

bausa:

Federal Institute for Occupational
Safety and Health

BAuA research project

SysDEA

Systematic analysis of dermal exposure to
hazardous chemical agents
at the workplace

Overview and experimental concept

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Unit 4.1 "Exposure Scenarios"

Contractor SysDEA Project



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Outline

- **Motivation**
- **Objectives of SysDEA**
- **Project overview**
- **Timeline**
- **Execution**
- **Project Expert Committee**

Occupational dermal exposure – current status

- Risk assessment for chemicals is one of the main regulatory tasks for Occupational Safety and Health
- Dermal occupational exposure can have a high human health impact
- Experiences from REACH and Biocides Regulation → Health risks of dermal exposure comparable to risks via inhalation exposure
- Suspected skin diseases as main part (32,5% in 2014) of notified suspected cases in Germany → comparable to EU
- Extensive inhalation exposure measurement data are available
- Inhalation exposure assessment is much better scientifically elaborated as for dermal exposure

Motivation

- Need for all stakeholders (Industry, NGOs, Authorities) to state occupational dermal exposure determination more precisely
- Need for method development
- Partly only qualitative dermal exposure assessment available
- Improved scientific justification by means of bigger collectives of dermal exposure data → less conservative exposure assessment feasible
- Strengthened basis for dermal exposure to reduce uncertainties

Determination of dermal exposure – challenges

Issues to be addressed by future research on dermal exposure:

- Measuring methods for occupational dermal exposure are currently not harmonized
- Scientific studies are missing concerning the evaluation of significance and applicability for existing measurement methods
- Need for detailed examination to what extent a measurement method takes into account the physical and chemical properties of the individual hazardous substance
- Lack of comprehensive systematic studies applying consistent/comparable methods to measure dermal exposure
- **WHO-Paper: “Environmental Health Criteria 242 (2014) - Dermal exposure” → gives partly similar recommendations**

Goals of the SysDEA research project (I)

Generation of a data collective on occupational dermal exposure by means of systematic investigations in test rooms.

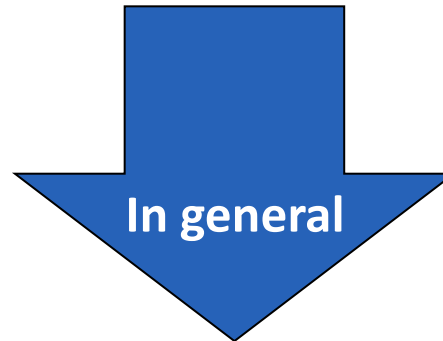
As a basis for:

- Characterisation of different measurement methods
 - ➔ strengths and weaknesses
 - ➔ if possible conversion factors

- An advanced assessment basis for risk assessment for chemicals
 - ➔ minimization of uncertainties

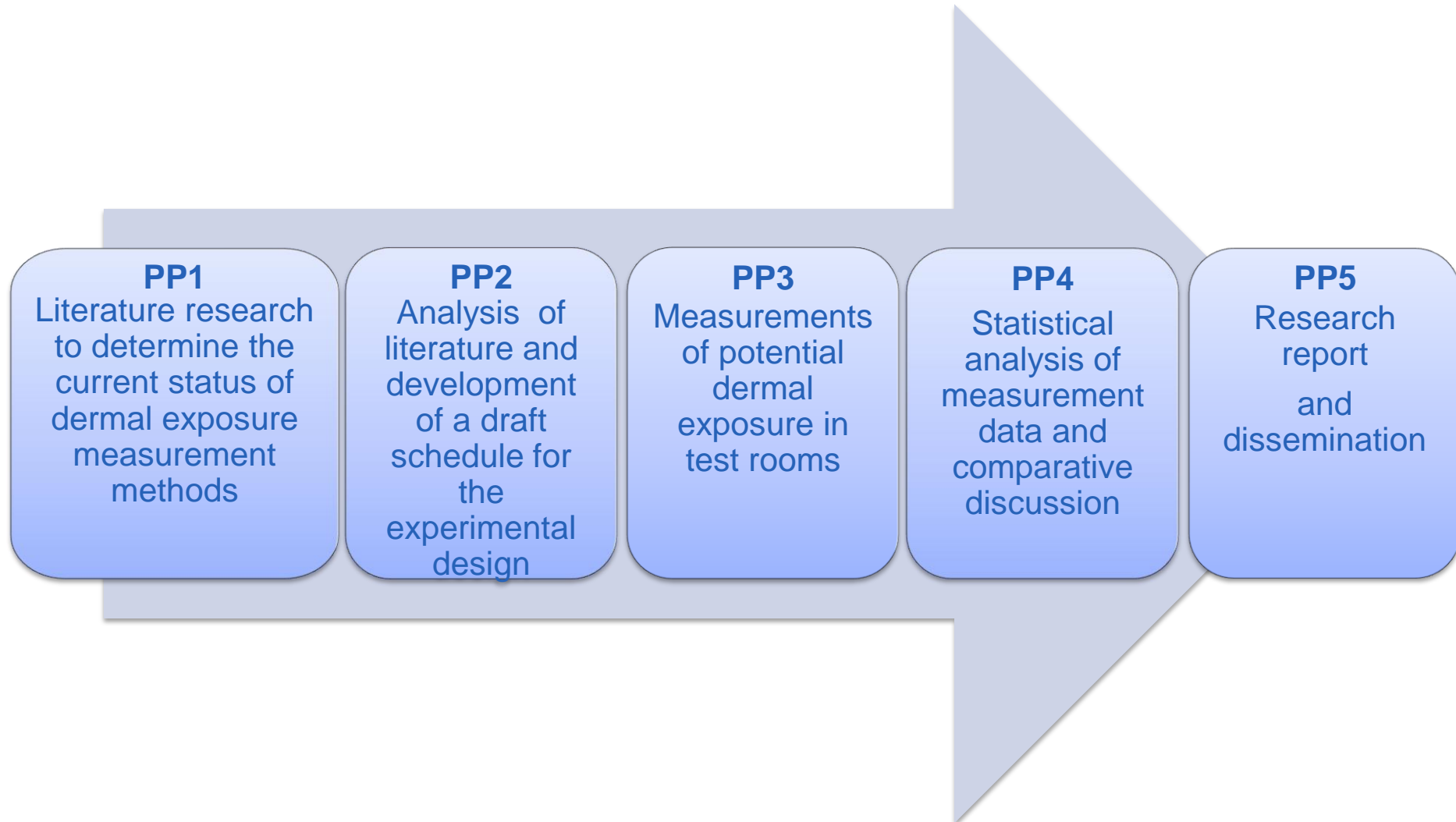
Goals of the SysDEA research project (II)

Utilize data for further development of dermal exposure assessment tools



Generation of scientific knowledge to improve and standardise measurement/assessment methods for dermal exposures to chemicals at the workplace

Project overview



Facts and figures

- **Project start:**

01.01.2014

- **Timeline:**

2014 – 2018

- **Project-Phases:**

PP 1: 01/2014 - 12/2014

PP 2: 01/2015 - 03/2016

PP 3: 04/2016 - 06/2017

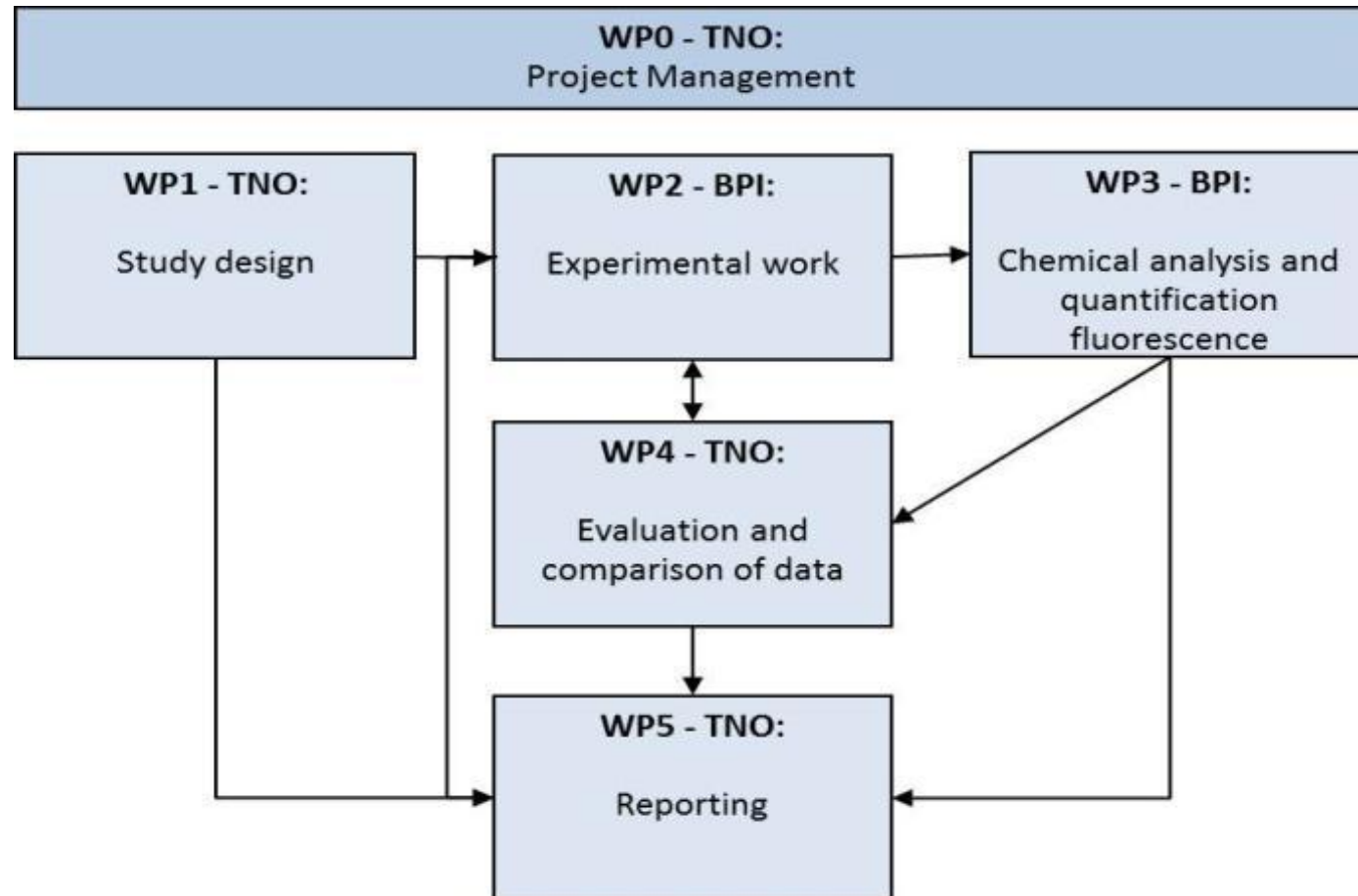
PP 4: 06/2016 - 07/2017

PP 5: 07/2017 - 04/2018



Project organisation

Project Phase **3-5** are subdivided into 5 work packages



Measurement methods in the frame of SysDEA

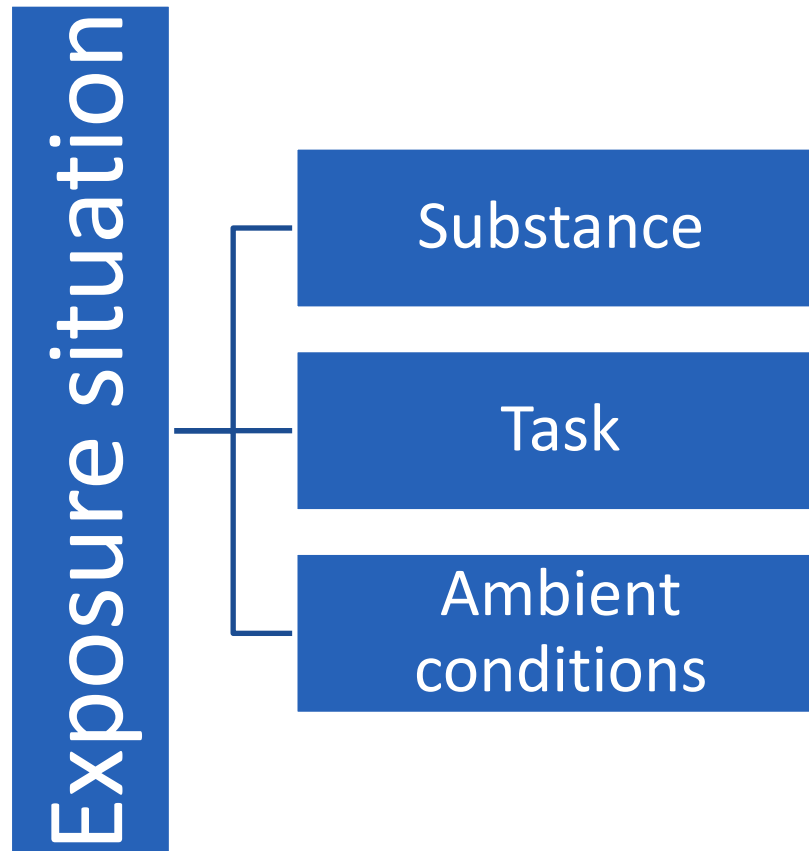
interception techniques	patches
	overall (e.g. Tyvek®)
	glove method
Removing techniques	wiping method
	rinsing method (hands)
In-situ techniques	Detection via UV-fluorescence or tracer by means of video imaging



green: hands blue: body orange: body + hands

Procedure (I)

Quantification of dermal exposure by various measurement methods for different exposure situations



Procedure (II)

Dermal exposure of volunteers performing selected tasks under defined and standardised conditions is to be measured in test rooms with liquid and solid test substances by different measurement methods.

Determinants to be standardised :

- Physical data
- Room size and room geometry
- Substance properties: viscosity, dustiness
- Execution of each individual tasks



Test chambers
at BPI premises

Substance selection criteria

The substances to be selected must not be harmful to the user

Substance shall be fluorescent itself or miscible with a fluorescence tracer

Three types of test substances:

- high viscosity liquid
- low viscosity liquid
- dusty solid

Current proposal is to also test order of dustiness using dustiness tests to know the exact dustiness of the solid substance used

Selected tasks

Main selection criteria for tasks to be investigated:

- Tasks shall cause a significant dermal exposure
- Tasks shall be relevant for exposure assessments in the context of chemical regulations (e.g. REACH and Biocides)

Task group	Product and activity
A. Transfer	1. Dusty solid - Dumping
	2. Low viscosity liquid - Pouring
	3. High viscosity liquid - Pouring
B. Spreading	1. Low viscosity liquid - Rolling
	2. High viscosity liquid - Rolling
C. Spraying	1. Low viscosity liquid - Surface spraying
	2. High viscosity liquid - Surface spraying
D. Immersion / dipping	1. Low visc. liqu. - Manually handling immersed objects
	2. High visc. Liqu. - Manually handling immersed objects
E. Handling of objects	1. Dusty solid - Handling a contaminated object

Controlled ambient conditions

The main exposure determinants shall be measured and documented for each measurement:

- **details of the task execution**
 - working time, exposure time
 - specifics or anomaly during task
 - information about the emission source
 - distance between operator and emission source
 - number of emission sources
- **climatic conditions**
 - (room) temperature
 - humidity
 - atmospheric pressure
- **details about the technical risk management measures**
 - kind of ventilation
 - flow conditions

Training of volunteers

Precautions that all experiments are performed as reproducible as possible → reach a high level of standardisation.

- Exposure situations designed relatively short (max. 30 min) and easy to conduct
- Volunteers will receive a proper instruction on exactly how to perform the activities
- Training concerning the dermal sampling methods explaining the role of the volunteers with regard to the dermal sampling methods
- Documentation of instructions

Pre-testing Phase

Validation / calibration of the different measurement methods with regard to:

- Repeatability / reproducibility
- Linearity (including possible leveling off after a certain loading)
- Differences between different ways of applying the formulations
- Determining background levels
- Determining the detection limit

Fluorescence Measurements - System requirements

Lighting has to be as diffuse as possible

- Intensity in camera image of known fluorescent object independent of position and rotation.

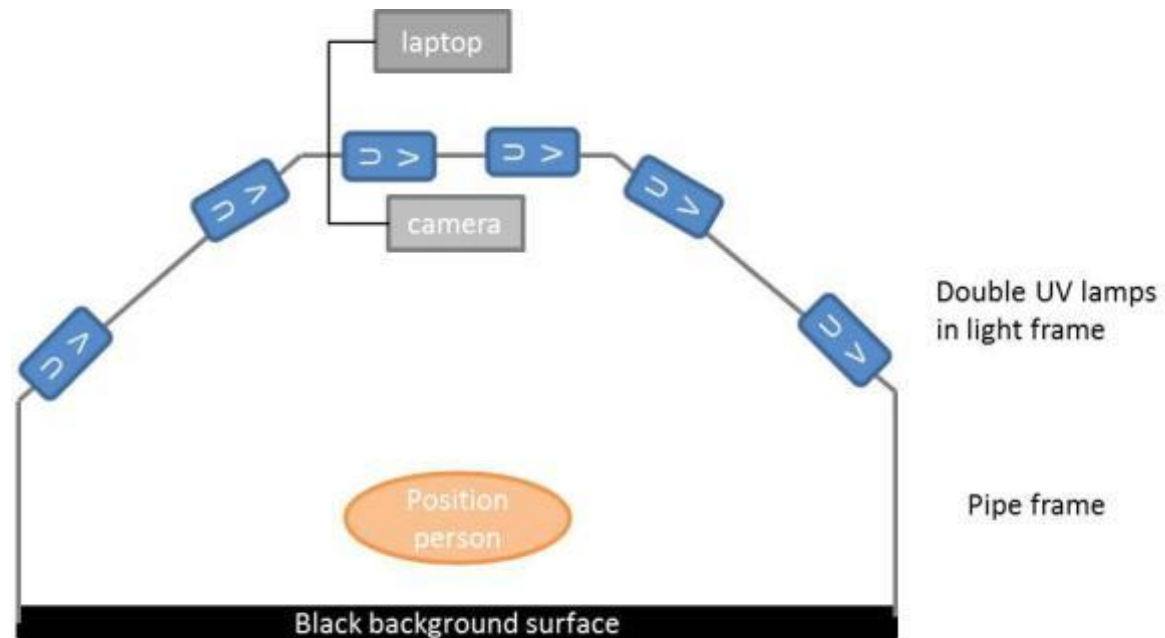
Camera pixel values should be linear to intensity of light

- Due to image processing on camera normally not linear
- Processing raw images using - **dcraw utility** - → linearity is possible

System set-up:

- 6 UV-lights in a half-round
- Control camera by laptop/PC

Optimisation Experimental Setup - Fluorescence Measurements



Adaption procedure focusses on:

- Optimisation shutter time, diaphragm, ISO-values
- Ideal placing of reference objects
- Positioning of UV-sources → Angle and height dependency
- Practical issues:
 - Step stones for volunteers to assure same position
 - making sure that the set-up does not get contaminate

Rolling → potential exposure



Scientific Discussion

Scientific questions arising in the course of the SysDEA project will be discussed with experts on dermal exposure to evaluate the scientific outcome by means of

- Written procedure
- Informal workshops

In 11/2015 the final installment of the informal project scientific committee with experts from Employers' Liability Insurance Association, industry and science was performed

Project scientific committee

The final committee now consists of

- Dr. K. Galea, Head of exposure science section, Institute of Occupational Medicine (IOM)
- Prof. Dr.-Ing. Udo Eickmann, Institution for Statutory Accident Insurance and Prevention in Health and Welfare Services (BGW), Department Hazardous Substances / Toxicology
- Jan Urbanus, Team Lead Exposure Science, Risk Science Team, Shell Health
- Prof. Dr. rer. nat. Thomas Göen, IPASUM-Institute and Outpatient Clinic of Occupational, Social and Environmental Medicine of the University of Erlangen-Nuremberg

Thank you for your attention



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