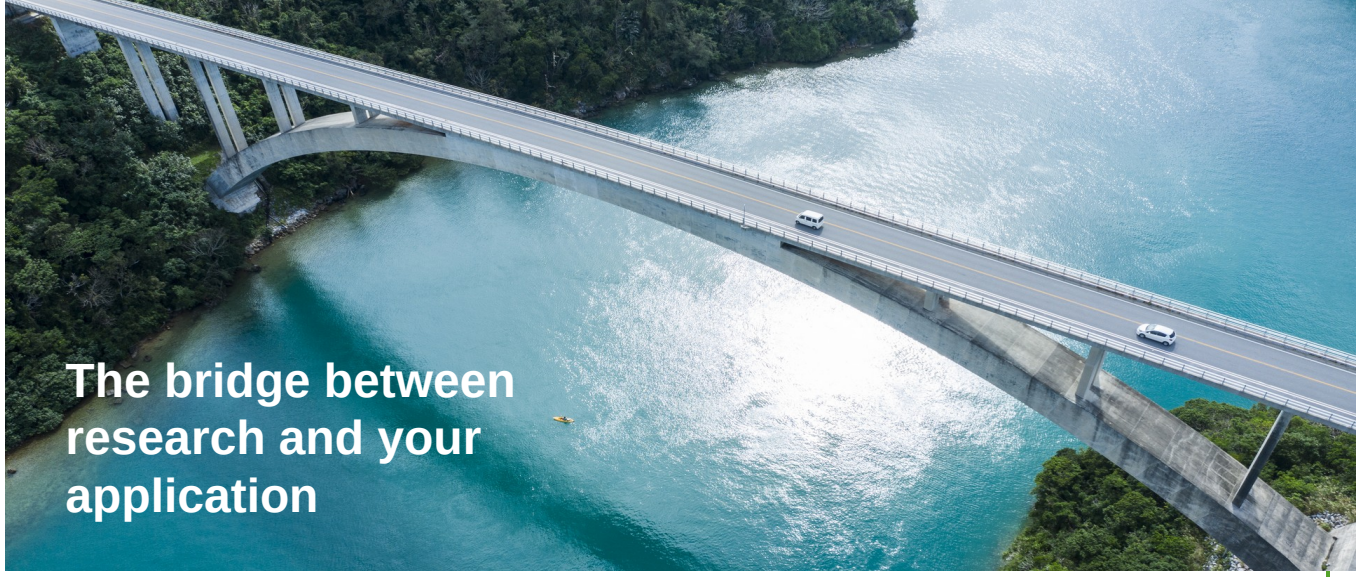




invite
- innovations
- visions
- technologies

Drug Delivery Innovation Center

DDiC
Drug Delivery innovation Center

Info Package, September 2026

2018 | 2019
INNOVATIVE
THROUGH RESEARCH
Awarded by the
Stifterverband
INV2413LEV

Drug Delivery Innovation Center

Goals & Basics

The DDiC was founded in 2017 to become a world-class Center of Excellence dedicated to address the most relevant challenges in pharmaceutical industry

- Drug delivery & poor bioavailability
- Modeling & Prediction
- Drug formulations for biomolecules
- Sustainability research
- Process engineering
- Smart automation

The DDiC is based on partnership and close collaboration between

- academia
- industry
- public stakeholders

Drug Delivery Innovation Center

Background

- **Drug Delivery Innovation Center (DDiC)** aims to bridge basic research and industrial applications in pharmaceutical technology
- **The DDIC** is an **open consortium** with
  - **Tier 1 members** being research-driven pharmaceutical companies,
    currently: Bayer AG, Johnsson & Johnsson Innovative Medicine, Merck KGaA*
  - **Tier 2 members** providing materials, equipment, software, and know-how to support projects
  - **Academic partners** ensuring scientific excellence (TU Dortmund, HHU Düsseldorf as founding members)
- **INVITE GmbH**, located in the CHEMPARK Leverkusen, Germany, **leads the consortium and builds the legal frame**.
- We are looking forward to **discuss the opportunities of the DDIC with new members**.

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*known as Merck KGaA at Darmstadt, Germany, in the US and Canada

Vision and Mission

Drug Delivery Innovation Center (DDiC)

- **DDIC leverages leading academic and industrial partnerships to accelerate innovation in drug delivery through collaborative, international, and multi-disciplinary research.**
- **Science**
  - Advance pharmaceutical innovations through ***pre-competitive research*** and close collaboration within multidisciplinary academic and industrial networks.
  - Generate ***process understanding*** as the foundation for predictive modelling, advanced process control, and data-driven pharmaceutical manufacturing.
- **Education**
  - Develop ***highly qualified talents*** for industry partners, e.g. with a unique doctoral training environment
  - Strengthen ***next generation of pharmaceutical scientists*** by supporting the Master's program in Industrial Pharmacy at HHU Düsseldorf
- **Products & Innovation for Patients**
  - ***Translate science into innovations & technologies*** to improve patient's life

DDIC – a partnership network

Benefits for partners

A strong global *partner network* provides the foundation for *scientific excellence*, high level in *education*, and *talent development* that meets the evolving needs of the *pharmaceutical industry*



Network of leading research institutes across disciplines to address complex pharmaceutical challenges

Pharmaceutical industry

Accelerate access to proprietary technologies through collaborative pre-competitive research

Equipment manufacturer

Demonstrate new technologies for manufacturing, analyzing and improving pharmaceutical products to 'Big Pharma'

Pharmaceutical suppliers

Introduce excipients, materials, drug delivery technologies or software to accelerate product development

DDiC Research Clusters

DDiC defines 9 research clusters

Research clusters cover a broad spectrum of pharmaceutical science and technologies

	Research Cluster
1	Low solubility / Poor bioavailability of oral drugs
2	Drug delivery forms for special patient groups / Personalized medicines
3	Continuous processing
4	Fundamental process understanding / PAT / Scalability
5	Models for predicting biopharmaceutical properties
6	Drug formulations for biomolecules (focus: mAbs and ADCs)
7	Nanomedicines / Nanotechnologies
8	Sustainability Research
9	Lab automation

Innovative solutions

Current challenges in the pharmaceutical industry

Drug delivery & poor bioavailability	■ Overcoming poor bioavailability with non-standard formulation like amorphous, nano or 3D-printing ■ Drug Delivery for special patient groups (pediatrics & geriatrics)
Drug formulations for biomolecules	■ Advance formulations for biologics, peptide delivery, ADC, mAb ■ Drug delivery for cell-based / gene therapy
Process engineering	■ Down-scaling (equipment & processes) or continuous processing ■ Advanced Process Understanding (incl. Design Space, Scalability and PAT)
Modeling & Prediction	■ Rationale formulation design / pharmaceutical material science / biopharmaceutical properties ■ Process modeling / simulation /predicting (AI-assisted process optimization and scale-up)
Sustainability research	■ Sustainable packaging of pharmaceuticals ■ Green chemistry
Smart automation	■ Robotics lab: Mobile lab robotics, AI supported automated processes ■ Digitalization, automation, smart lab infrastructure

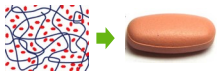
Completed Research Projects

Jointly with HHU Düsseldorf, TU Dortmund, LMU Munich

DDiC Drug Delivery innovation Center

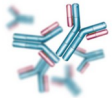
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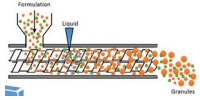




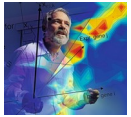
doi.org/10.1016/j.apsb.2013.11.001







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Topics for Doctoral Theses (2017 – 2020)

8 Doctoral Dissertations: 5 oral, 3 parenteral

Amorphous solid dispersions (ASD)
- stable oral dosage forms
- hot melt extrusion

Individualized medicine
- implants, inserts

Biopharmaceuticals
- high concentration, low viscosity

Continuous manufacturing
- granulation
- in-silico modelling & exp. verification

Topics for Doctoral Theses (2021 – 2025)

8 Doctoral Dissertations : 6 oral, 2 parenteral

Amorphous solid dispersions (ASD)
- fate in GI-tract
- kinetic of drying, QC

Special patient groups
- 3D-gel printing for early clinical supply
- ped. formulation develop. & modelling

Biopharmaceuticals
- amino acid derived amphiphiles for stabilization & release
- inhaled mRNA delivery

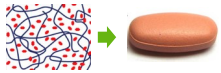
In-silico modeling
- hot melt extrusion
- PBPK-modelling

PBPK: Physiologically based pharmacokinetic
M&S: modelling & simulation

Current Research Projects

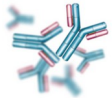
Jointly with academic and industrial partners

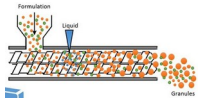




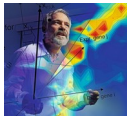
doi.org/10.1016/j.apsb.2013.11.001







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Topics and projects since 2025

Doctoral Dissertations: 2
BSc and MSc Thesis: 2
PostDoc: 1

Strain Rate Sensitivity Tabletablity (BSc)

– Rate-Dependent Modeling of Tableting Processes

technische universität dortmund

Continuous wet granulation (PhD)

– Process understanding & PAT Strategy for Conti Wet Granulation

GHENT UNIVERSITY

Johnson&Johnson Innovative Medicine

Multi attribute methods (MAM) for Biologics (PostDoc)

– Development and Implementation of MAM LC-HRMS Workflow for Biotherapeutics

QC ASD Dissolution methodology (PhD)

– discriminatory QC dissolution method development for amorphous solid dispersions

UNIVERSITÄT BONN

AI based HPLC peak detection (BSc)

– Identification of the smallest peaks and individual events in the mass spectrum using machine learning

technische universität dortmund

MERCK

Industry

Network of Current Partners

Current status of DDiC members

- **Tier 1**
  - Bayer AG
  - Merck KGaA
  - Johnson&Johnson Innovative Medicine (Janssen N.V.)
- **Tier 2**
  - Ashland Industries Deutschland GmbH → Excipients
  - Bohle Maschinen & Verfahren GmbH → Manufacturing Equipment
  - DFE Pharma → Excipients
  - DigiM (SME) → Digital Images
  - INOSIM Software & Consulting GmbH (SME) → Production Process Simulation
  - Nisso Chemical Europe GmbH → Excipients
  - Parsum GmbH (SME) → Inline Particle Size Measurement
  - Phoenix Contact → Electronics and Automation
  - Physiolution GmbH → GI-tract Simulated Dissolution, SME
  - Siemens AG / PSE Enterprise → Digital Twins
  - Syntegon → Manufacturing Equipment

Academia

Network of Current Partners

DDiC Drug Delivery innovation Center

invite

Heinrich Heine Universität Düsseldorf
Prof. Dr. J. Breitkreutz
Jun.-Prof. Dr. M. Hacker
Prof. Dr. K. Wohlgemuth

Ghent University
Prof. Dr. T. de Beer

technische universität dortmund
Prof. Dr. G. Schembecker
Prof. Dr. M. Thommes
PD Dr. C. Brandenbusch

SDU
Prof. Dr. M. Brandl

LMU Ludwig-Maximilians-Universität München
Prof. Dr. O. Merkel
Prof. Dr. W. Friess

Universität Bonn
Prof. Dr. K. Wagner

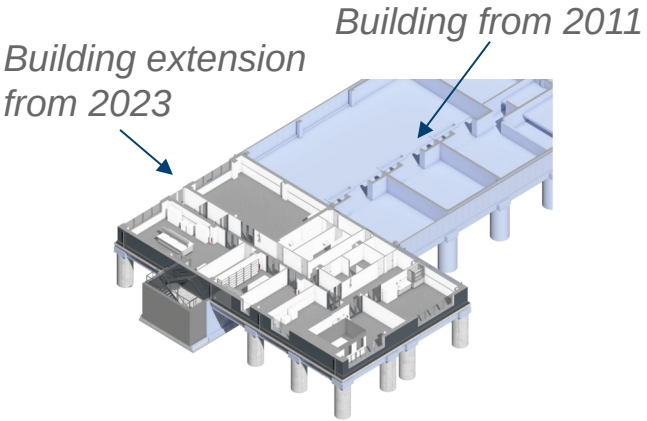
Lab facilities open for members

INVITE and university

Currently available facilities at INVITE with new lab and pilot plant facilities

- 3 labs with ~70 m² for handling active ingredients of **OEL 3**
- Additional lab area of ~600 m² for handling active ingredients up to **OEL 4**

Further facilities at partner university labs





GERTEIS Roller compactor

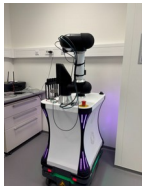


SOTAX Dissolution



SYNTEGON Xelum R&D





uMobile Lab Robot



AGILENT UHPLC

DDIC Membership Concept

Two options to become a member

Trial membership possible

Tier 1

50 k€ p.a.

- Member of Scientific Board (SB)
  - *Definition of research topics at DDIC*
- Full access to Technical Committees (TC)
  - *PhD program review*
  - *Steering the content of running theses*
- PhD mentoring
  - *Individual projects possible*
  - *Test field with your own materials*
- Free technical licenses to IP
- Opportunity to use INVITE facilities
- 30 k€ voucher for projects
- Further: All rights being granted to Tier 2 partners

Tier 2

in-kind contribution

- SB: One representative of all Tier 2 partners
- For projects with material contributions
  - *PhD program review in TCs*
  - *Test your product in a highly visible environment*
    → Results are later part of publications
  - *Royalty-bearing licenses*
- Access to
  - *DDIC report data base, publications*
  - *DDIC facilities*
  - *Talent pool*
    → observe your future employee over a long period of time
  - *Public funding consortia, Partner network*
  - *Technology trends*
- Preferred partner for community

Executive Summary

- **DDiC** connects leading academic institutions, pharmaceutical companies, and technology partners in an international, multi-disciplinary **drug delivery innovation network**.
- **DDiC** bridges scientific research and industrial application to **accelerate proprietary pharmaceutical innovation**.
- **DDiC** strengthens pharmaceutical education (*Industrial Pharmacy* master's and PhD programs). It provides its partners with a valuable **pool of young talents** that has been monitored over an extended period of time.
- Located at INVITE and CHEMPARK Leverkusen, **DDiC** provides access to state-of-the-art **infrastructure** and a unique **collaboration platform** across the pharmaceutical value chain.

Contact: INVITE GmbH, **Dr. Jan-Olav Henck**
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DDIC

Summary of benefits to its members

- Access to the Open-Innovation Platform at INVITE with a unique network of partners along the pharmaceutical value chain
- Unique opportunity to work on pharmaceutical and process engineering issues simultaneously and jointly with recognized university chairs
- Shape technology development in the area of drug delivery with partners in academia and industry in a pre-competitive environment
- INVITE offers the capabilities and experience (e.g. F3-factory) to set-up and successfully run publicly funded projects. Partners of DDIC will have the opportunity to join the (international) consortia for these projects
- First-hand insights into all joint research projects (20-30 PhD and master programs in steady state envisioned together with partner universities), thus substantially increasing return on own research investment
- Option to run proprietary research projects as part of on-going PhD-studies or as separate PhD-studies with option to use Invite facilities
- Temporary staff exchange (to DDIC or from DDIC to company) for training and development of new capabilities.
- Access to talents (i.e. graduates of PhD and master programs)
- Technical non-exclusive, world-wide license to IP developed at the DDIC