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VI-TRAIN
VIrtual TRAINing for traditional crafts

IO 4: Virtual Building Damage Identification Training

VI-TRAIN-Crafts - VIrtuell TRAINing for traditional Crafts

Reference number: 2020-1-AT01-KA226-VET-092635

Final results

Provided by:

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UBW GmbH
Vienna, November 2023

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Content

Tables

Figures

1. WHAT IS THE VI-TRAIN-CRAFTS PROJECT ABOUT?

Cultural Heritage (CH) is in the focus of the European Union as motor for employment, economic drive and development. In order to guarantee longevity & usability of European Heritage it is inevitable to keep up with the requirements of society like new technology and digitisation.

The Covid19 crisis added some urgency to the issue as training organisations strongly suffered from restrictions and new rules, which were threatening traditional education and training activities. Especially in regard to hands-on-training, where instructors need to get really close to learners to teach practical skills.

The consortium of VI-TRAIN Crafts has taken the challenge of developing innovative training for traditional/threatened crafts and handling of building damages, which will boost the digitization of training in (built) Cultural Heritage. A big focus is given to crafts that are almost nowhere trained any more. Lots of those crafts do need a lot of experience and guidance by experienced craftspeople. This training in particular will be boosted by various digitisation support.

The anticipated objectives of VI-TRAIN Crafts were:

- to identify appropriate means of distance learning for the training of craftspeople (manual work),
- to identify appropriate means of online cooperation in training, regarding functionality, GDPR and data security
- to derive success criteria for highly accepted digital solutions
- to develop and test a virtual/3D-crafts training system by using sensors and VR/AR
- to develop and test a virtual/3D-buidling damage identification training system
- to investigate and test options overcoming restrictions, e.g. move sickness,
- to develop a train-the-trainer system for application of selected tools in training of traditional crafts

Participants of the courses developed in VI-TRAIN Crafts can obtain a European certificate by undergoing a certification process provided by ECQA, which is an internationally active organisation specialised in certification of skills and competences.

VI-TRAIN Crafts enriches the offer of The European Heritage Academy (EHA), which will be in charge of delivering VI-TRAIN Crafts training courses after completion of the project. EHA is situated at Charterhouse Mauerbach, the future EU Competence and Community Centre for Architectural Conservation, being set up during INCREAS, a Pilot project for Cultural and Creative Industries, Finance, Learning, Innovation and Patenting for Cultural and Creative Industries (FLIP for CCIs-2).

2. Description of the Selected Approach

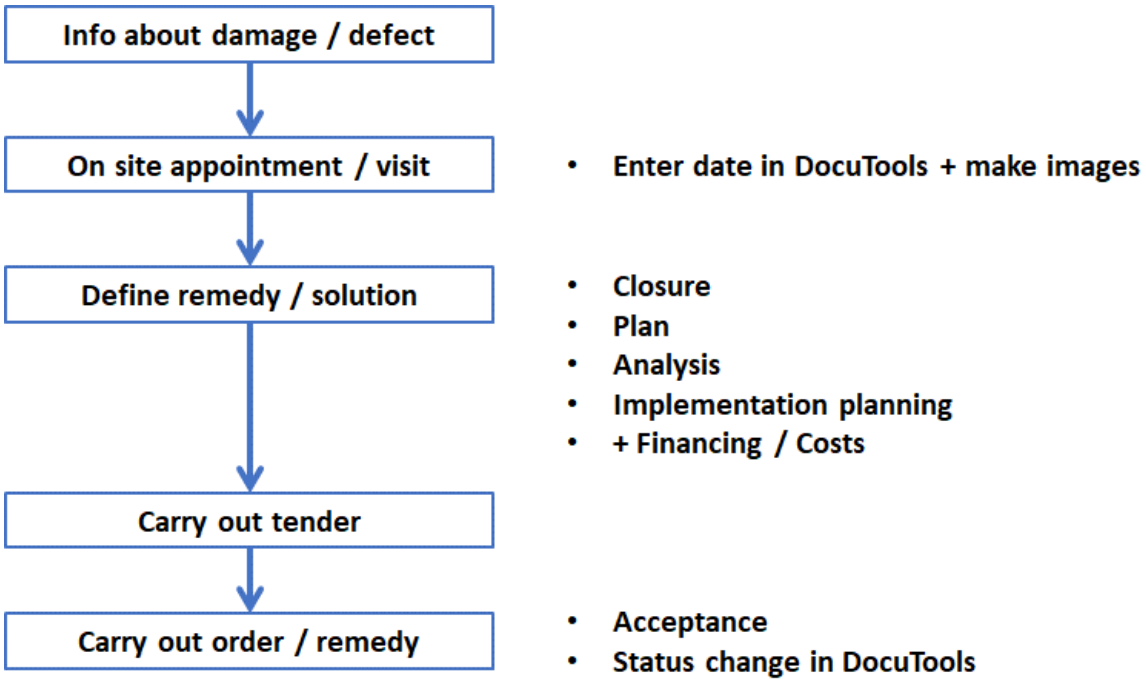
Based the studies (O1 and O2) and defined requirements of the partner organisation and their staff members the structure of the content of the e-learning platform as well as the content of a virtual training course for craftspersons for historic buildings and CH sites will be developed. The final output will include a training curriculum, including the trainer concept and the detailed description of structure, schedule and activities of this virtual training. Training material for "VI-TRAIN-Crafts - Virtual Building Damage Identification Training" will be developed and tested:

1. Develop Learning Outcomes per learning element
2. Develop training material by using the design.train.mastery Navigator
3. Translate from EN into partner languages
4. Support all partners in using the ECQA platform and online joint classes for teaching
5. Test training material “VI-TRAIN-Crafts - Virtual Building Damage Identification Training” (virtual)

Needs analysis: deepening the experiences and knowledge on available virtual education (best practice cases)

The development of the skill set of the new "VI-TRAIN-Crafts - Virtual Building Damage Identification Training” is the fundamental basis to achieve the project targets. The skill set describes the target profile's competences in terms of learning units, which are themselves defined by learning elements. All partners have to agree on the skill set, and should involve as many competent partners as possible to verify its wide relevance. Based on this skill set, learning elements will be assigned to consortium partners for further development notably in terms of training material and test questions. Included in the skill set are explanations (subtexts) of learning elements and cognitive levels for each topic or subtopic in the test. These details This skills set is part of enlarged Job Role “Built Cultural Heritage Management" (the former "Heritage Asset Management").

In several meetings the consortium defined a standard process which is used as base for the training course. This process is shown in following figure:



The consortium identified as important for the further project work and the follow-up the integration to and into the existing tools for documentation and accounting. This integration is the main cause of acceptance by stakeholders. However, for the training purpose it is impossible to cover all relevant systems.

3. Developing an ECQA Skills Card

3.1. General structure of Skills Cards

The ECQA skill sets are based on the skills definition proposed by the Department of Trade and Industry in the UK for the National Vocational Qualification standards. A skills definition contains the following items (see following Figure):

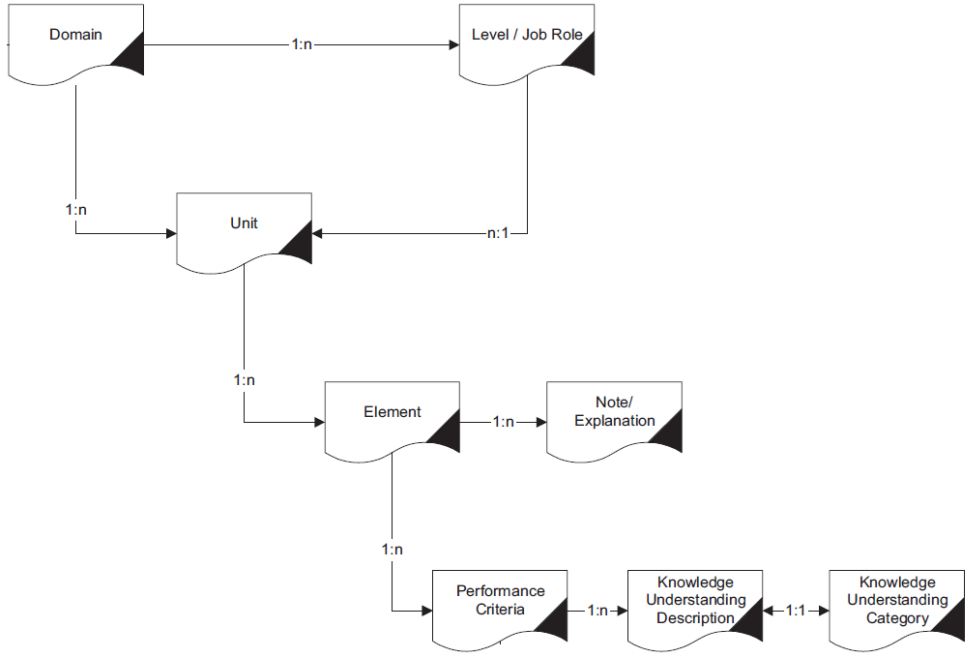


Figure 1: Structure of an ECQA skills card

It consists of following elements:

- Learning unit (identifier, name and description)
- Learning element (identifier, name and description)
- Performance Criterion (identifier, name and description)
- Performance Criterion Knowledge Understanding (Description)

The Performance Criterion description is containing the Learning Outcomes.

3.2. Structure of the VI-TRAIN-Crafts Virtual Crafts Training Expert Skills Cards

The VI-TRAIN-Crafts Virtual Crafts Training Expert for (Built) Cultural Heritage Skills Card is following the ECQA basic structure but put together Learning Units and Learning Elements in one part, which the consortium calls Curriculum. For this curriculum the consortium completed following elements:

- Curriculum
- Learning Outcomes
- Training Materials

3.2.1. Curriculum

The current curriculum contains elements which cover:

- Introducing to Cultural Heritage Management
- Tools for virtual training of manual crafts work
- Types of training virtualisation
- Virtual training of manual crafts work
- Ecological Footprint of virtual training of manual crafts work
- Implementation of virtual training for manual crafts work

The curriculum also shows the link the chosen EQF level.

Curricula	Unit	Learning element	Online/f2f	EQF Level
Virtual Building Damage Inspector for Cultural Heritage				EQF
	U1	**Introduction**		
VBI	U1.E1	Cultural Heritage Management - Overview	online	4
	U2	**Scanning theory**		
VBI	U2.E1	Laser scanning	face-to-face	4
VBI	U2.E2	Photogrammetry	face-to-face	4
VBI	U2.E3	Drones	face-to-face	4
VBI	U2.E4	Building Information Modelling	face-to-face	4
VBI	U2.E5	Modelling of traditional Buildings	face-to-face	4
	U3	**Scanning practice**		
VBI	U3.E1	Use of Laserscans	face-to-face	4
VBI	U3.E2	Use of Drones	face-to-face	4
VBI	U3.E5	Use of Photogrammetry	face-to-face	4
	U4	**Building Damage Identification**		
VBI	U4.E1	Process of Building damage Inspection	face-to-face	4
VBI	U4.E2	Virtual Building Damage Inspection	face-to-face	4
VBI	U4.E2	Assessment of Building Damage Inspection	face-to-face	4
VBI	U4.E3	Feasibility and Business Concept of Virtual Building Damage Inspection	face-to-face	4
	U5	**Application of scanning in the Cultural Heritage Sector**		
VBI	U5.E1	Application of scanning in the Cultural Heritage Sector	face-to-face	4

Table 1: Curriculum "Virtual Building Damage Inspection for (Built) Cultural Heritage"

3.2.2. Learning outcomes

VI-TRAIN-Crafts uses Learning outcomes to structure the training materials for Virtual Building Damage Inspection. To define Learning Outcomes (LO) means:

"… think first about what is essential that students know or be able to do after the course or program – what students need to know and could make powerful use of to enhance their lives and more effectively contribute to society. We believe that such reflection will lead instructors to focus on a broad synthesis of abilities that combine knowledge, skills and values into a whole that reflects how people really use knowledge."[1]

[1] Battersby, Mark: "So, What's a Learning Outcome Anyway?", p.1

Competence Card	ECQA Certified Virtual Building Damage Inspector for Cultural Heritage (VBI)				
Unit Identifier	Unit Name	Element Identifier	Element Name	Performance Criterion Identifier	PC Comment
(starts with 1)	(should not be empty)	(starts with 1)	(should not be empty)	(starts with 1)	(may be empty)
VBI-U1	**Introducing to Cultural Heritage Management**	VBI-U1.E1	Cultural Heritage Management-Energy Expert / Overview	ECH-U1.E1.LO1	The learner is able to explain measures for improving energy efficiency of traditional buildings properly
				ECH-U1.E1.LO2	The learner is able to apply appropriate energy efficiency measures in the repair / refurbishment of historic buildings, both in projects and their day-to-day role
VBI-U2	**Scanning theory**	VBI-U2.E1	Laser Scanning	ECH-U2.E1.LO1	The learner is able to explain the basics and the use of Laser Scanning
		VBI-U2.E2	Photogrammetry	ECH-U2.E4.LO1	The learner is able to explain the basics and the use of Photogrammetry
		VBI-U2.E3	Drones	ECH-U2.E5.LO1	The learner is able to explain the basics and the use of Drones
		VBI-U2.E4	Building Information Modelling	ECH-U2.E7.LO1	The learner is able to explain the basics and the use of Building Information Modelling
		VBI-U2.E5	Modelling of traditional Buildings	ECH-U2.E7.LO1	The learner is able to describe the appropriate modelling of traditional buildings
VBI-U3	**Scanning practice**	VBI-U3.E1	Use of Laserscans	ECH-U3.E1.LO1	The learner is able to use Laserscans
		VBI-U3.E2	Use of Drones	ECH-U3.E2.LO1	The learner is able to use Drones
		VBI-U3.E3	Use of Photogrammetry	ECH-U3.E3.LO1	The learner is able to use Photogrammetry
VBI-U4	**Building Damage Identification**	VBI-U4.E1	Process of Building Damage Inspection	ECH-U4.E1.LO1	The learner is able to explain the optimal process of Building Damage Inspection
		VBI-U4.E2	Virtual Building Damage Inspection	ECH-U4.E2.LO1	The learner is able to explain how virtual building damage inspection is working
		VBI-U4.E3	Assessment of Building Damage Inspection	ECH-U4.E3.LO1	The learner is able to explain how the assessment of virtual building damage inspection is working
		VBI-U4.E4	Feasibility and Business Concept of Virtual Building Damage Inspection	ECH-U4.E4.LO1	The learner is able to explain the feasibility and business concept for virtual building damage inspection
VBI-U5	**Application of scanning in the Cultural Heritage Sector**	VBI-U5.E1	Working Practices Virtual Building Damage Inspection	ECH-U4.E5.LO1	The learner is able to apply the learnings related to virtual building damage inspection
				ECH-U4.E5.LO2	The learner is being able to actively convince others from the advantages of virtual building damage inspection

Table 2: Learning Outcomes "Virtual Building Damage Inspection"

4. Preparation Learner Event

4.1. Training logistics

4.1.1. Relevant steps and information

Training logistics include every organisational task around preparing, conducting and post-processing a training. This means:

- Getting a training venue
  - Apply checklist “Selecting a venue”
  - Decide / negotiate the training venue
- Prepare training
  - Define a training session plan
  - Announce/invite participants
  - Inform participants on travel and transportation options
  - Organise field work facilities (if not available at the training venue)
  - Check your preparation (e.g. availability of training material, handouts, test material for haptic exercises)
- Prepare the training venue 1-2 hours before training start
  - Check your preparation (e.g. availability of training material, of flip chart, of flip chart pens, of pinboards or equivalents)
  - Organise the setting in the training rooms
  - Check the infrastructure (e.g. beamer/TV, lights, shadings, catering, refreshing rooms)
  - Make sure contact persons are available

Checklist “Selecting a venue”

What is needed for the training (e.g. field work facilities, break-out rooms for group work, required equipment, required catering for food and – mainly – for beverages, contact person)?

Checklist “Prepare an upcoming training”

What the organiser needs to prepare before the training (e.g. organise beverages, equipment like flipcharts, beamer and flipchart pens)?

Checklist “Prepare training room for training”

What the trainer needs to do before the training starts on the first training day? What need to be done in the following days (e.g. checking and in most cases adapting the room setting, checking facilities, preparing agenda, preparing group work and group working facilities, checking workshops, checking training material, checking internet connection for learning portal)?

4.2. Training venues and preparation

The consortium decided to conduct this training course in the Charterhouse Mauerbach due to the logistical advantages (the transport of the required equipment like drones are easy and short.

The development of the required training materials have started and will be finished before the course will start. The invitation is sent to all partners.

4.3. Used products/materials for the Learner Event

The consortium generated a detailed 3D model of the Charterhouse Mauerbach and of a wall for Building Damage Inspection resp. a model from the monk's cell. These are available here:

Monk's cell: https://p3d.in/TlP6E
Wall survey: https://p3d.in/AELBi

4.4. Training materials

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Version: 2021
Authors: PRO-Heritage Project team

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page 1

Programme

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1. **Definition**
2. **Objective(s)**
3. **Available Certifications**
4. **Training Offers**
5. **Certification and Recognition**

ECQA Certified Training Programme
U1.E1 Cultural Heritage Management

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U1.E1
Cultural Heritage Management

1. Definition

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Cultural Heritage (Asset) Management

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- A (cultural) heritage asset is an item that has value because of its contribution to a nation's society, knowledge and/or culture
- They are usually physical assets, but some countries also use the term in relation to intangible social and spiritual inheritance
- It contains:
  - Historic buildings; war and other memorials; historic parks and gardens; conservation areas; archaeological sites etc.
  - Listed / not listed buildings
  - Designated / not designated
  - Independent of current use

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U1.E1
Cultural Heritage Management

2. Objective(s)

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Project objective(s) VI-TRAIN

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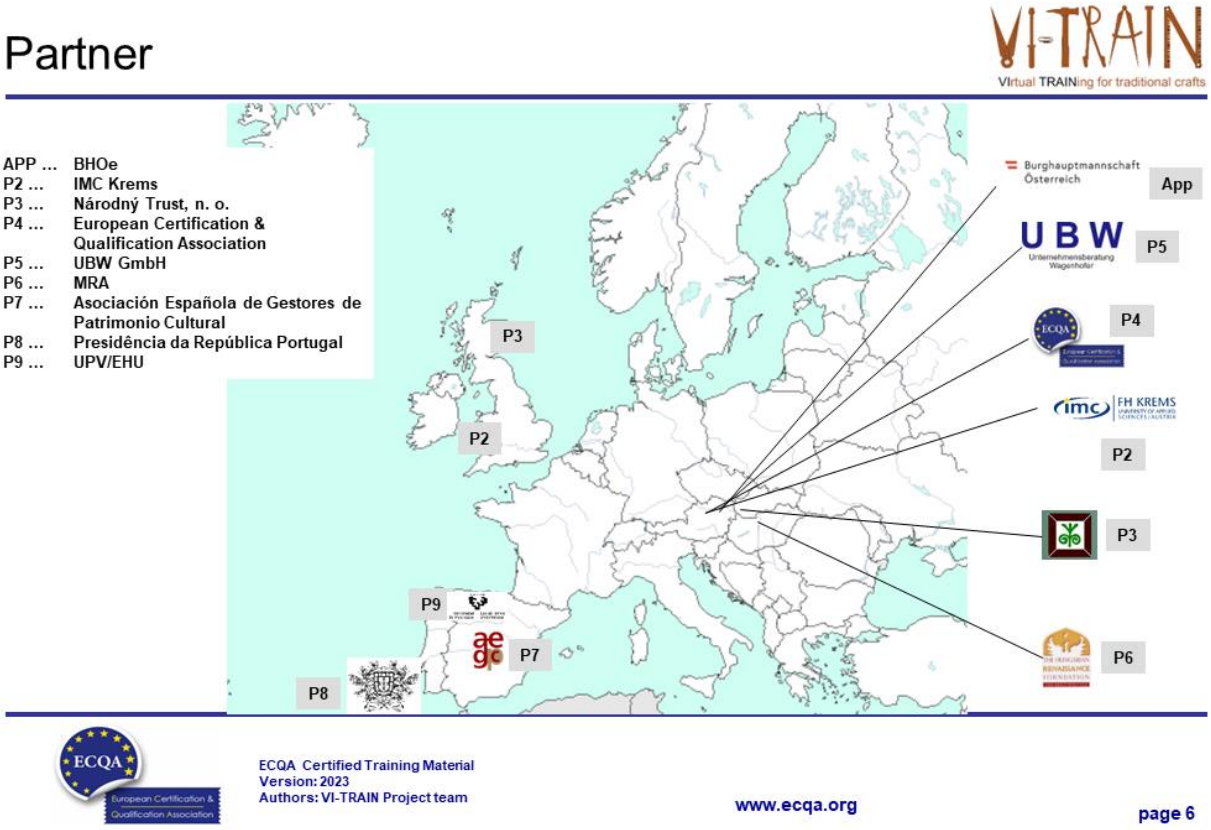
The anticipated objectives of VI-TRAIN are:

- to analyse and identify appropriate means of distance learning for the purpose of training craftspeople (manual work), specifically for traditional crafts
- to analyse and identify appropriate means of online cooperation in trainings regarding functionality, GDPR and data security
- to derive success criteria for highly accepted digital solutions
- to develop and test a virtual/3D-crafts training system by using sensors and VR/AR
- to develop and test a virtual/3D-buidling damage identification training system
- to investigate and test options overcoming restrictions, like move sickness, hesitation to use digital means, in VR/AR for craftspeople and building damage inspectors
- to develop a train-the-trainer system for application of selected tools in training of traditional crafts

Partner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APP ... BHOe
P2 ... IMC Krems
P3 ... Národný Trust, n. o.
P4 ... European Certification & Qualification Association
P5 ... UBW GmbH
P6 ... MRA
P7 ... Asociación Española de Gestores de Patrimonio Cultural
P8 ... Presidência da República Portugal
P9 ... UPV/EHU
Burghauptmannschaft Österreich
App
UBW
P5
P4
FH KREMS
P2
P3
P6
P9
P7
P8
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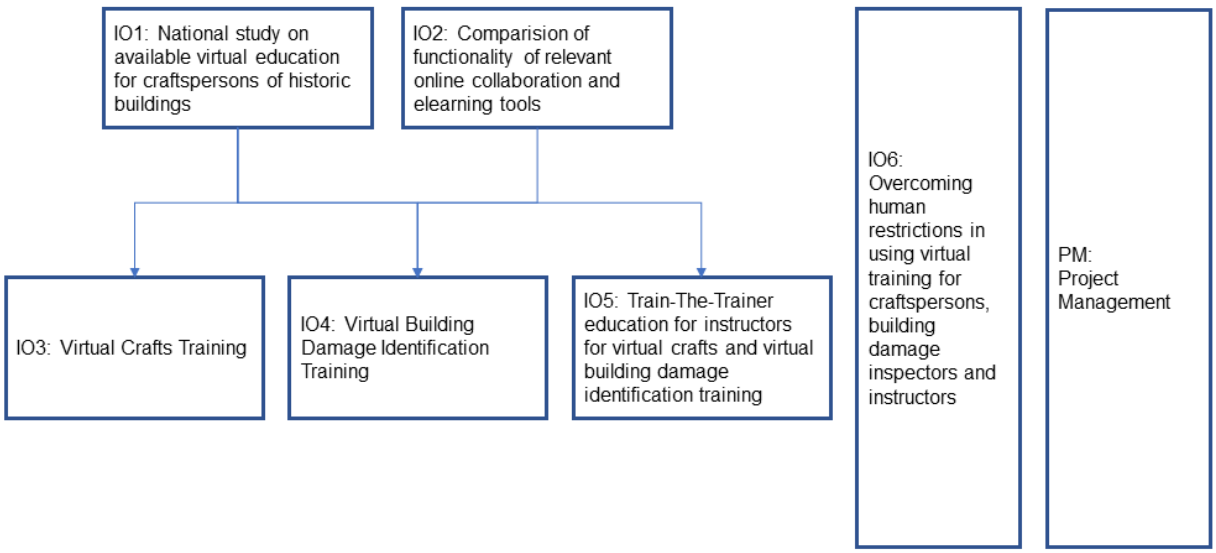
page 6

General approach



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3. Available Certifications

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Available Certifications

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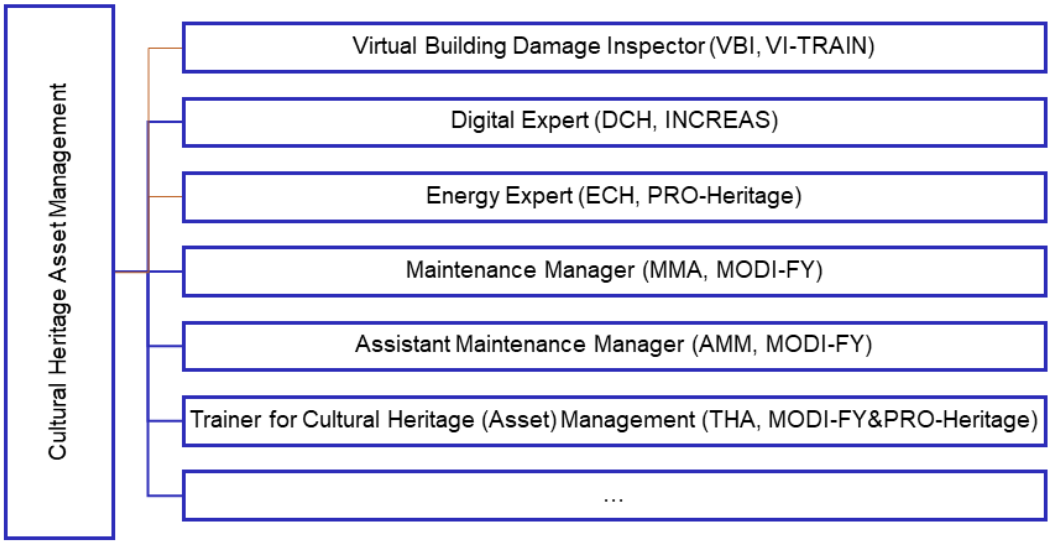
For Built Cultural Heritage:

- Certified Virtual Building Damage Inspector
- Certified Digital Expert
- Certified Energy Expert
- Certified Trainer for Cultural Heritage (Asset) Management
- Certified Maintenance Manager
- Certified Assistant Maintenance Manager
- Certified Construction Site Worker in Built Heritage

Structure and development



Target groups

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Persons:
- Tradespersons
- Manager of (mainly built) heritage assets, like historic buildings
- Manager of adaptive (re-)use projects in heritage assets
- Ascended staff member of responsible organisation
- Volunteers within targeted/responsible organisations
- New staff member of responsible organisation

Professions:
- Architects and structural engineers
- Civil engineers and planners
- Restorers
- Art historians
- and many more …

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4. Training Offers

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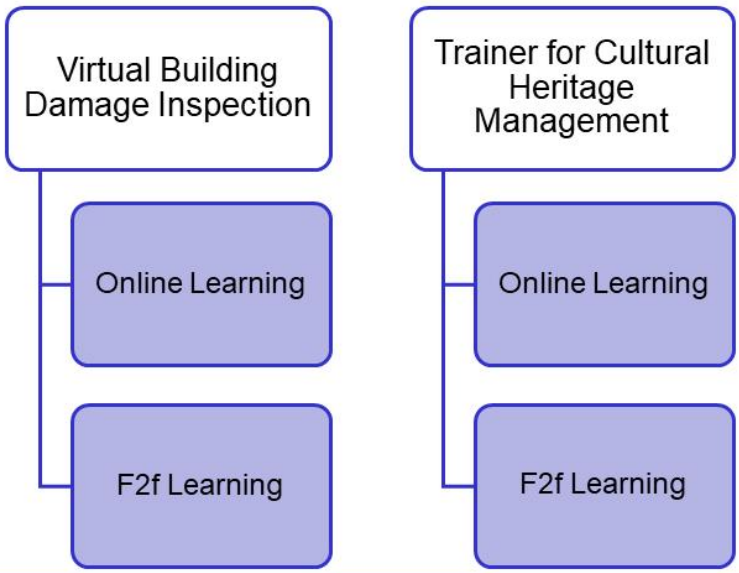
Training offers



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5. Certification and Recognition

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Certification and Recognition

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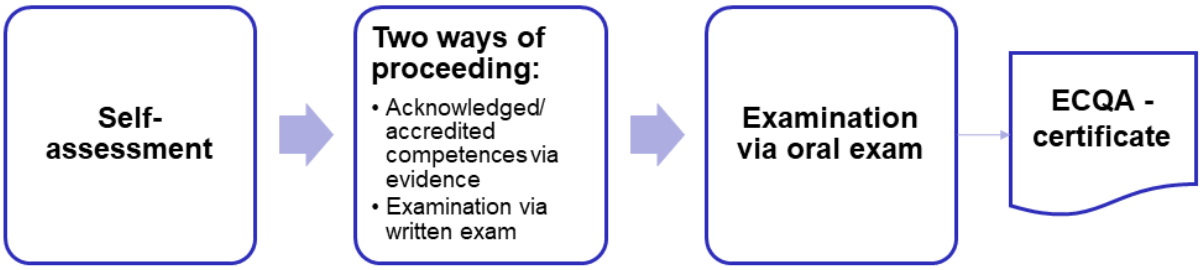

Author

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- Gerald Wagenhofer: UBW Unternehmensberatung Wagenhofer GmbH
- Master degree in Business Administration
- Gerald is a certified Lean Six Sigma Master Black Belt, certified Scrum Master, certified Trainer for Cultural Heritage and trained more than 500 Green and Black Belts resp. project sponsors in Maintenance Management for Cultural Heritage, Lean Six Sigma methodology, Change Management and Soft Skills, like Facilitation, Meeting skills, Presentation skills. He had also trained people in Strategy and Controlling/Monitoring skills
- Gerald is working as a business consultant since 1991. The main target groups are the Public and Non-Profit sector. The projects were mainly dealing with processes and their connection to the strategies of the respective organisations

Reference to Authors

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Programme

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1. **Terminology**
2. **Modelling**
3. **Use of BIM for Cultural Heritage**
4. **References**

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1. Terminology

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Terminology

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Model:

- In science, a model is a more or less comprehensive representation of reality
- Human creative activity: unthinkable without models
- The real world is full of complex interrelationships.
- A model allows us to create a simplifying, reducing view of a part of it (the "original") and to orientate ourselves on it

Terminology

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Business Information Model:

- is a process involving the generation and management of digital representations of physical and functional characteristics of places
- integrates structured, multi-disciplinary data to produce a digital representation of an asset across its lifecycle, from planning and design to construction and operations
- Managed in an open cloud platform for real-time collaboration
- is more than visual 3D
- it allows to connect digitally building characteristics with sketches & plans

Terminology

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Digital Twin:

- is a virtual representation of an object or system that spans its lifecycle
- is updated from real-time data, and
- uses simulation, machine learning and reasoning to help decision making
- is a virtual model designed to accurately reflect a physical object
- The object being studied is outfitted with various sensors related to vital areas of functionality
- These sensors produce data about different aspects of the physical object's performance, such as energy output, temperature, weather conditions and more
- This data is then relayed to a processing system and applied to the digital copy

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U2.E4
Building Information Modelling

2. Modelling

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Modeling 1

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Set level of detail:

- Rough/low
  consists of very few, to be precise only the most necessary polygons, to represent the shape of the modelled object. Small details are details are often simply left out and the outer form only roughly corresponds to reality
- Medium/standard
  has accordingly many more polygons in order toto reproduce even the small details of the modelled object realistically
- Fine/high
  lies between the two levels of detail

Modeling 2

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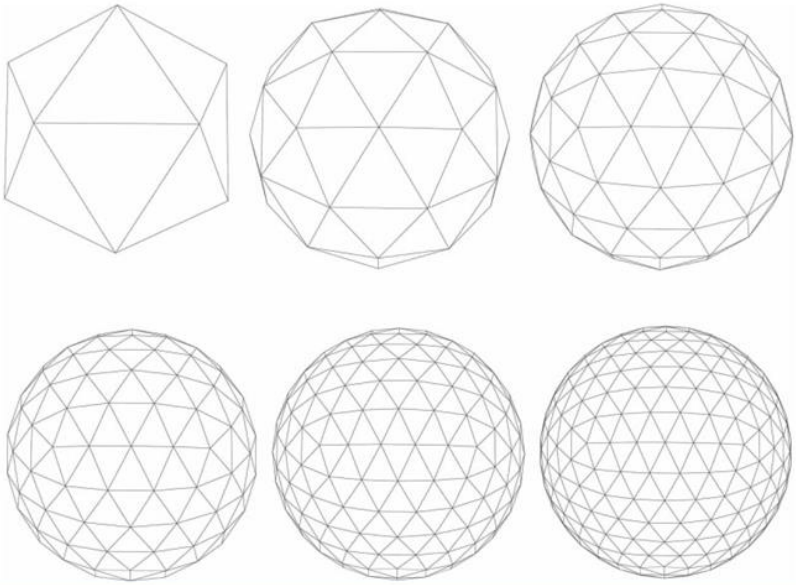
Polygons:



Modeling 3

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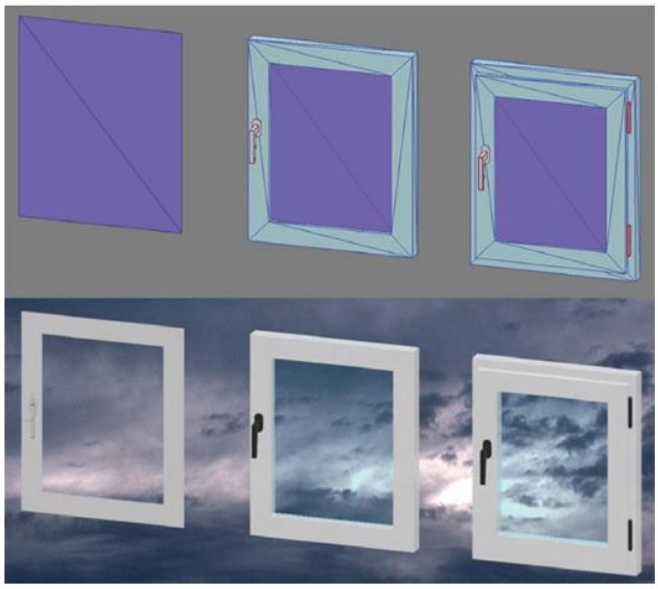
Set level of detail:

Modelling details	simple	medium	high
Rough (examples): - Window/door openings - Planar stair railings - Rough roof shape	X	X	X
Medium (examples): - Window/door frames - Simple stair railings - Differentiated roof form		X	X
Fine (example): - Door handles, window handles - Baseboards - Moulded stair railings - Roof gutters, parapet plates			X

Modeling 4



Level of detail using the example of a window:

- On the left, the window is modelled as a singe layer consisting of only two polygons (low-poly)
- in the middle the window has a frame and already a window handle
- On the right, the window is modelled in great detail (high poly), with frame and sash, handle and hinge
- Below the rendering of the models; the left window does not have the handle via the modelling, but via the texture

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3. Use of BIM for Cultural Heritage

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Specific Challenges in Traditional Buildings 1

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IFC:

- Developed by buildingSMART International (bSI)
- In the IFC data structure the different elements such as wall, column, etc. are contained
- At each alphanumeric and quantitative information is attached to each element
- Which information an element carries is defined in the property sets = Pset
- For quantities/masses there are the Quantity Sets = Qto
- The advantage is that everyone can access stored information at the specific/identical point

→ The required information are not included in the IFC

Specific Challenges in Traditional Buildings 2

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LOI (Level of Information):

- defines what information must be available
  - at what time
  - from whom
  - coming from whom

LOG (Level of Geometry):

- basically describes which geometrical information needs to be present in the system and when it needed

→ Built Cultural Heritage is always containing the highest level of information and geometry because it is already built

LOI (Level of Information)

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LOG (Level of Geometry)

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REQUIRED HBIM LEVEL OF GEOMETRY					
LOG 100 CONCEPTUAL MODEL, HISTORICAL REPORTS, ARCHIVES	**LOG 200** APPROPRIATE GEOMETRY, 3D SURVEY, DATA ACQUISITION	**LOG 300** PRECISE GEOMETRY, SCAN-to-BIM MODEL OBJECT	**LOG 400** BIM USES CONSERVATION PLAN	**LOG 500** CONSERVATION SITE	**LOG 600** AS-BUILT, LLCM, CDE, HUBs
historical building contracts, historical drawings, historical documentation (pictures, photos and documents)	*on-site data acquisition, 3D surveying, 2D/3D restitutions (plans and sections, 3D meshes)*	*object modeling, precise drawing extraction*	*material/decay mapping, diagnostics IRT, NTD,BIM-to-FEA, energy analysis, BIM implants, on-site construction management, WBS and computation*	*on-site construction interventions of conservation*	*Life Cycle Cost Management and Monitoring, VR and sensor-based communication purposes*

Level of Development (LOD) = LOG + LOI

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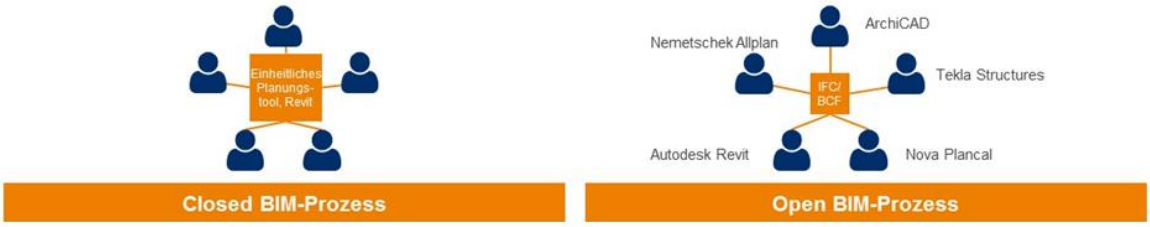
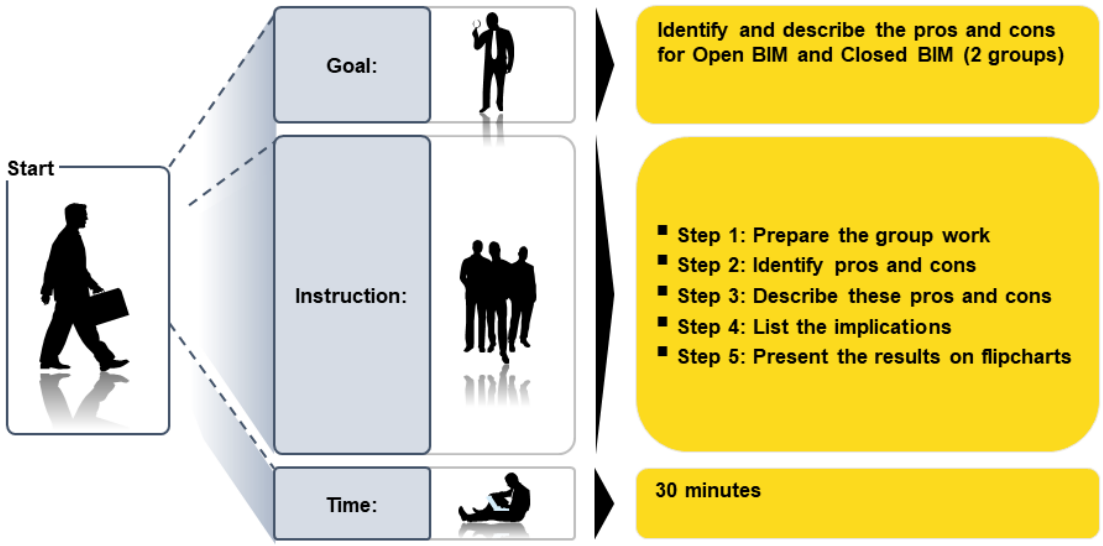
Project type	LOI	LOG
Maintenance/Service	LOI 500	LOG 500
Repair/Restoration	LOI 500	LOG 500
Refurbishment	LOI 300 LOI 400 LOI 500	LOG 300 LOG 400 LOG 500

BIM Philosophy



Exercise: OpenBIM vs. ClosedBIM



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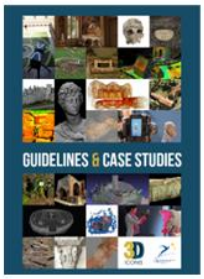

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U2.E5
Modelling of traditional buildings

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Programme

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1. **Terminology**
2. **Challenges in Modelling Traditional Buildings**
3. **Benefits of BIM use**
4. **References**

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1. Terminology

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Traditional Buildings – Definition

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- These are understood to be buildings constructed before 1919. Modern materials and techniques were used widely in the construction industry from around this time onwards.
- Traditional buildings are often referred to as being of 'breathable construction'. This means that the construction materials used can absorb and release moisture.

Building Damage

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- A distinction is made between structural damage and structural defect
- Structural damage is usually the cause of a construction defect
- A building defect is a deterioration in the condition of a property
- The warranty for immovable property such as buildings is 3 years in Austria
- Building damage can be caused by incorrect construction methods or low-quality building materials
- The most common types of structural damage are mold, cracks, peeling, roof damage, basement moisture and floor and terrace damage
- The causes of structural damage can be many and varied and should be noted by an expert

Structural damage vs. defect

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Wrong material used

Crack in a old wall

Wood destroying fungi

Crack in newly built brick wall

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2. Challenges in Modelling Traditional Buildings

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Special Requirements Traditional Buildings I

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- Old, partly heterogeneous and unknown building fabric with special maintenance requirements
- Special interaction between use, operation and value preservation
- often complex ownership structures and very different groups of user groups
- Historical documentation as a special requirement for IT-knowledge management
- Diverse research needs, for which information has to be provided
- Sometimes very large amounts of data that are difficult to handle
- Sometimes surprising findings and the need to adapt data
- Dealing with unknown and unplannable factors during construction & refurbishment & expansion

Special Requirements Traditional Buildings II

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- Need to integrate data from different sources and keep it up-to-date- correspondingly many interfaces with different IT systems
- Very special, different kind of value chains in historic preservation and restoration
- Use of rare and increasingly sought-after occupational groups in crafts and restoration
- Consideration of SMEs and micro-enterprises as well as individual experts and their skills and knowledge gaps

Complete Models

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When introducing BIM, it must be noted that all trades must be represented in specialist models, coordination models and finally in an overall model, such as:

- Historical inventory and current condition (incl. listed building status).
- Architecture
- Statics and construction
- Technical building equipment, building control systems
- Interior design, flexible equipment and furnishings

System architecture

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Beside of BIM there are other systems in place:

- Commercial systems (enterprise resource planning, SAP, etc.)
- Operational applications (asset management, CAFM, exhibition and congress management, etc.)
- Special solutions, such as real estate databases, documentation tools
- Workflow tools such as electronic governmental file systems

Typical Demand Cases

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- Identify historical documents and make them digitally analysable, available, the contents understandable
- Produce a model series on historic building conditions, also available for Augmented Reality/Virtual Reality/Mixed Reality (AR/VR/MR) applications on the part of the cultural users
- Plan, simulate, and evaluate necessary maintenance and preservation measures in relation to evaluate the associated risk
- Plan, simulate and optimize future construction measures
- Plan, visualize and optimize future uses
- Plan and visualize future operational concepts
- Etc.

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3. Benefits of BIM use

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Benefits for New Buildings

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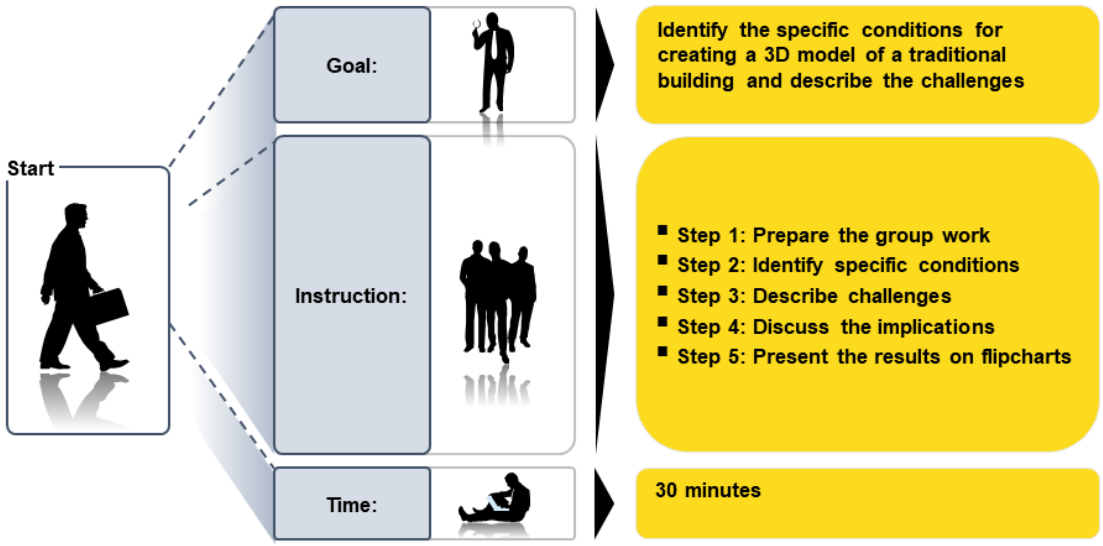
Main BIM drivers in new construction are efficiency gains in planning, construction and building operation. These advantages depend on:

- Achieving a high degree of standardisation
- Making processes as efficient as possible thanks to the highest possible degree of repeatability
- Ensuring consistent processes via standardised data structures
- To use the data from planning in official procedures and tenders as consistently as possible
- To use the planning data in construction preparation, construction logistics and on the construction site
- To use the construction documentation as an optimal basis for operation

Modelling Traditional Building



Specific conditions

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For modelling traditional buildings:

- Geometry
- Thick walls
- Heterogeneous wall structure and materials
- Small-scale nature
- Level of Development = Level of Geometry + Level of Information
- Plans showing construction periods resp. historic plans
- Change Management / Mobilising Stakeholder

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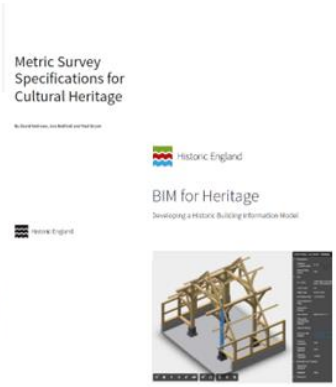

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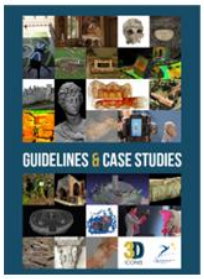

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U3.E2 Drone Exercise

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U3.E2
Use of Drones

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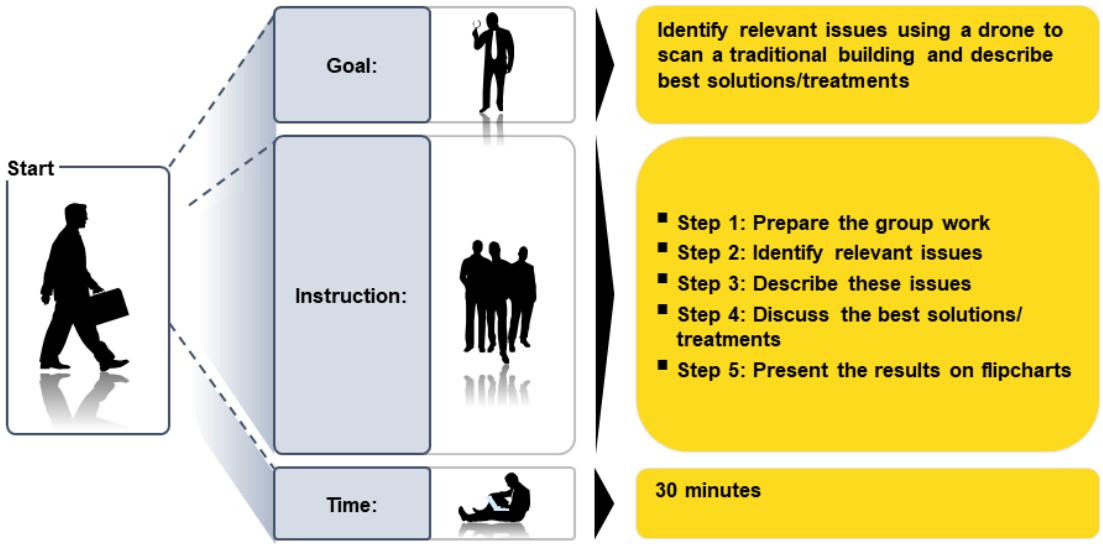
Exercise: Use of Drones



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U3.E3 Use of Photogrammetry

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U3.E3
Use of Photogrammetry

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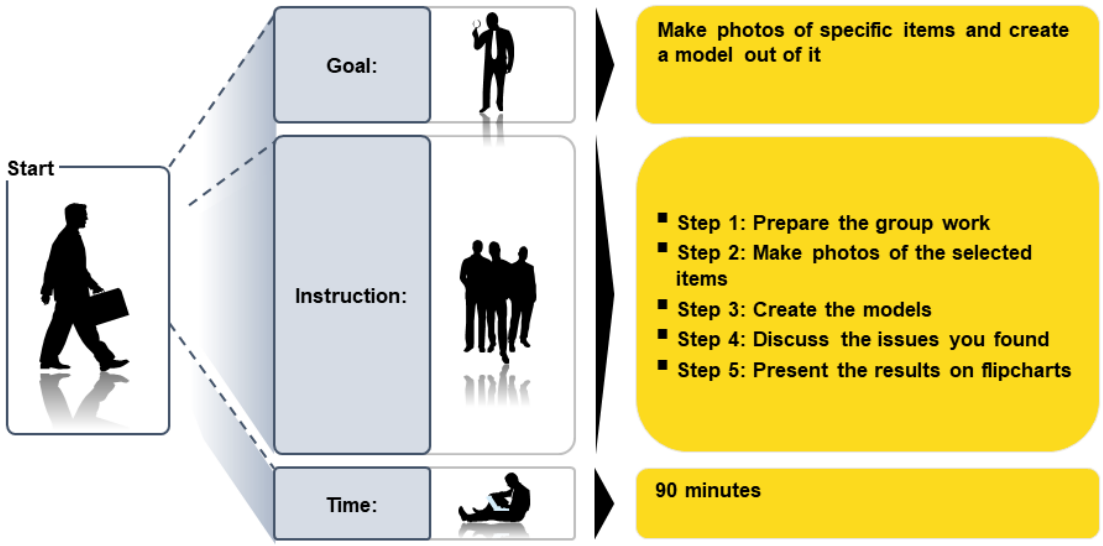
Exercise: Use of Photogrammetry



Objects for Exercise

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Examples in the Charterhouse Mauerbach:

- Tree next to chapel
- Column next to Church
- Trash box next to side entrance and
- Wall in Charterhouse

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U4.E1
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Programme

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1. **Terminology**
2. **Process**
3. **References**

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U4.E1 Process of Building Damage Inspection

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U4.E1
Process of Building Damage Inspection

1. Definition

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Terminology

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- A (cultural) heritage asset is an item that has value because of its contribution to a nation's society, knowledge and/or culture
- They are usually physical assets, but some countries also use the term in relation to intangible social and spiritual inheritance
- It contains:
  - Historic buildings; war and other memorials; historic parks and gardens; conservation areas; archaeological sites etc.
  - Listed / not listed buildings
  - Designated / not designated
  - Independent of current use

U4.E1
Process of Building Damage Inspection

2. Process

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Introduction

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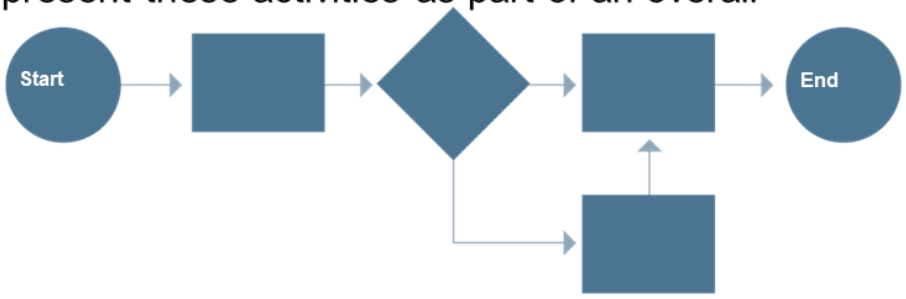
- Just about everything we do is in the form of processes
- A process is a set of activities that transforms one or more inputs into outputs that are of value to the customer
- To gain a basic understanding of how activities occur, it is important to represent these activities as part of an overall process e.g.:



Definition of a Process

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A process is a series of activities that transform one or more inputs into outputs that are of value to the customer.

Process Presentation

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- Provides a visibly simplified structure for thinking through a complex process
- Gives the team an opportunity to look at the whole process
- Is a way of seeing that changes affect the whole process
- Identifies initial areas or steps that do not deliver value

Process Boundaries

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- Identifying the starting and ending points of the process is the first important step in process mapping. After the boundaries are established, the team can define all the necessary steps, events and activities that make up the process.
- Usually, the starting point of a process is the first step where the input comes from the supplier. The end point is usually given with the delivery of the product to the customer or the service.

Standard Symbols for Process Representation

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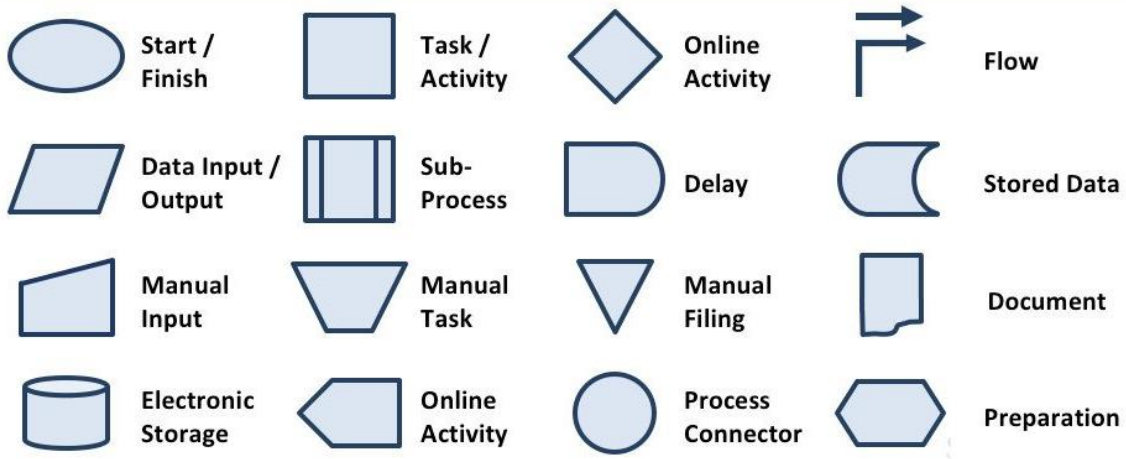
Process Mapping Symbols



Process Flowchart

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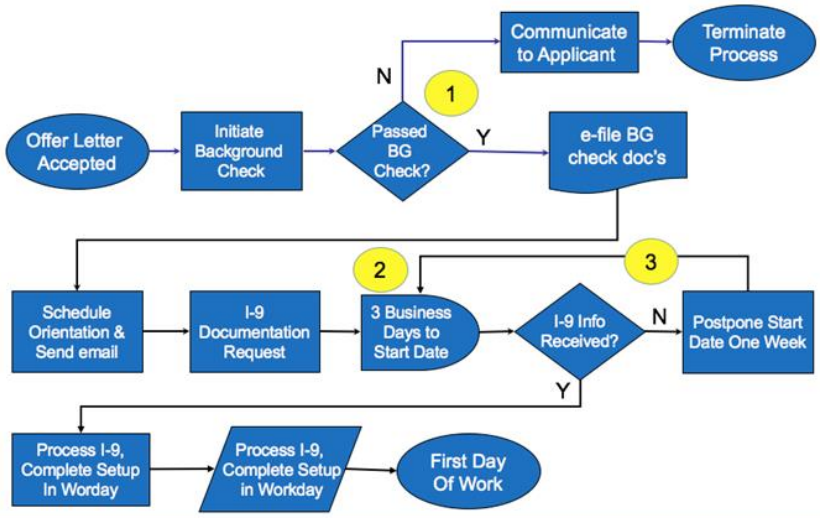
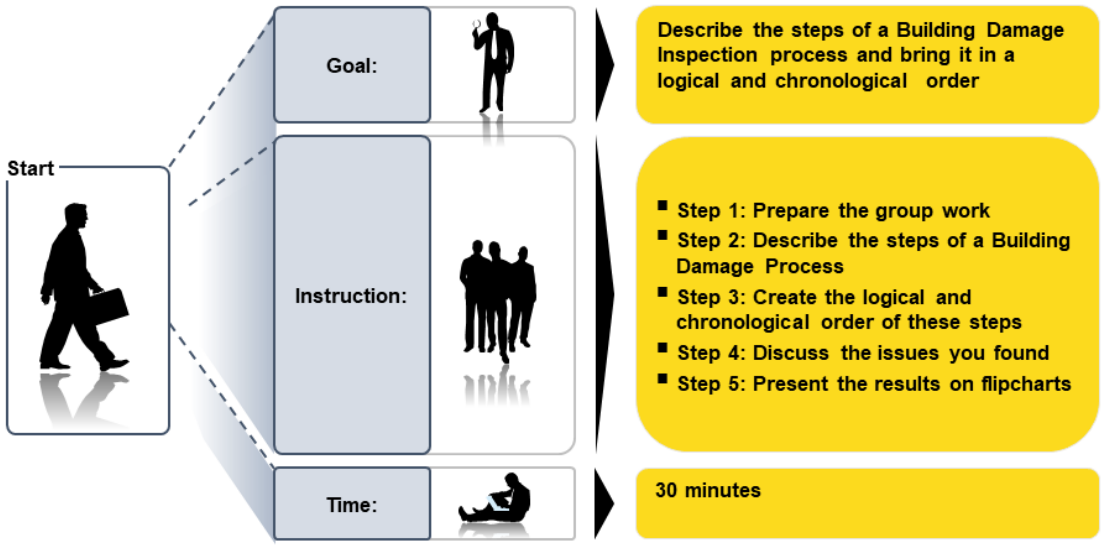
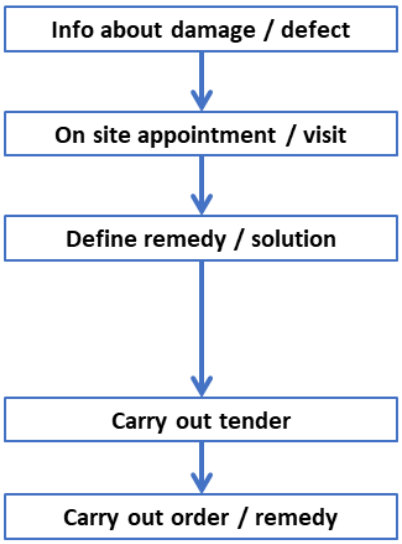
Process Flowchart – Employee Onboarding Process



Exercise: Process Building Damage Inspection



Basic Process



- Enter date in DocuTools + make images
- Closure
- Plan
- Analysis
- Implementation planning
- + Financing / Costs
- Approval
- Status change in DocuTools

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U4.E1 Process of Building Damage Inspection

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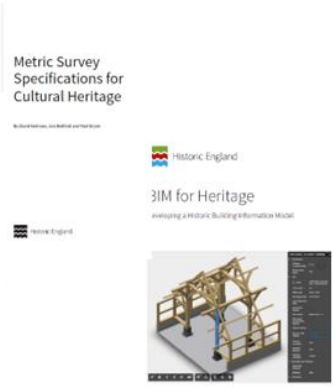

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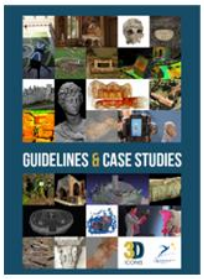

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U4.E2 Virtual Building Damage Inspection

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Programme

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1. **Terminology**
2. **Inspection Procedure and Rules**
3. **References**

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U4.E2 Virtual Building Damage Inspection

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Virtual Building Damage Inspection

1. Terminology

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Terminology

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Virtual means:

- created by computer technology and appearing to exist but not existing in the physical world
- done using computer technology over the internet, and not involving people physically going somewhere

→ For building damage inspection this means:

- Using digital means for the inspection
- Could happen at the same time
- Changes in processes and organisational roles

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2. Inspection Procedure and Rules

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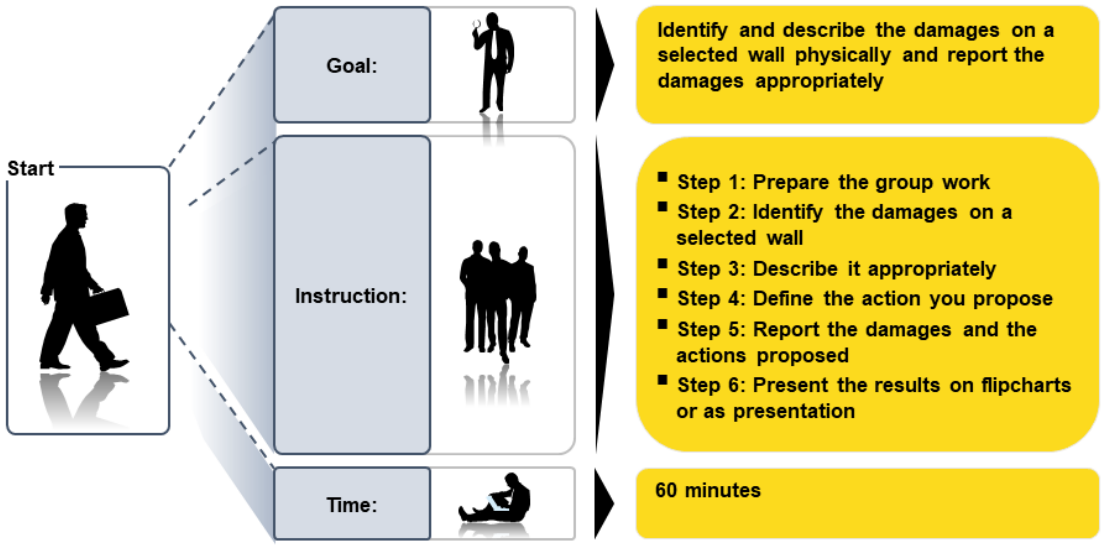
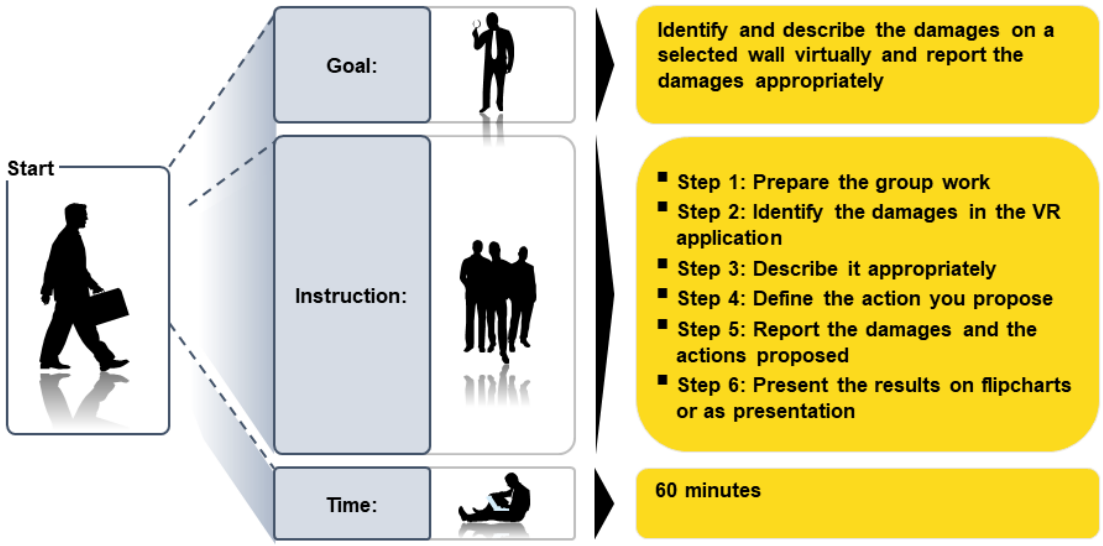
Exercise: Building Damage Inspection



Exercise: Virtual Building Damage Inspection



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5. References

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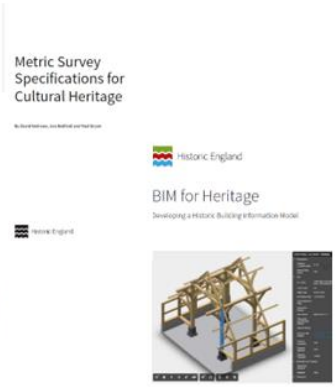

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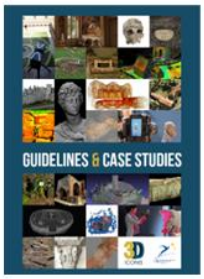

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U4.E3
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Programme

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1. **Terminology**
2. **Assessment Approach**
3. **References**

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U4.E3 AssessmentBuildingDamageInspection

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Assessment of Virtual Building Inspection Results

1. Terminology

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Terminology

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Assessment:

- the act of judging or deciding the amount, value, quality, or importance of something, or the judgment or decision that is made

Evaluation:

- the process of judging or calculating the quality, importance, amount, or value of something

Inspection:

- the act of looking at something carefully, or an official visit to a building or organization to check that everything is correct and legal

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2. Assessment Approach

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General approach I

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- Scanning site
- Creating 3D point cloud
- Creating 3D Model
- Checking delta to reality
- Releasing 3D model

Laserscanner

General approach II

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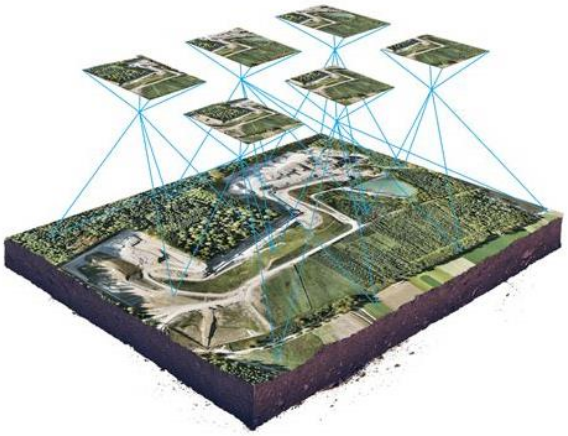
- Scanning site
- Creating 3D point cloud
- Creating 3D Model
- Checking delta to reality
- Releasing 3D model

Photogrammetry



General approach III

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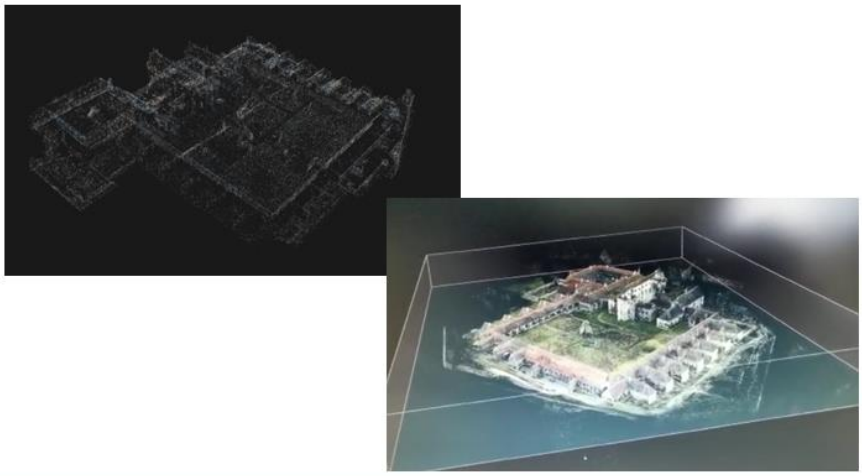
- Scanning site
- Creating 3D point cloud
- Creating 3D Model
- Checking delta to reality
- Releasing 3D model

3D point cloud



General approach IV

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Scanning site

Creating 3D point cloud

Creating 3D BIM Model

Checking delta to reality

Releasing 3D model

BIM model

General approach V

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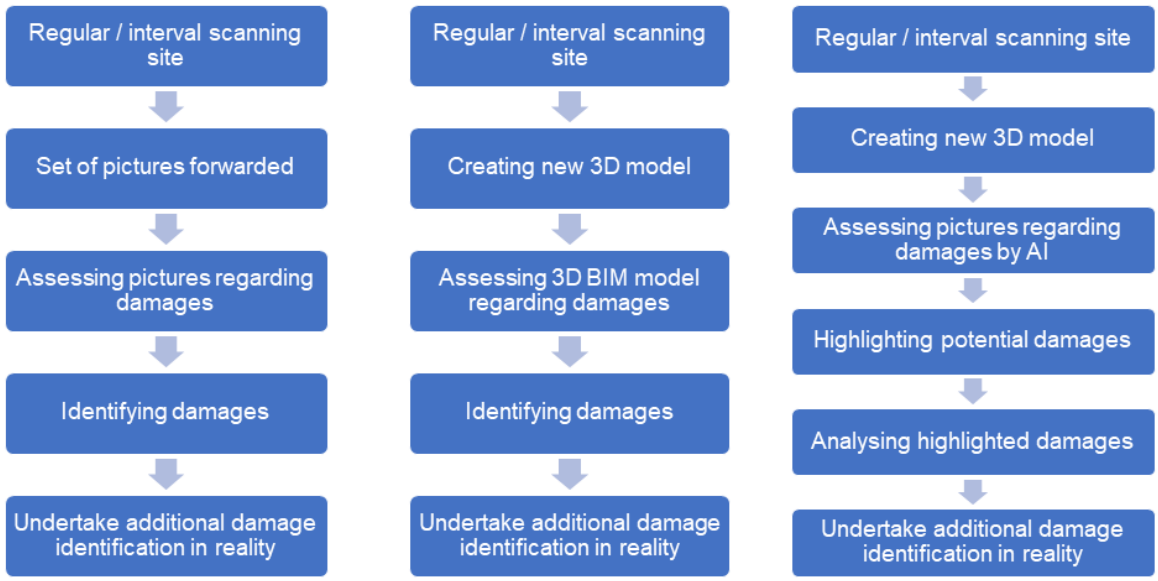
- Scanning site
- Creating 3D point cloud
- Creating 3D Model
- Checking delta to reality
- Releasing 3D model

BIM model

Aerial photo

Three Ways of Assessment



Types of Damage Identification

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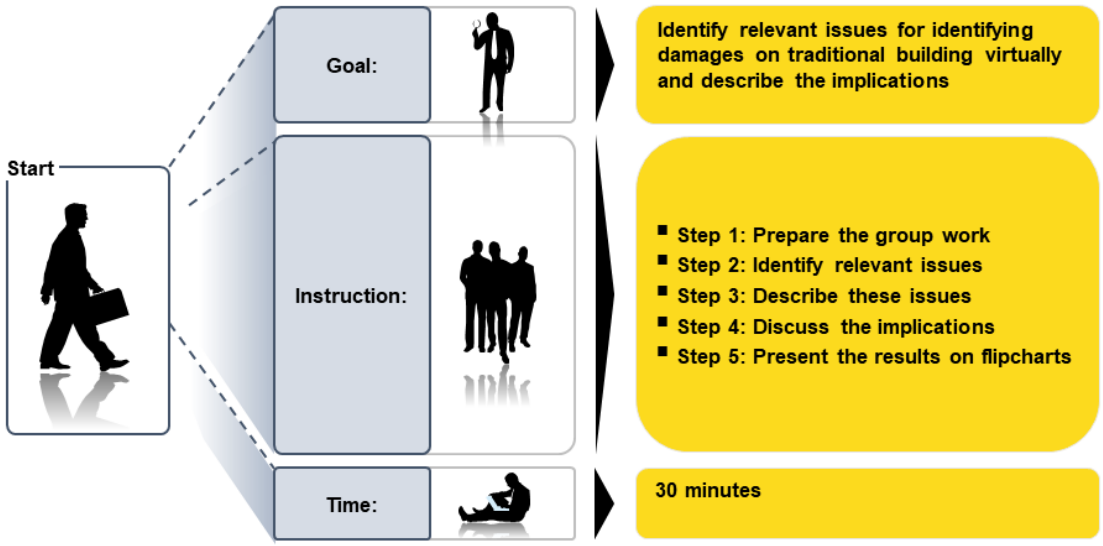
- Visual inspection – needed, but not sufficient 
- Haptic inspection 
- Olfactive inspection 
- Auditive inspection 
- Special inspection (reaction of watering) 

Exercise: Damage Identification



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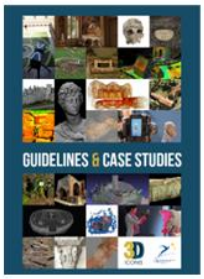

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U4.E4
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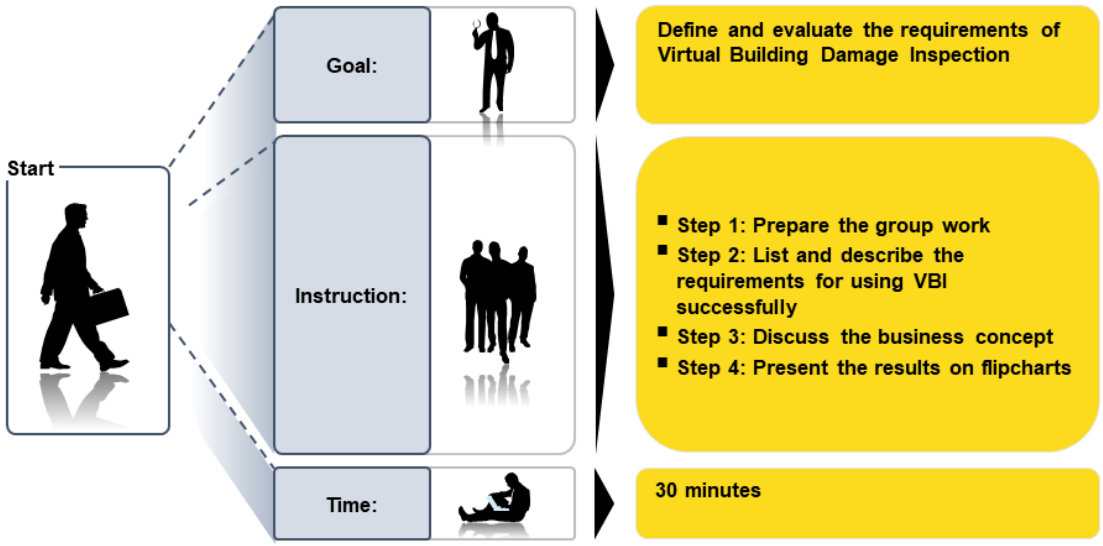
Exercise: Ecological Footprint



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5. Assessment of the Selected Approach

5.1. Standard process

The defined process was applied in the Learner Event. Additional remarks were made by the partner:

- The Virtual Inspection of Building Damage based on the scanned model of a wall in the Charterhouse Mauerbach is seen by all partners and by all involved experts as feasible. The accuracy of the model and zoom in and out functionality provide an appropriate base for an inspection of Building Damages
- The virtual inspection of Building Damages cannot replace the real/physical inspection. A proper inspection needs haptically tests like knocking on or spitting on.
- Usually, the inspection is done twice. A first inspection to identify the spots which needs a closer look on. The second inspection will be clarifying the required measures for repair/refurbish.

5.2. Flying a drone

- The first inspection can be done by a layperson with drones. The only pre-condition is that the person knows the building and its hidden corner/edges.
- There are some restrictions regarding drone flights. For instance, at the Imperial Palace Vienna drone flights need some lead time for preparation, for permissions and for dealing with security risks.
- Another challenge is the license for flying drones. There is an online learning tools and exam available for flying drones. Even flying with drones during the training course is a problem because of legal and insurance issues.

5.3. Development of a 3D Model

- There are several methods to develop a 3D model. The first one method is using a 3D Laser scanner which provides a 3D dots cloud. From this the model will be created. The advantage of this method is that the model can be used for other purposes like Building Information Modelling which is based on 3D dots cloud.
- The second method is using photogrammetry, which is based on photos made by drones and other means. This need a certain number of photos because for the model there is an overlay of two thirds necessary. For using this method the owner/manager of a historic buildings need to provide a huge data storage capacity.

5.4. Further Developments

- The current solution is based on a manual matching of the current inspection with the previous one. By doing this the expert is able to explore the spots which needs an immediately actions to avoid risks and/or to identify the spots which needs a detailed analysis.
- In future this match can be done by an artificial intelligence. This includes also the initiation of purchasing the required craft work. The AI will also involve experts for detailed analysis.

6. Conclusions

6.1. Summary of achievements

Based on the defined process for Building Damage Inspection the consortium identified the feasibility. By extending the inspection process to a two-level inspection guarantee a proper virtual inspection. The respective training courses and ECQA Skills card (Curriculum, Learning outcomes and training material) were developed and piloted in the Learner Event C2 in Mauerbach.
The model which will be used for the training purpose is detailed and accurate enough to conduct any inspection. However, for applying the standard process in the daily work there are some pre-conditions. The first one is that a regular inspection interval is in place. This is mostly available because there is European standard implemented for property inspections for risk assessment which defined that once a year each site will be inspected. The owner/ manager of a historic sites needs to check if this interval is sufficient. The second is again the effort to develop a 3D model based on the scan or photos made during an inspection – each time a new model. The costs for these recordings have to take into consideration as well. On the other hand, these 3D models will be stored and together with the initial data a huge data storage capacity and the internal operating capacity to run the model on the PCs or Laptops. Then, after each inspections the 3D models have to be compared, analysed and used for deriving measures. Only as future development it will be possible that an Artificial Intelligence can take over this task.

6.2. Contact to the Coordinator´s Data Protect Officer

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