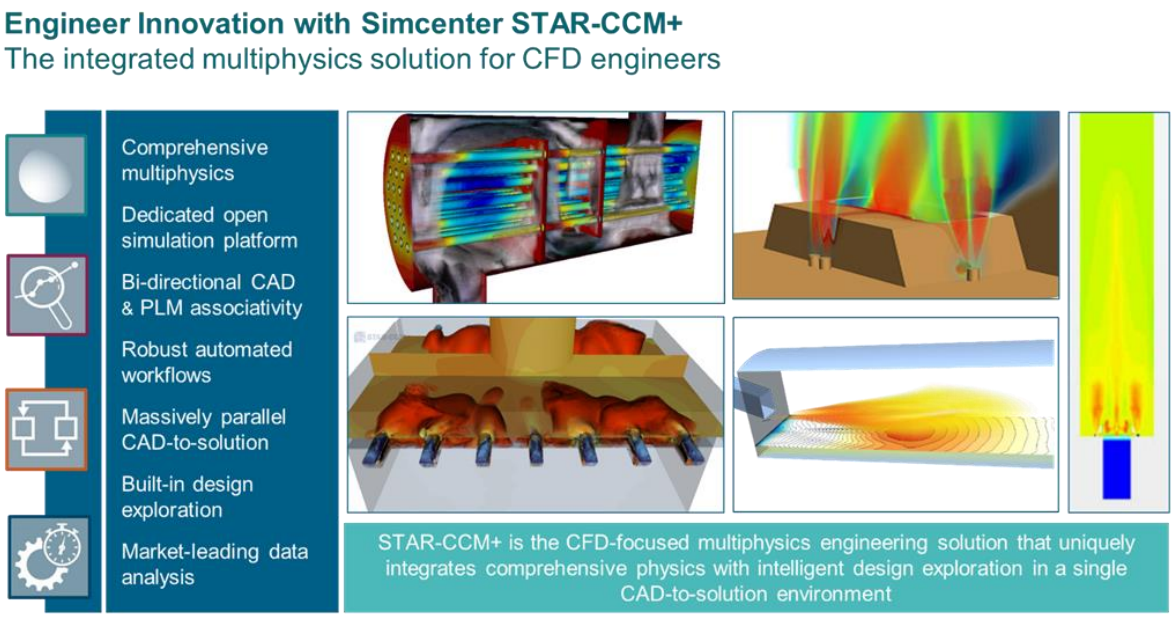


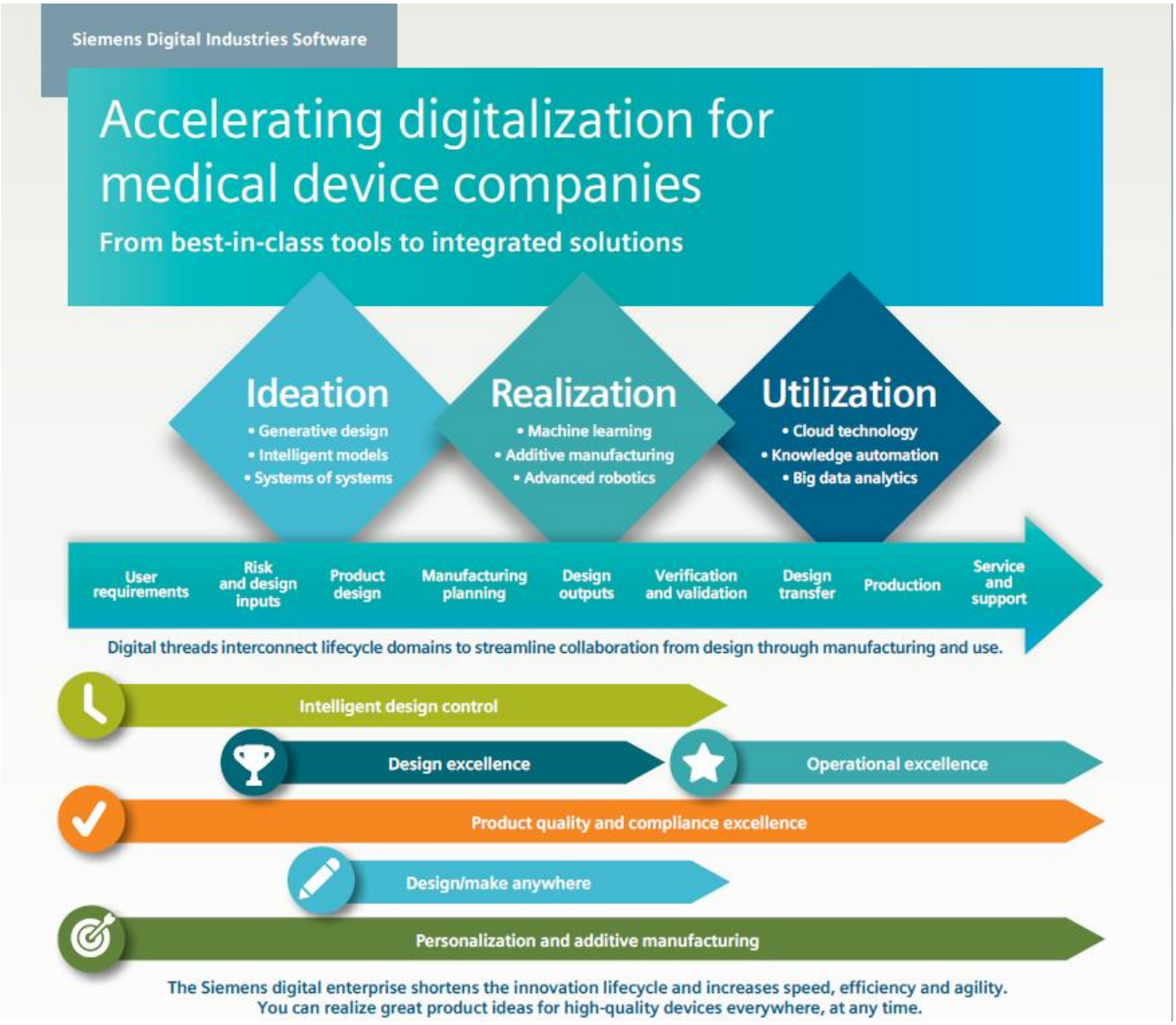


16.1.4 Design Analysis & Functional Performance

Simulation is already playing a prominent role in establishing product performance in the verification stages of device development. But it can also being used at every stage of the process, from concept development to design refinement and hand-off to manufacturing. Simulation and testing are not just important for generating objective evidence of device performance for regulatory agencies, they are foundational to good engineering practice.





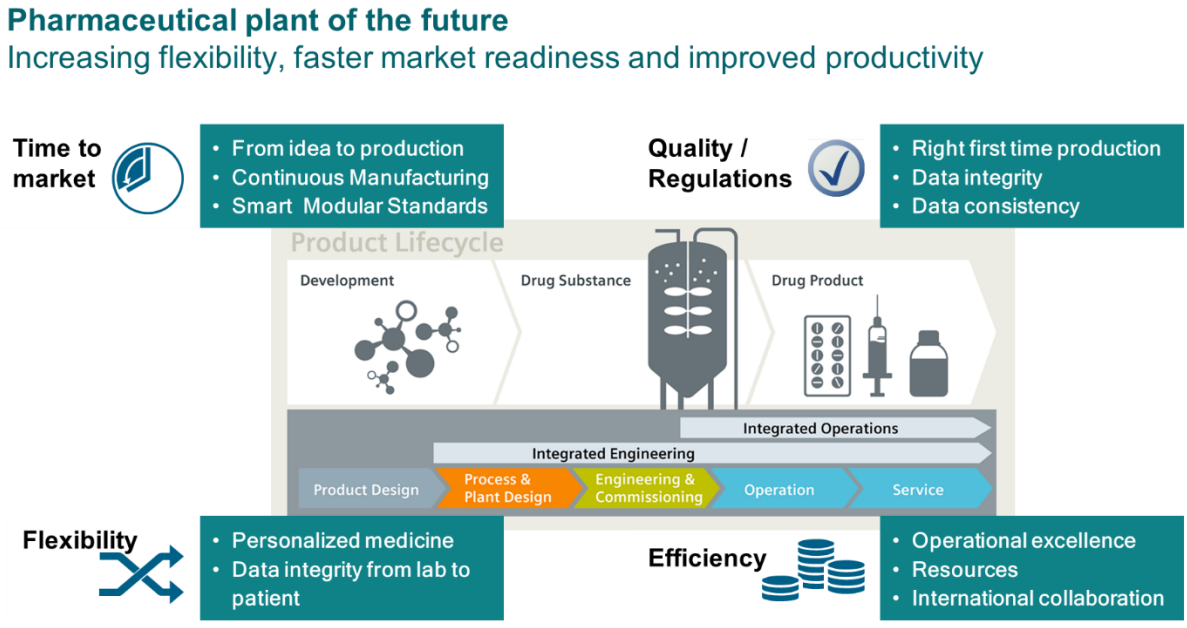


Medical device manufacturers need to accelerate the development of innovative, high-quality products that are easy for both medical professionals and patients to use safely and that fully comply with all relevant government regulations. Using Solid Edge® software from Siemens Digital Industries Software, medical device and equipment manufacturers can speed product development and perform virtual testing and analysis of designs to ensure that new products meet customer needs and regulatory requirements for high-quality, easy-to-use devices. They can also communicate better with suppliers, customers and regulatory bodies during the product development process, reducing the errors and delays that can prevent bringing new products to market in a timely manner. Faster introduction of high-quality products to the market results in increased cash flow and higher profit margins. Using Solid Edge improves product development performance for medical device manufacturers in these key process areas: Communicate new designs to potential customers Medical device manufacturers can significantly improve how they communicate designs to potential customers and regulatory bodies during the product development process, and sales staff can quickly convey the innovative features and ease-of-use of your

designs. Using Solid Edge makes that possible with the creation of rich 3D product information, including photorealistic images and animations.

The Solid Edge advantage:

- Combine the speed and simplicity of direct modeling with the flexibility and control of parametric design that is made possible with synchronous technology
- Use integrated Solid Edge Simulation analysis capabilities to ensure high performance, safety and product durability
- Model complex shapes using Solid Edge surface design capabilities
- Use advanced assembly design techniques to model equipment enclosures around electromechanical components and other subassemblies
- Integrate electrical and electronic components into equipment using Solid Edge XpresRoute software cable routing capabilities
- Demonstrate compliance with government regulations with secure document vaulting and electronic workflow management with signoffs
- Create attractive product images and animations that communicate innovative designs to potential customers



17 CNC Controller lab

Highly qualified personnel are a decisive success factor in the metalworking industry – now more than ever. This results in a high degree of responsibility for you as teacher or instructor, since it is your task to convey the corresponding expertise – through optimized, practice-oriented training.

This is especially true when it comes to CNC manufacturing, where the market requirements with regard to quality, adherence to deadlines and variety of variants are increasing continuously. Innovative, efficient and holistic solutions are demanded – solutions with which the trainees can be optimally prepared for their task quickly and efficiently.

Table 3 Siemens Sinumerik Training Racks

S. No.	Training kits	Benefits
1	Sinumerik 808D – Mill & Turn Sinumerik 840D SL Simutrain	• CNC programming simulator kit • Learning of Turning & Mill programming • Hands on CNC service and maintenance training can be undertaken • PLC programming training can also be undertaken • Drive commissioning can also be undertaken.

The training advantages:

- Control emulating training software for the PC
- DIN-compliant programming and ShopMill/ ShopTurn programming
- Simple programming with integrated online help
- Trainee locations can be linked to form a didactic network
- Optional linking to a CAD system for rapid program creation
- Import of machine tool geometries for fast program creation
- Option “virtual machine for training” for 3-D visualization of the machining process
- Realistic keyboard with original layout.

S. No.	Items
1	Siemens Sinumerik 808D – Milling Controller
2	Siemens Sinumerik 808D – Turning Controller
3	Siemens Sinumerik 840D-SL CNC Controller
4	Siemens Sinutrain

	Technical Specification
1	**808 – PPU 151 – Turn & Mill** • PPU151 • Electronic Handwheel • Tool box • MCP for SINUMERIK 808D

	• 840D Emergency Push Button • Contact Block with 1NO + 1NC
2	**840D SL** • SINUMERIK; 840D sl; NCU 710.3BPN with PLC 317-3PN/DP • SINUMERIK Operate, 4.7 SP2, CF with license • CNC software (toolbox), CD/DVD • Axis/spindle, each additional (A01) • Operation, SINUMERIK Operate on NCU (S00) • Residual material detection and machining for contour pockets (P13) • Machining step programming and multiple clamping of (P17) • Simultaneous recording (real-time simulation of current machining) (P22) • 3D simulation 1 (finished part) (P25) • OP 08T TCU integrated (membrane keys, 640x480 pixels) • MCP 310C PN (mechanical keys, width 310 mm) • Round 40 mm mushroom pushbutton activation element (Emergency stop) • Switching element with 2 switching contacts • Spindle / rapid traverse override rotary switch • Handwheel with front panel 76 mm x 76 mm • I/O module PP 72/48 PN • DRIVE-CLiQ cable; DRIVE-CLiQ cable (by the meter) IP20/IP20 ; 1.00 m • DRIVE-CLiQ cable; DRIVE-CLiQ cable (by the meter) IP20/IP20 ; 5.00 m • DRIVE-CLiQ cable; DRIVE-CLiQ cable (by the meter) IP20/IP20 ; 3.00 m • SITOP smart 20.00 A **Drive system / Supply system** • Smart Line Module; 5.00 kW • Double Motor Module; 3.00 A • for the following axes: Axis1 + Axis2 • Double Motor Module; 9.00 A • for the following axes: Axis3 + SPDL • Line choke **Axis1 / Drive system / Supply system** • Motor supply cable; SPEED CONNECT MC500 without brake cable; 3.0m • DRIVE-CLiQ cable; DRIVE-CLiQ cable MOTION CONNECT 500 IP20/IP67 ; 3.00 m • Synchronous servo motor (feed motor) 1FT/1FK; 0.82 kW; Shaft height 48 mm **Axis2 / Drive system / Supply system** • Motor supply cable; SPEED CONNECT MC500 without brake cable ; 3.0 m • DRIVE-CLiQ cable; DRIVE-CLiQ cable MOTION CONNECT 500 IP20/IP67 ; 3.00 m • Synchronous servo motor (feed motor) 1FT/1FK; 0.82 kW; Shaft height 48 mm **Axis3 / Drive system / Supply system** • Motor supply cable; SPEED CONNECT MC500 with brake cable ; 3.0 m • DRIVE-CLiQ cable; DRIVE-CLiQ cable MOTION CONNECT 500 IP20/IP67 ; 3.00 m

	• Synchronous servo motor (feed motor) 1FT/1FK; 0.82 kW; Shaft height 48 mm **SPDL / Drive system / Supply system** • Motor supply cable; MOTION CONNECT 800 PLUS without brake cable (trailing-type); 3.0 m • External fan supply cable; SPEED CONNECT MC500 without brake cable ; 3.0 m • HTL_Signal cable 3 mtr • 1PH8 induction motor / synchronous motor; 2.80 kW; Shaft height 80 mm • SMC30 • Drive Clique cable 0.6 mtr • Adaptor cable

SinuTrain Software

SINUMERIC 808D

SINUMERIC 840D SL

Interfacing with the software:

The CNC controller can be interfaced with the MCD Module of the Product Digitalization lab to learn & create CNC Programs and validate the Machine operations and parameters. The students can learn how to program and test the CNC Program. The Lab also focus on the usage and functionality of HMI for diagnostics and troubleshooting. Has a rack to explain how CNC Programs control the Drives and Motors.

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December 20th, 2024

To,

The Registrar,
SRM University Sonipat,
Haryana (India)

Subject: Industry-Academia Collaboration: SRM University Sonipat & ACMA

Dear Sir,

The Automotive Component Manufacturers Association of India, ACMA, the apex body representing the interest of the auto component manufacturing industry in India. ACMA is focused on enhancing the interest of its members and automotive ecosystem nationally and at global platform. It aims to address challenges and leverage opportunities within the evolving mobility landscape. ACMA works collaboratively to drive innovation, skill development, sustainability, and community welfare. ACMA has vision to enable a transformative future for the Indian automotive industry by fostering innovation, enhancing skillsets, promoting sustainability, and ensuring inclusive growth. ACMA has funded and set up a Centre of Excellence (CoE) which is dedicated to the industry and focused to fill the skill gaps. Vide MoU dated August 2023, the ACMA's Centre of Excellence is operational inside the campus of SRM University, Sonipat since November 2023.

The Centre of Excellence (SAKSHAM) is equipped with state-of-the-art training facilities to bridge the gap between industry and academia. The initiative focuses on Mechatronics, Design, Electric Vehicle (EV) and Sustainability Laboratory to provide specialized training for industry professionals, students, and faculty members.

CoE represents a significant step forward in skill development and innovation, with an investment of Rs 8 crores dedicated to advanced machinery and an additional Rs 2 crores allocated for interiors and beautification to ensure a modern and conducive learning environment.

ACMA envisioned and created this platform where industry and SRM University Sonipat will collaborate to build future-ready talent. We believe this Centre of Excellence will not only address existing skill gaps but also foster innovation and growth for the industry and SRM University, Sonipat at large.

Sincere Regards,

Dinesh Vedpathak
CEO-Technology & Industrial Competitiveness
ACMA