Repository AgTecCollection

- An Attempt to Rescue Analog Agricultural Engineering Knowledge -

CIGR 2022

Kyoto (Japan, Dec. 2022)

Prof. em. Dr. Hermann Auernhammer

TUM Emeritus of Excellence

CIGR Fellow

Member of CIGR Academy

Senior Excellence Faculty

Technical University of Munich (Germany)

Outline

1. What to do when…
2. mediaTUM® and Digitalization
3. Indexing and Publication
4. Downloads and User Interfaces
5. Further Challenges
6. Conclusions

What to do with scientific material when …

… the familiar visualization technology has to be replaced by new technology
(slide → overhead transparencies → PowerPoint → Meta Universe → …)

… available space has to be limited

… a move to other rooms is imminent

… a person leaves the group / the team

… the department / chair is closed down

…

Typically, much then ends up in the trash and is lost forever !!!

What is lost then …

… images (photographs in color or black and white, drawings, pictorial notes, posters)

… documents (books, notes, conference proceedings, journals, theses, dissertations, doctoral theses, post-doctoral theses, certificates, ...)

… films and/or videos

… research data (measurement data, calculation data, calculation programs, ...)

But this is documented science (scientific material) !!!

It's culture !!!

In Ag-Engineering - for decades, the slide stood dominant, as it …

… relies on standardized dimensions

… is easy to transport

… allows any sequential arrangement

… brings technology into the presentation room as an image of practice

… is visible and explainable for all attendees

…

The slide is the knowledge and information store par excellence !!!

Outline

1. What to do when…

2. mediaTUM® and Digitalization

3. Indexing and Publication

4. Downloads and User Interfaces

5. Further Challenges

6. Conclusions

Two challenges for us at the end of the 90s of the last century

1. **Ending the use of overhead transparencies changes habits:**
   - Simple arrangement of required transparencies as for slide use (take and paste)
   - Reorganization possible even during the presentation
   - Moreover, changes and additions possible during the presentation

The contents of the overhead transparencies *(they were simple copies)* ***must be made available digitally***

2. **The reorganization of the Ag-Sciences at TUM-Weihenstephan**
   - Agriculture becomes land use systems
   - More basic research must be increased
   - Concentration on fewer chairs (which one will be closed, our ones too ?)

Save whatever can be saved !!!

Decisions in 2001:

1. We need to start digital archiving
2. Because of the transition from overhead transparencies to PowerPoint the clear decision was made to start with the digitization of slides
3. No selection is made → all available material has to be included (nobody knows what is needed tomorrow and the day after tomorrow, a poor quality image is better than no image)
4. With the digitization an archiving and a retrieval must be realized

Scientifically, under these conditions, one always starts with a preliminary test !

The preliminary test:

1. With a single image scanner 1,000 slides were digitized
2. An EXCEL table with columns for the digitized object, the ID, author(s), year and keywords was used for data entry
3. The keywording was done without limitation per object and free choice of keywords

Solution being unsatisfying

but

1,000 digital copies available !!!

Dia	ID	Autor(en)	Titel	Jahr	Schlagwort
	LTW-00001	Grimm, K.; Brenner, W.	Schleifvorrichtung im Scheibenradfeldhäcksler	1963	Scheibenradfeldhäcksler, Schleifeinrichtung
	LTW-00002	Auernhammer, H.	Silomaisernte mit Seitenwagen-Feldhäcksler	1976	**Schlepper**, Feldhäcksler, Automatikwagen, Silomais
	LTW-00003	Schulz, H.	Laden von Stallmist mit Frontlader	1968	**Traktor**, Frontlader, Stallmist, Stallmiststreuer
	LTW-00004	Estler, M.	Kalibrierung von Maissaatgut	1972	Mais, Saatgut, Kalibrierung, Rundlochsieb
	LTW-00005	Brenner, W.	Einlagerungsverfahren von Häckselgut in Hochsilos	1962	Grünfutterernte, Feldhäcksler, Hochsilo, Einlagerunstechnik, Mechanisierungsverfahren, **Zugmaschine**
	LTW-00006	Wenner, H.-L.	Anbau-Beetpflug	1978	Pflug, Dreipunktanbau, Beetpflug, **Trekker**
	LTW-00007	N. N.	Einachs-Stalldungstreuer	1964	Standardtraktor, **Bulldog**, Miststreuer

TUM-Library and TUM Chair of Ag-Technology (LTW) in cooperation

1. The media server "mediaTUM®" is being created at the library of the TU Munich
2. The chair can contribute digitized material with metadata
3. For further use the chair is provided with hardware and software for digitization
4. A fruitful cooperation develops for both sides

Without IT platform and IT support

no repository !!!

Phase	*TUM Library*	*TUM AgTec (LTW)*
2000 - 2003	DFG application "TUM -Publication Server"	Test digitization EXCEL recording
2003 - 2006	System development Open-Source "mediaTUM®" Integration of test digitals LTW	Digitization of all slides - LTW (TUM-AgTec) - LTM (TUM-AgEng) - HUB (AgEng, Berlin)
2006 - 2009	System extension AgEng Classification System AgEng Metadata Schemes	Doublet analysis Metadata revisions Test-Publication Creation of the "AgTecCollection"
2009 - today	Search algorithm Auto-citation tool Usage tool English keywords	Indexing & Publication Integration "Movies & Videos" Integration "Research Data"

Digitization took place in 3 time phases

1 **2004 / 2005**

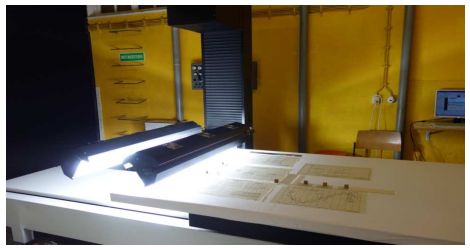
Student assistants independently handled **digitization of all slides** (# >51,000) in two parallel processes:

1. Cleaning, unique labeling, metadata capture, filling of round magazines
2. Scanning in 3-shift operation 7/24 (100 slides, 2000 dpi = 8 h/magazine)

Slides are transferred to the TUM archive in long-term stable boxes

2 **2016**

Existing **drawings before 1974** (# >2,100, partly >A0) scanned on the large scanner in the TUM Museum of Architecture (supporting surface 2.18 * 1.10 m, also originals handed over to the TUM archive)



3 **2018**

All **drawings 1974 - 2018** (# >14,000, A4 and A3, also those available as slides) scanned (drawings made by hand until 1990 also handed over to the TUM archive)

Outline

1. What to do when…

2. mediaTUM® and Digitalization

3. Indexing and Publication

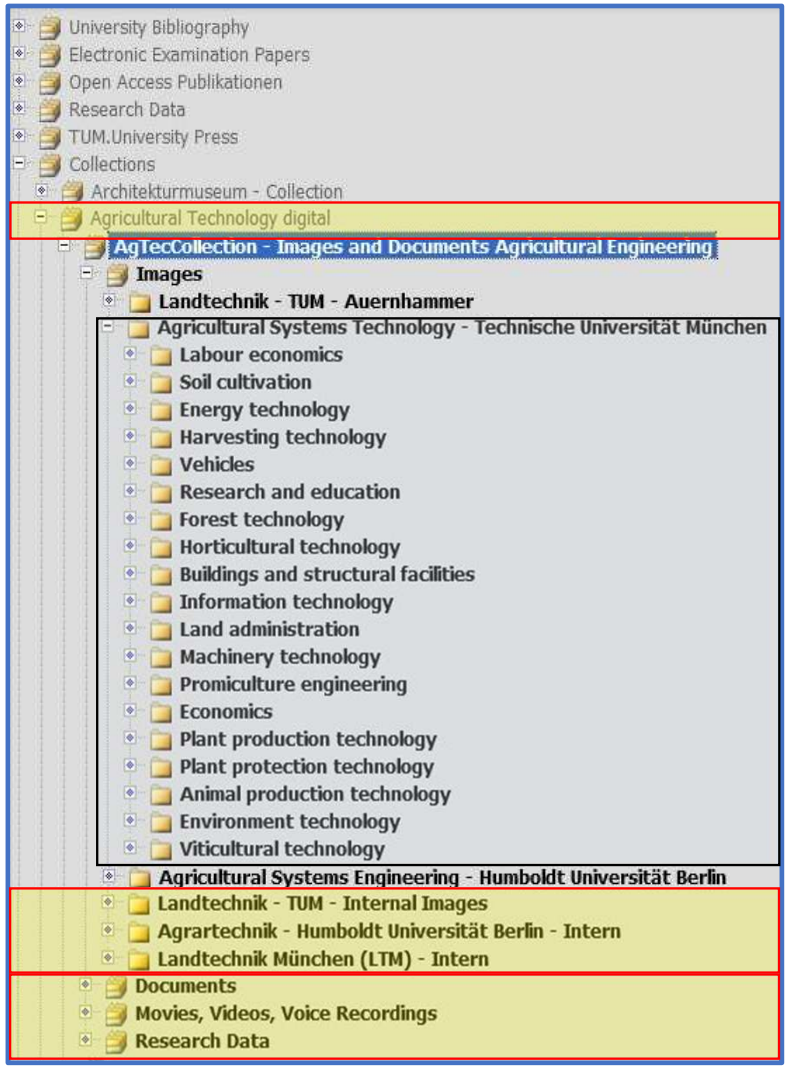
4. Downloads and User Interfaces

5. Further Challenges

6. Conclusions

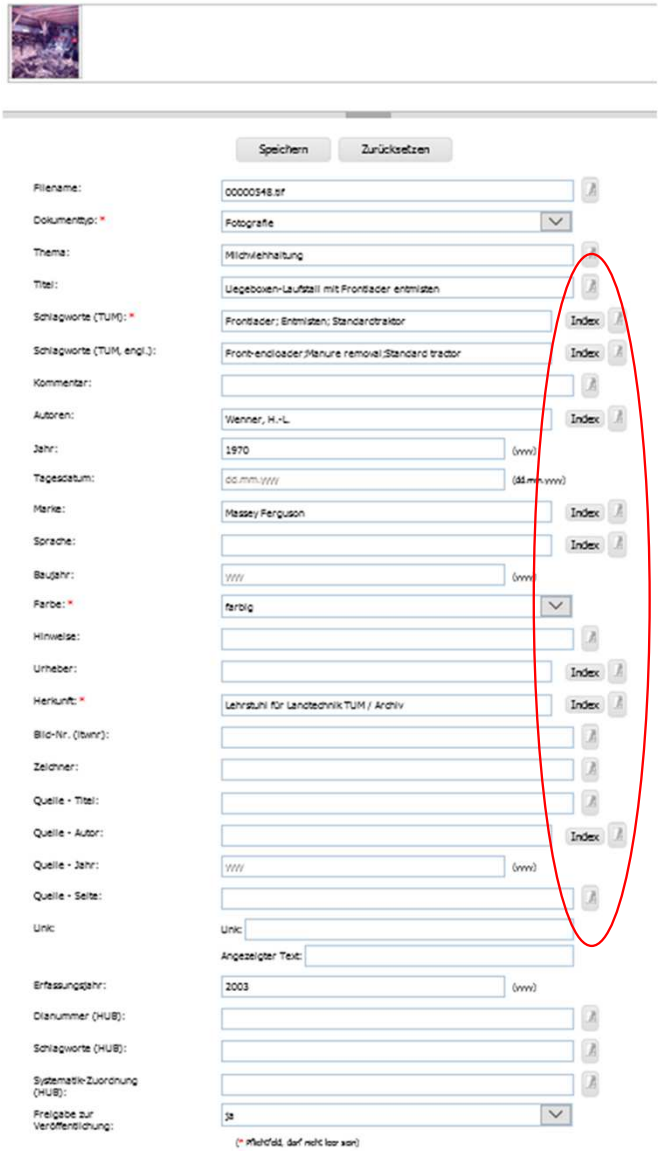
Classification of AgTecCollection

- Team mediaTUM® creates the classification system based on the existing classification at the chair with collections for images and documents
- A directory has max. 3 subdirectories (folders)
- The directory structure corresponds to keywording (e.g. an image with tires is classified as “Machinery technology/Driveline & Hitch systems/ Tyres/Type”)
- Extension with collections for videos/films and research data
- Internal directories for "not visible directories”



Indexing and publication in case of available Metadata

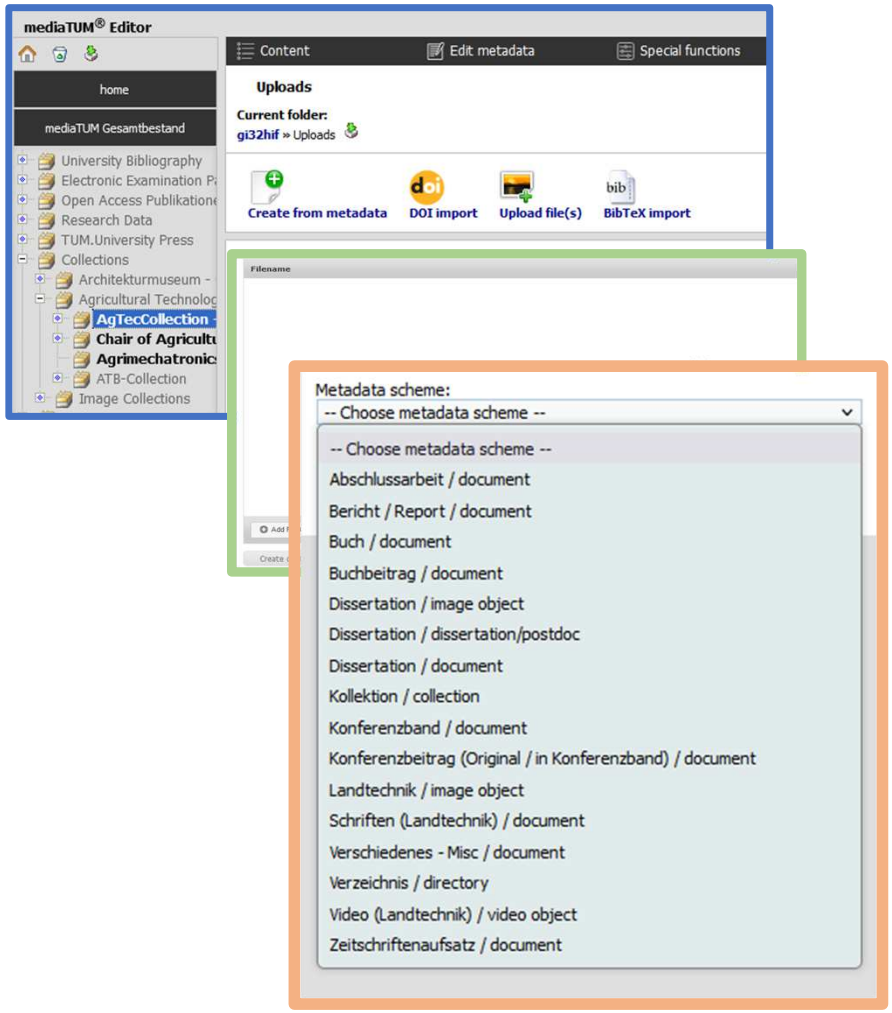
- Digitized images are uploaded by the mediaTUM® team, inserting the available metadata (EXCEL file) from the scan action into “Editing folders”
- **Per image** for indexing and publication in the classification folder(s) **3-5 min** are required (publication in multiple classification folders is possible)
- **Per document** for indexing and publication in the classification folder(s) **10-15 min** are required (publication in multiple classification folders is possible)
- In addition to general indices, a closed keyword index "agricultural technology" is created
- Successive expansion of the metadata schemes are made by the mediaTUM® team as required



Workflow for upload, indexing and publication in case of new objects

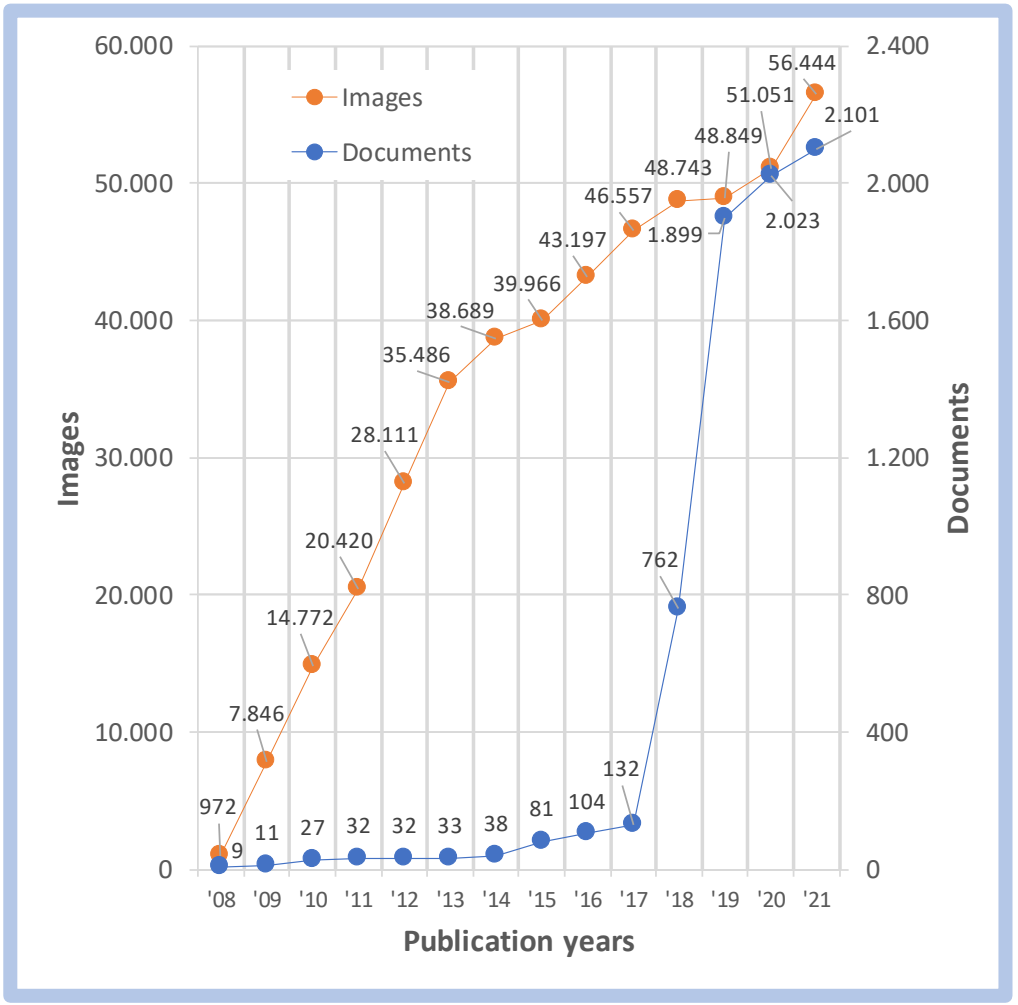
- Open Upload folder
  - Select Upload file(s)
    - Drag files into upload window and start upload
      - Select required “Metadata scheme”
        - Select “Create object”

- Perform indexing and publication for each uploaded object as shown before



Publication activity for images and documents

- Publication of the images mainly 2008 - 2013, 2016 -2018 and in 2020-2021
- Accompanying publication of documents 2008 to 2017
- Focus on publication of documents 2017 to 2020



Published objects by the end of 2021

- The repository is dominated by images
- With the images predominantly photographs with about 55 % share

  In addition, a high proportion of schematic drawings and diagrams with about 35 %
- Documents with about 50 % as publications (book, conference, journal) and about 50 % reports (research reports, dissertations, student research projects)

Object type	*Numbers*	*Share*
Images	56,444	96.4
Documents	2,101	3.5
Movies & Videos	4	0.0
Research data	4	0.0
Total	58,553	100.0

Image type	*Numbers*	*Share*
Photography	31,526	55.9
Overview	4,870	8.6
Schematic drawing	10,340	18.3
Diagram	9,192	16.3
Mapping	516	0.9
Total	56,444	100.0

Document type	*Numbers*	*Share*
Book & Contribution	163	7,8
Conference & Contribution	140	6,7
Journal article	727	34,6
Research report	457	21,8
Dissertation & Habilitation	110	5,2
Term paper	484	23,0
Miscellaneous	20	1,0
Total	2,101	100.0

Outline

1. What to do when…
2. mediaTUM® and Digitalization
3. Indexing and Publication

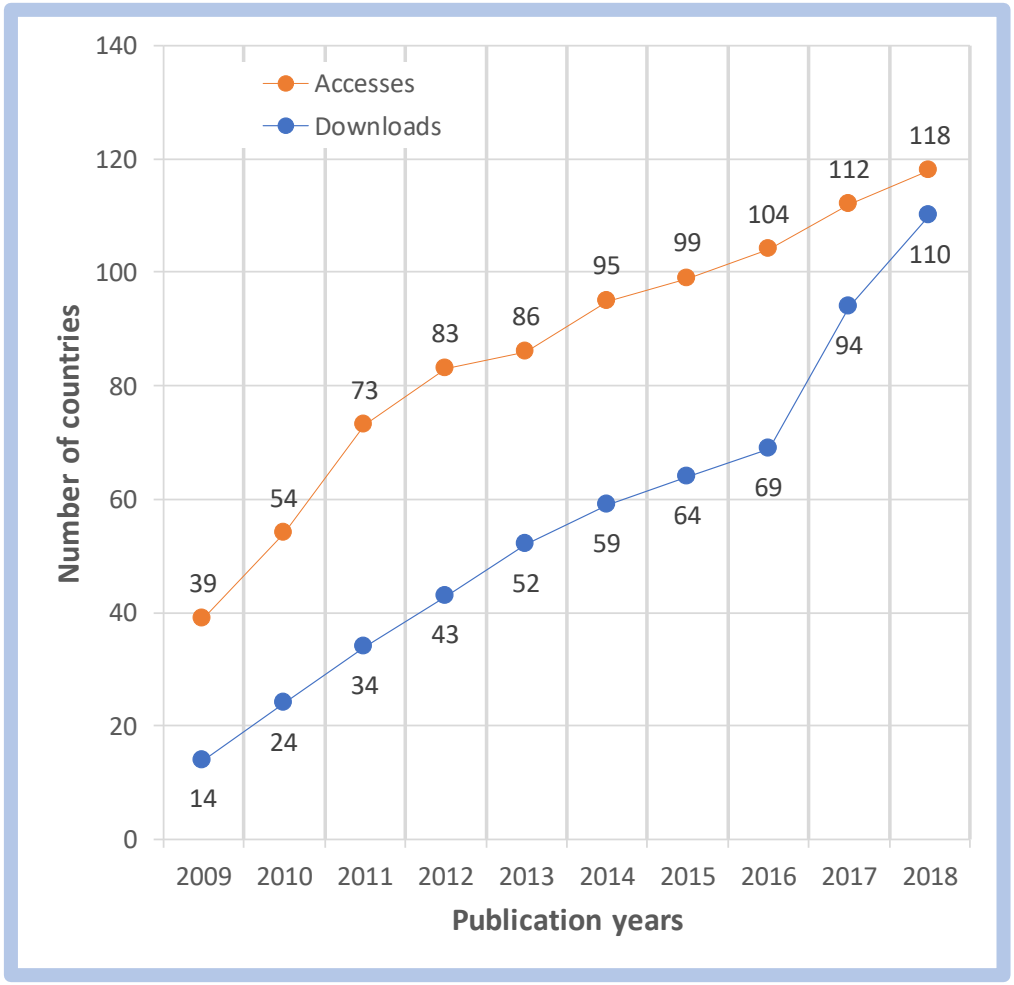
4. Downloads and User Interfaces

5. Further Challenges
6. Conclusions

Accesses and downloads

- Accesses and downloads increase continuously with the addition of new countries
- As of 2018, the numbers of countries with downloads are approaching those of accesses (after eng. keywords are available)

- In 2018 already more than 50 % of published objects downloaded more than once
- Average downloads
  - per image = 2.5
  - per document = 16



Download countries 2009-2018

- Steady increase in the number of new countries with downloads
- But each year decreasing number of newly added countries until 2016
- The "Engl. keywords" introduced at the end of 2016 opened up the collection content to many more countries (now everyone finds something!)

English access is essential !

Year	Added countries with downloads
2009	Austria, Belgium, Switzerland, Germany, France, Italy, Netherlands, Romania, Luxembourg, Latvia, Poland, Thailand, Bosnia and Herzegovina
2010	Denmark, Norway, Iran, Spain, United States, Canada, China, Czech Republic, Serbia, Slovak Republic
2011	Croatia, Slovenia, Estonia, Finland, Great Britain, Japan, Sweden, Turkey, Hungary, Bulgaria
2012	Satellite Privider, Syria, Liechtenstein, Oman, Lithuania, Russia, Brazil, Armenia, Israel
2013	Greece, Portugal, India, Lebanon, Colombia, Ukraine, Mexico, European Union, South Africa, Taiwan
2014	Ireland, Singapore, Turkmenistan, Egypt, New Zealand, Kuwait, Iceland
2015	Australia, Azerbaijan, Korea (South), Philippines
2016	Argentina, Aland Islands, Chile, Macedonia, Malaysia
2017*	Indonesia, United Arab Emirates, Morocco, Hong Kong, Kenya, Suriname, Viet Nam, Cambodia, Moldova, Mongolia, Algeria, Uganda, Cameroon, Peru, Pakistan, Venezuela, Bangladesh, Belarus, Papua New Guinea, Dominican Republic, Ethiopia, Guatemala, Kazakhstan, Bolivia, Jamaica
2018	Ivory Coast, Paraguay, Tanzania, Uruguay, Uzbekistan, Rwanda, Namibia, Saudi Arabia, El Salvador, Yemen, Albania, Kyrgyzstan, Guinea, Nepal, Panama, Iraq

*Nov. 2016: English keywords added to metadata images (Status: 2018-12-31)

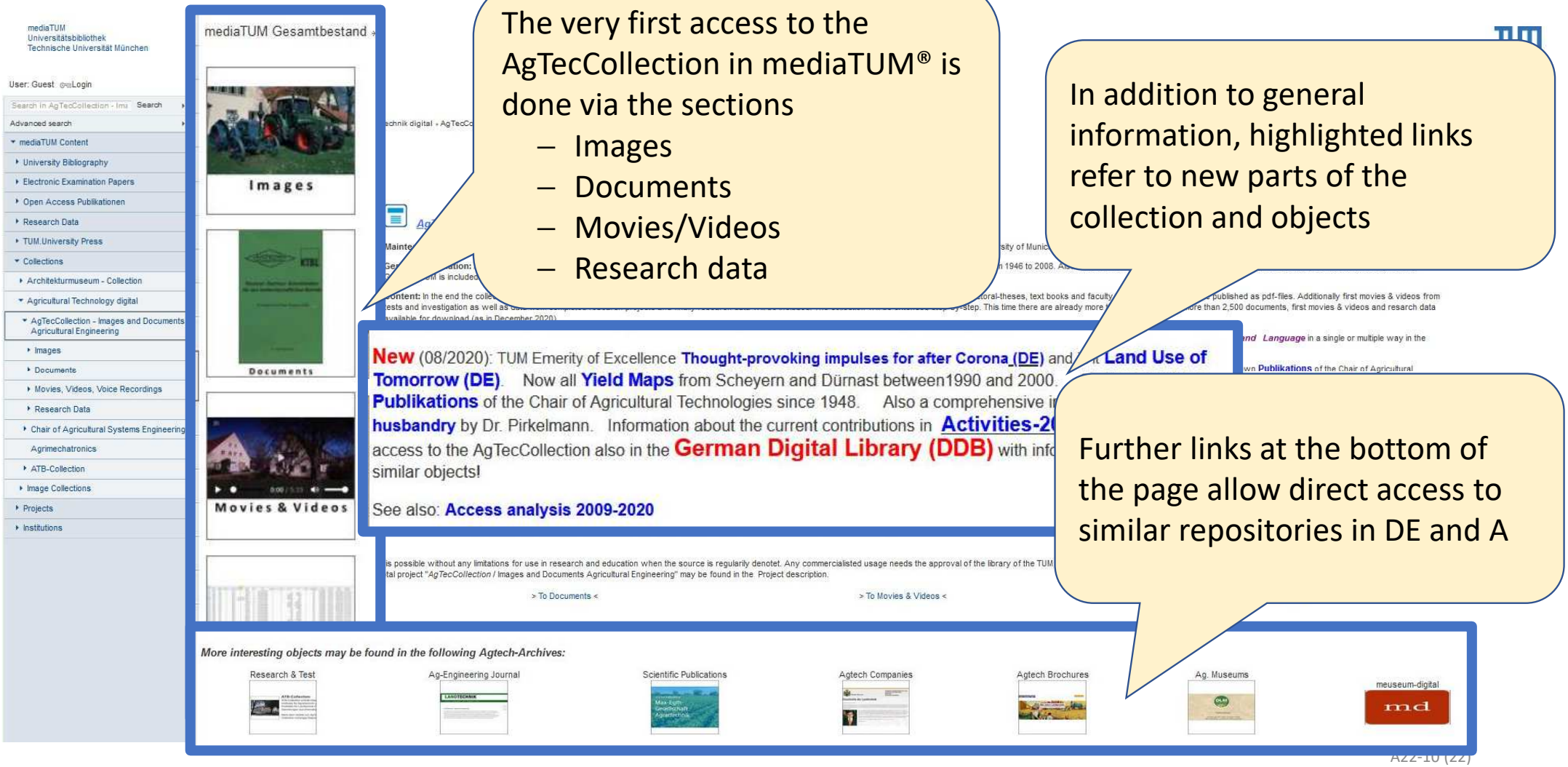
Download activities by countries

- A large proportion of downloads cannot be allocated to countries (insufficient analysis algorithm)
- D, USA and A dominate the downloads
- Only countries from the northern half of the globe are represented in the top20 (more than 99 % of downloads)
- The top20 countries are "loyal users" of the collection (average of 58 % share/month means downloads every second month)
- Unexpectedly high downloads are recorded even for short-term use (e.g. Oman)

Rank	*Country*	*Downloads*	*Share*	*Months*	*Share*
1	Not recognized	161,946	38. 29	110	99. 1
2	Germany	156,251	36. 95	111	100
3	USA	61,849	14. 62	83	74. 8
4	Austria	15,975	3. 78	108	97. 3
5	China	3,981	0. 94	34	30. 6
6	Switzerland	3,462	0. 82	95	85. 6
7	Netherlands	3,004	0. 71	98	88. 3
8	Polen	2,068	0. 49	89	80. 2
9	Great Britain	1,299	0. 31	55	49. 5
10	Oman	1,223	0. 29	4	3. 6
11	Belgium	1,218	0. 29	62	55. 9
12	Ukraine	997	0. 24	28	25. 2
13	Italy	994	0. 24	78	70. 3
14	Greece	992	0. 23	29	26. 1
15	Canada	976	0. 23	65	58. 6
16	France	933	0. 22	59	53. 2
17	Rumania	604	0. 14	54	48. 6
18	Luxemburg	519	0. 12	65	58. 6
19	Hungary	518	0. 12	48	43. 2
20	Russia	425	0. 10	43	38. 7
...	...	...	...	...	...
110	Iraq	1	0	1	0

As of: 2018-12-31

Homepage - Sections



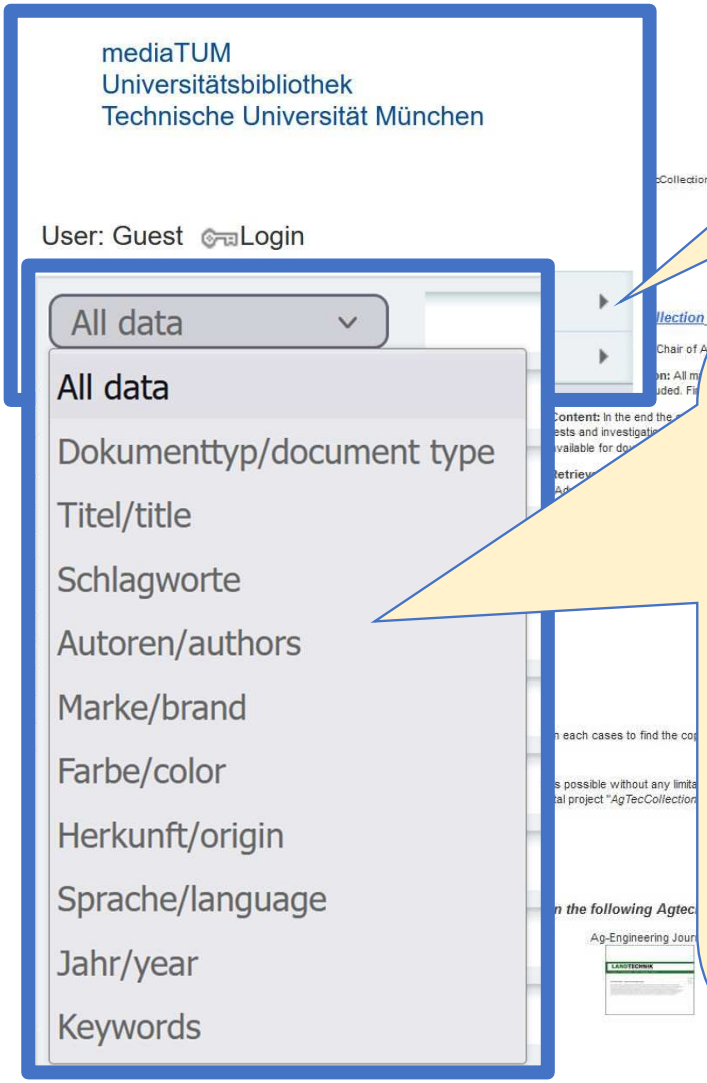
The very first access to the AgTecCollection in mediaTUM® is done via the sections

- Images
- Documents
- Movies/Videos
- Research data

In addition to general information, highlighted links refer to new parts of the collection and objects

Further links at the bottom of the page allow direct access to similar repositories in DE and A

Homepage and search options (User interface of mediaTUM®)



The "Simple Search" in mediaTUM® corresponds to the "GOOGLE Search" available worldwide and normally ends up with hundreds of objects

While the “Advanced Search” offers options to allow very specific and detailed results with:

- Document type (Photograph, Overview, Scheme, Diagram, Map)
- Authors (Index)
- Brand (Index)
- Color (colored, monochrome, black and white)
- Origin (Index)
- Language (Index)
- Year (from - to)
- Keywords (Index)

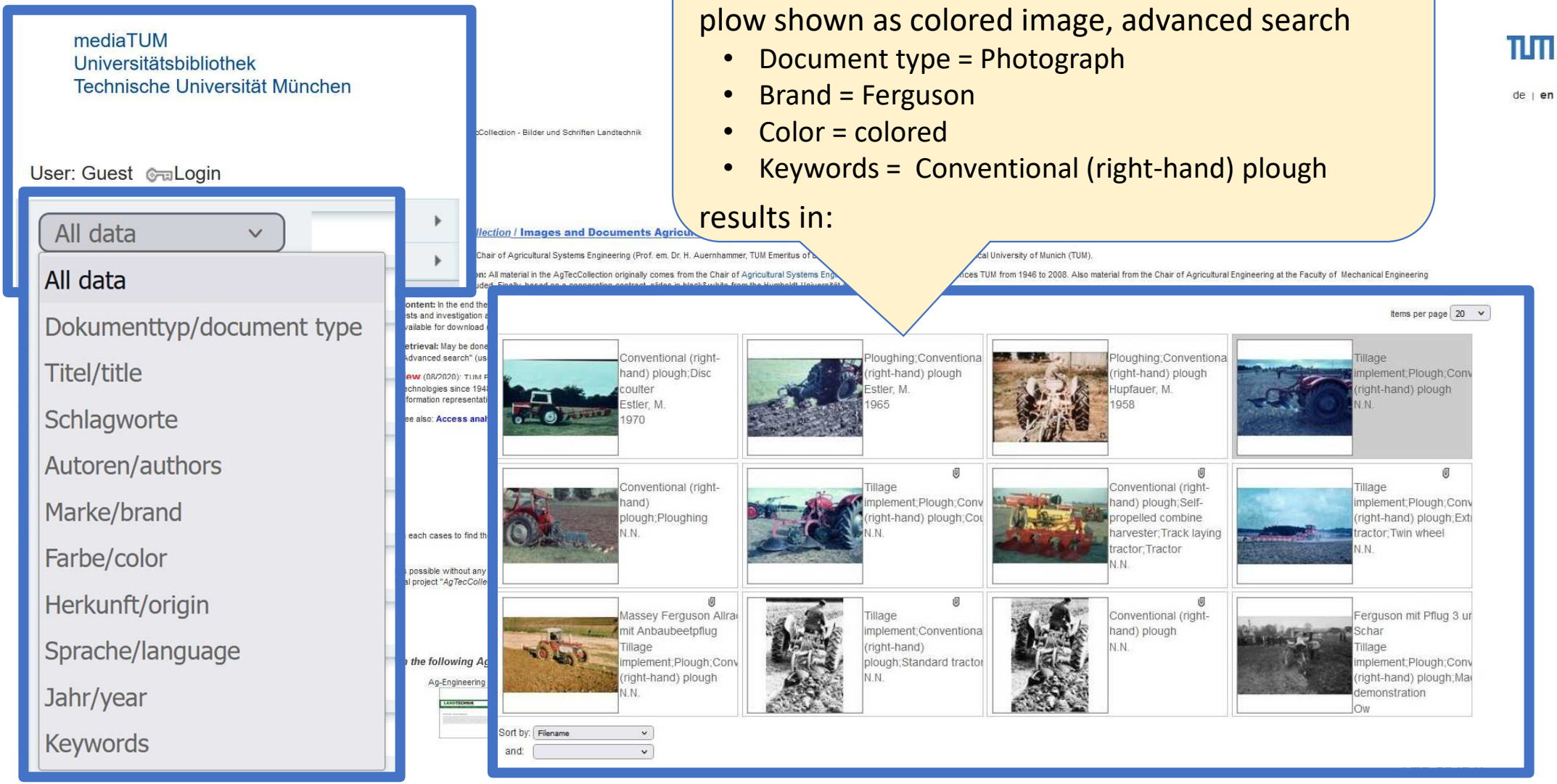
in up to 10 selected criteria

Homepage and advanced search

Example: Ferguson tractor with rear-mounted plow shown as colored image, advanced search

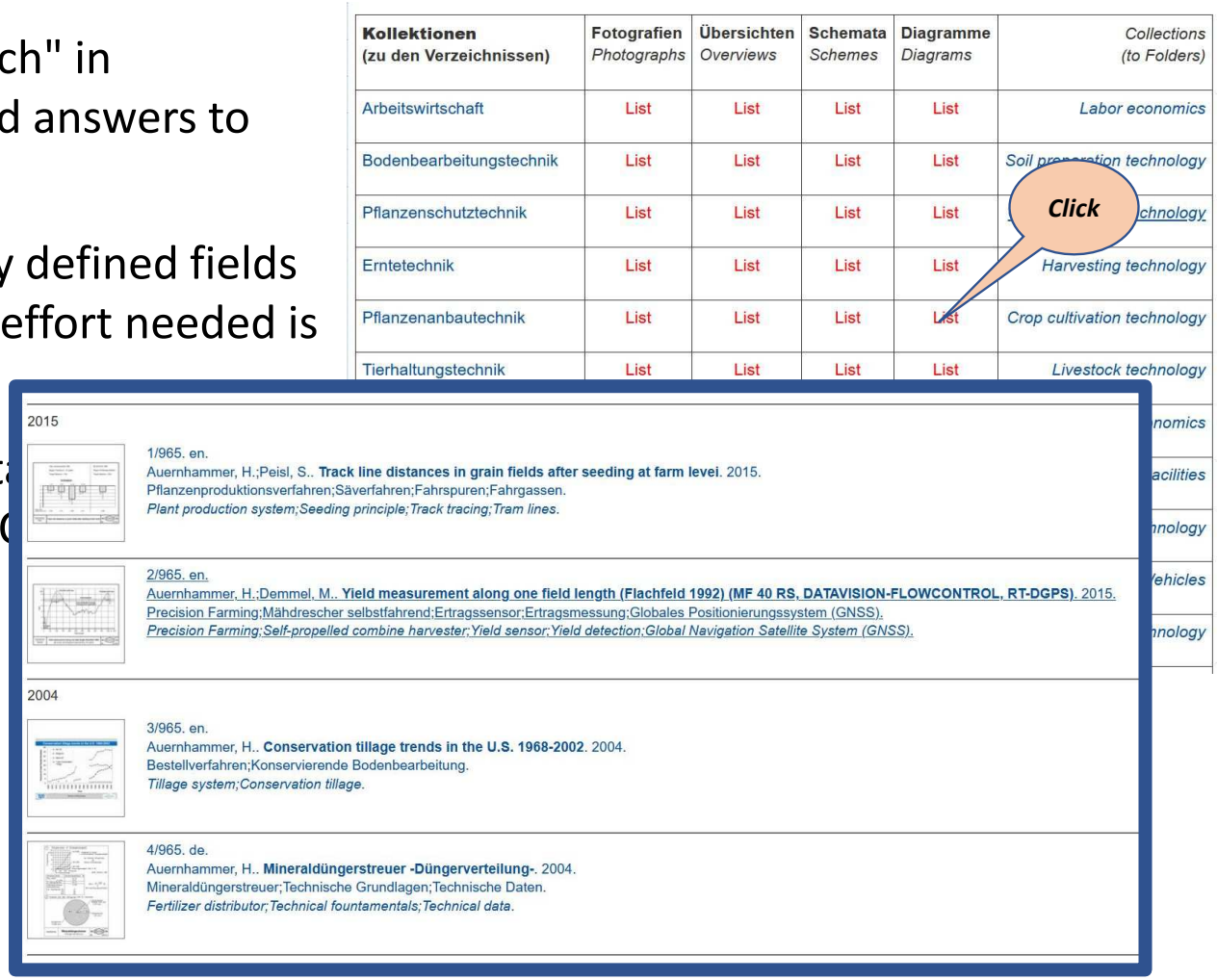
- Document type = Photograph
- Brand = Ferguson
- Color = colored
- Keywords = Conventional (right-hand) plough

results in:



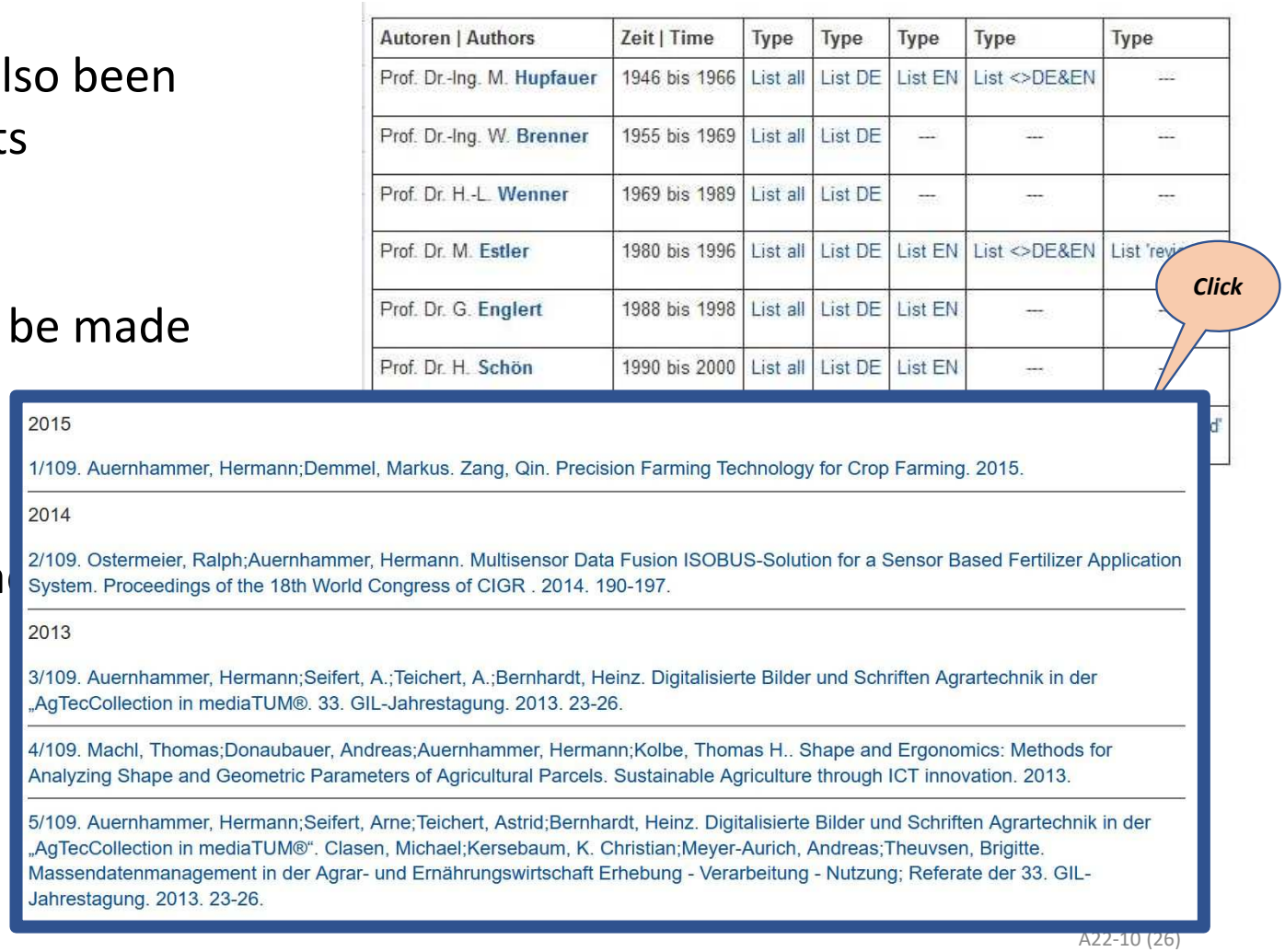
User friendly AgTecCollection Interface with “Link - show - find” – Example Images

- **As shown**, the "Advanced Search" in mediaTUM allows very targeted answers to selected questions
- **However**, if searches for clearly defined fields of work are required, then the effort needed is relatively high
- **Therefore**, so-called selection t… been integrated into the AgTec… such questions



User friendly AgTecCollection Interface with “Link - show - find”– Example Documents

- **Something similar** has also been integrated for documents
- There, the selection can be made **according to languages**
- And in the special case a **decades**



Autoren | Authors	Zeit | Time	Type	Type	Type	Type	Type
Prof. Dr.-Ing. M. **Hupfauer**	1946 bis 1966	List all	List DE	List EN	List <>DE&EN	---
Prof. Dr.-Ing. W. **Brenner**	1955 bis 1969	List all	List DE	---	---	---
Prof. Dr. H.-L. **Wenner**	1969 bis 1989	List all	List DE	---	---	---
Prof. Dr. M. **Estler**	1980 bis 1996	List all	List DE	List EN	List <>DE&EN	List "revi
Prof. Dr. G. **Englert**	1988 bis 1998	List all	List DE	List EN	---	
Prof. Dr. H. **Schön**	1990 bis 2000	List all	List DE	List EN	---	

Click

2015

1/109. Auernhammer, Hermann;Demmel, Markus. Zang, Qin. Precision Farming Technology for Crop Farming. 2015.

2014

2/109. Ostermeier, Ralph;Auernhammer, Hermann. Multisensor Data Fusion ISOBUS-Solution for a Sensor Based Fertilizer Application System. Proceedings of the 18th World Congress of CIGR . 2014. 190-197.

2013

3/109. Auernhammer, Hermann;Seifert, A.;Teichert, A.;Bernhardt, Heinz. Digitalisierte Bilder und Schriften Agrartechnik in der „AgTecCollection in mediaTUM®. 33. GIL-Jahrestagung. 2013. 23-26.

4/109. Machl, Thomas;Donaubauer, Andreas;Auernhammer, Hermann;Kolbe, Thomas H.. Shape and Ergonomics: Methods for Analyzing Shape and Geometric Parameters of Agricultural Parcels. Sustainable Agriculture through ICT innovation. 2013.

5/109. Auernhammer, Hermann;Seifert, Arne;Teichert, Astrid;Bernhardt, Heinz. Digitalisierte Bilder und Schriften Agrartechnik in der „AgTecCollection in mediaTUM®“. Clasen, Michael;Kersebaum, K. Christian;Meyer-Aurich, Andreas;Theuvsen, Brigitte. Massendatenmanagement in der Agrar- und Ernährungswirtschaft Erhebung - Verarbeitung - Nutzung; Referate der 33. GIL-Jahrestagung. 2013. 23-26.

AgTecCollection – Documentation of all previous Activities allows Repeatability

- But, all these are only selected examples and possibilities
- All in all, far more and much more comprehensive information on past activities could be shown and discussed
- They are all documented and can be viewed by everyone retrospectively up to the very first considerations in so-called activity listings.

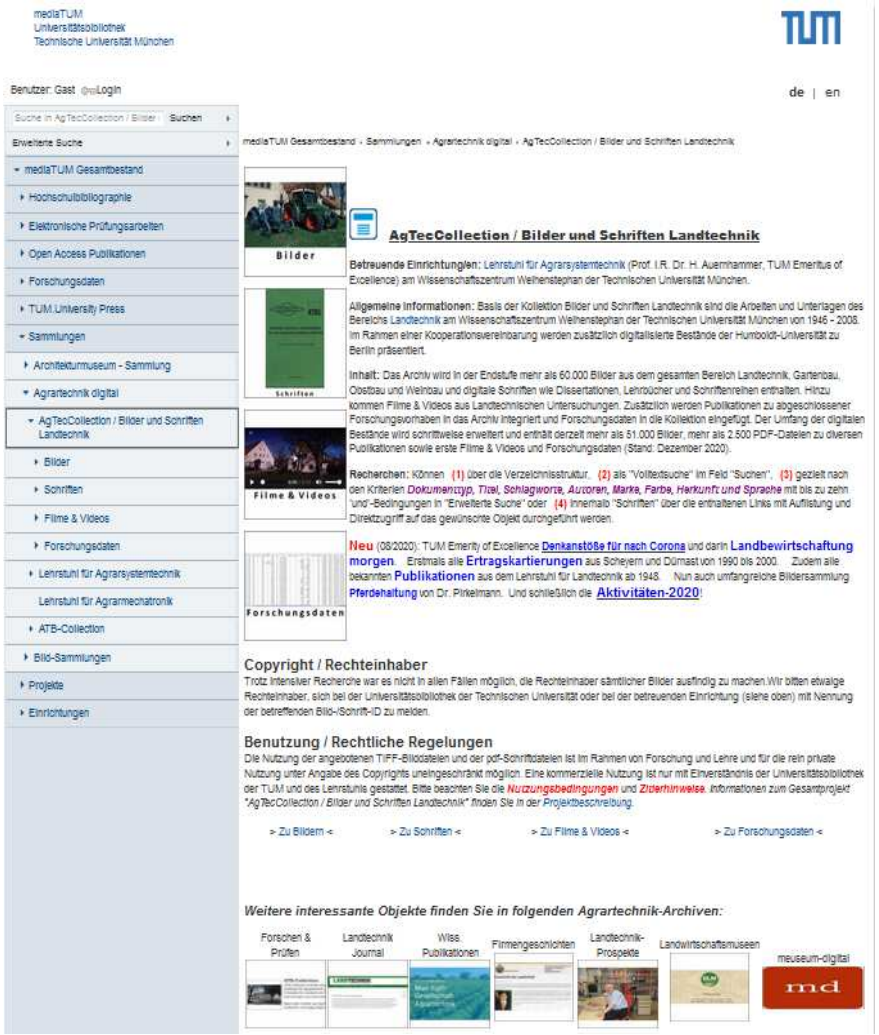
	Datum/Date	Activities in 2021
iften, 6 ufwand	31-12-2021	At the end of the year, the collection contains 52,875 images, 2,471 scriptures, 6 films/videos and 14 objects in the research data for public access. In addition, 5,120 images and 130 documents are stored in the protected internal area. The total workload for the AgTecCollection work this year was 507 hours.
n. ischer	16-11-2021	The indexing and publication of all 7,706 previously unpublished drawings from 1974 to 1989 has been completed. Of these, 1,714 were moved to the internal area due to poor quality or fragmentary presentation.
ür den 100- einer er	20-04-2021	For the first time, an analysis of the accesses to the AgTecCollection is prepared for the period 2009 to 2020. The respective top100 accesses are explicitly listed with the respective metadata and concluded with a classified access table. Conclusions from the analysis conclude the publication.
nd zu th en für die	20-03-2021	For images of Landtechnik Weihenstephan, extended search options with associated notes on the procedure and results including new selection tables by mechanization areas and for drawings by decades are released for use.

Lessons learned: AgTecCollection as of today

- The decision to "preserve all analog material" became a mammoth task
- Only the availability of a platform, library assistance and the help of IT-specialists made it possible to build and design it
- Domestic and worldwide use confirm the need for digitized analog knowledge
- English access is indispensable for this

→ And so the question arises:

- **Is this all ?**
- **What is to be concluded from this ?**
- **And what is, what would be done then ?**



Outline

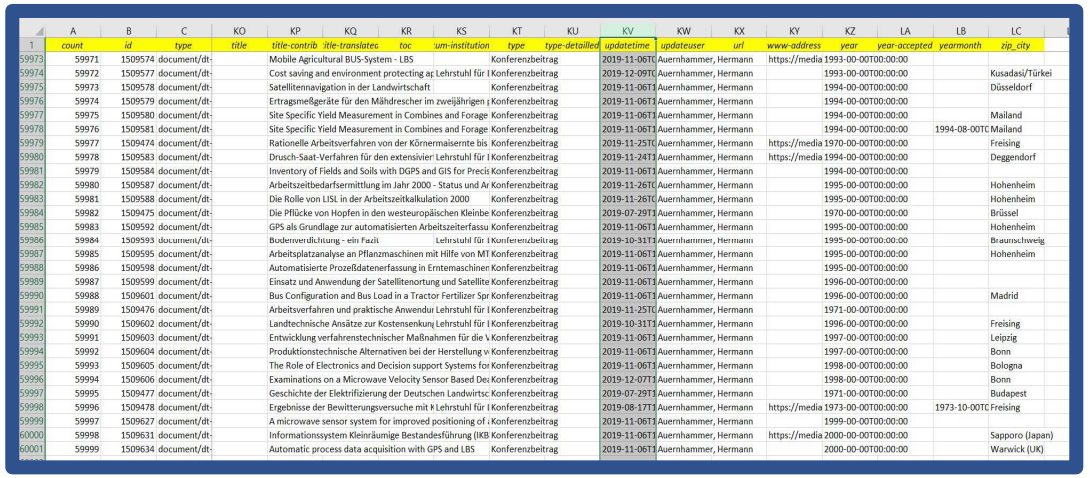
1. What to do when…
2. mediaTUM® and Digitalization
3. Indexing and Publication
4. Downloads and User Interfaces

5. Further Challenges

6. Conclusions

AgTecCollection (and other repositories too) more than just search and download ?

- A digital repository means
  - Software
  - Objects
  - Metadata
- Objects and metadata are the real treasure in the system, but of course they do not have to be in the same place
- And so the metadata gets a special meaning, because it can always be connected with the objects about their appropriate links wherever the objects are available



	A	B	C	KO	KP	KQ	KR	KS	KT	KU	KV	KW	KX	KY	KZ	LA	LB	LC
1	count	id	type	title	title-contrib	title-translated	toc	um-institution	type	type-detailled	updatetime	updateuser	url	www-address	year	year-accepted	yearmonth	zip_city
59973	59971	1509574	document/dt		Mobile Agricultural BUS-System - LBS				Konferenzbeitrag		2019-11-06T0	Auernhammer, Hermann		https://media	1993-00-00T00:00:00			
59974	59972	1509577	document/dt		Cost saving and environment protecting ap			Lehrstuhl für I	Konferenzbeitrag		2019-12-09T0	Auernhammer, Hermann			1993-00-00T00:00:00			Kusadasi/Türkei
59975	59973	1509578	document/dt		Satellitennavigation in der Landwirtschaft				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1994-00-00T00:00:00			Düsseldorf
59976	59974	1509579	document/dt		Ertragsmeßgeräte für den Mähdrescher im zweijährigen				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1994-00-00T00:00:00			
59977	59975	1509580	document/dt		Site Specific Yield Measurement in Combines and Forage				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1994-00-00T00:00:00			Mailand
59978	59976	1509581	document/dt		Site Specific Yield Measurement in Combines and Forage				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1994-00-00T00:00:00		1994-08-00T0	Mailand
59979	59977	1509474	document/dt		Rationelle Arbeitsverfahren von der Körnermaisernte bis				Konferenzbeitrag		2019-11-25T0	Auernhammer, Hermann		https://media	1970-00-00T00:00:00			Freising
59980	59978	1509583	document/dt		Drusch-Saat-Verfahren für den extensivier			Lehrstuhl für I	Konferenzbeitrag		2019-11-24T1	Auernhammer, Hermann		https://media	1994-00-00T00:00:00			Deggendorf
59981	59979	1509584	document/dt		Inventory of Fields and Soils with DGPS and GIS for Precis				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1994-00-00T00:00:00			
59982	59980	1509587	document/dt		Arbeitszeitbedarfsermittlung im Jahr 2000 - Status und Ar				Konferenzbeitrag		2019-11-26T0	Auernhammer, Hermann			1995-00-00T00:00:00			Hohenheim
59983	59981	1509588	document/dt		Die Rolle von LISL in der Arbeitszeitkalkulation 2000				Konferenzbeitrag		2019-11-26T0	Auernhammer, Hermann			1995-00-00T00:00:00			Hohenheim
59984	59982	1509475	document/dt		Die Pflücke von Hopfen in den westeuropäischen Kleinbe				Konferenzbeitrag		2019-07-29T1	Auernhammer, Hermann			1970-00-00T00:00:00			Brüssel
59985	59983	1509592	document/dt		GPS als Grundlage zur automatisierten Arbeitszeiterfassu				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1995-00-00T00:00:00			Hohenheim
59986	59984	1509593	document/dt		Bodenverdichtung - ein Fazit			Lehrstuhl für I	Konferenzbeitrag		2019-10-31T1	Auernhammer, Hermann			1995-00-00T00:00:00			Braunschweig
59987	59985	1509595	document/dt		Arbeitsplatzanalyse an Pflanzmaschinen mit Hilfe von MT				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1995-00-00T00:00:00			Hohenheim
59988	59986	1509598	document/dt		Automatisierte Prozeßdatenerfassung in Erntemaschinen				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1995-00-00T00:00:00			
59989	59987	1509599	document/dt		Einsatz und Anwendung der Satellitenortung und Satellite				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1996-00-00T00:00:00			
59990	59988	1509601	document/dt		Bus Configuration and Bus Load in a Tractor Fertilizer Spr				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1996-00-00T00:00:00			Madrid
59991	59989	1509476	document/dt		Arbeitsverfahren und praktische Anwendu			Lehrstuhl für I	Konferenzbeitrag		2019-11-25T0	Auernhammer, Hermann			1971-00-00T00:00:00			
59992	59990	1509602	document/dt		Landtechnische Ansätze zur Kostensenkun			Lehrstuhl für I	Konferenzbeitrag		2019-10-31T1	Auernhammer, Hermann			1996-00-00T00:00:00			Freising
59993	59991	1509603	document/dt		Entwicklung verfahrenstechnischer Maßnahmen für die V				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1997-00-00T00:00:00			Leipzig
59994	59992	1509604	document/dt		Produktionstechnische Alternativen bei der Herstellung v				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1997-00-00T00:00:00			Bonn
59995	59993	1509605	document/dt		The Role of Electronics and Decision support Systems for				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1998-00-00T00:00:00			Bologna
59996	59994	1509606	document/dt		Examinations on a Microwave Velocity Sensor Based De				Konferenzbeitrag		2019-12-07T1	Auernhammer, Hermann			1998-00-00T00:00:00			Bonn
59997	59995	1509477	document/dt		Geschichte der Elektrifizierung der Deutschen Landwirtsc				Konferenzbeitrag		2019-07-29T1	Auernhammer, Hermann			1971-00-00T00:00:00			Budapest
59998	59996	1509478	document/dt		Ergebnisse der Bewitterungsversuche mit K			Lehrstuhl für I	Konferenzbeitrag		2019-08-17T1	Auernhammer, Hermann		https://media	1973-00-00T00:00:00		1973-10-00T0	Freising
59999	59997	1509627	document/dt		A microwave sensor system for improved positioning of a				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			1999-00-00T00:00:00			
60000	59998	1509631	document/dt		Informationssystem Kleinräumige Bestandesführung (IKB				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann		https://media	2000-00-00T00:00:00			Sapporo (Japan)
60001	59999	1509634	document/dt		Automatic process data acquisition with GPS and LBS				Konferenzbeitrag		2019-11-06T1	Auernhammer, Hermann			2000-00-00T00:00:00			Warwick (UK)

→ This results in completely new possibilities and challenges, e.g. the AgTecCollection is based on a data matrix (Dec 31, 2021) of

- 58,553 lines (grown to 61,295 to date _ 2022-11-04)
- 348 columns

with a total of 2,613,999 data elements,
there are 1,418,377 with data,
and these contain 2,613,999 words.

AgTecCollection → Big Data ???

- The total of 1,418,377 data elements with the 2,613,999 words in it (numbers are counted as words) represent a very large number
- Their main focus is on the titles, the associated abstracts and the keywords in connection with the authors and the object-type descriptions
- Although they may not be comparable to other Big Data holdings despite the large number, they allow the use of their descriptive and analytical tools in data mining and in artificial intelligence algorithms

id	authors	title	abstract	lt-keywords	type	color
13995	Schön, H.	Funktionen eines Melkrobot		Automatische	Schemazeichr	schwarzweiß
13965	Schön, H.; Bau	Funktionsbereiche im Anbin		Funktionsbere	Schemazeichr	schwarzweiß
701145	N.N.	Funktionsprinzip einr Aufsan		Futtererntete	Schemazeichr	schwarzweiß
702926	N.N.	Funktionsprinzip und Arbeits		Bodenbearbe	Schemazeichr	schwarzweiß
14285	Estler, M.	Funktionsprinzip von Schäl-		Flügelschargru	Schemazeichr	schwarzweiß
701794	N.N.	Funktionsschema der elektro		Tieridentifikat	Schemazeichr	schwarzweiß
701126	N.N.	Funktionsskizze der Compac		Erntetechnik;I	Schemazeichr	schwarzweiß
701796	N.N.	Förderbandverteiler mit sch		Fütterungstec	Schemazeichr	schwarzweiß
14515	N.N.	Großmelkstände		Melkstand	Schemazeichr	schwarzweiß
701703	N.N.	Grundform einer Vorratsrau		Futtervorlage	Schemazeichr	schwarzweiß
14389	N.N.	Hauptbaugruppen und Bewe		Quaderballen	Schemazeichr	schwarzweiß
14388	N.N.	Hauptbaugruppen und Bewe		Quaderballen	Schemazeichr	schwarzweiß
702752	N.N.	Heckanbaugerät		Traktor;Beetp	Schemazeichr	schwarzweiß
701130	N.N.	Hydr. Einrichtung zum Aussc		Erntetechnik;(	Schemazeichr	schwarzweiß
697265	Logos, J. N.	Hydrostatisches Getriebe 'D		Traktor;Antrie	Schemazeichr	schwarzweiß
708555	N.N.	Kettenwandler in einem Get		Traktor;Antrie	Schemazeichr	schwarzweiß
710763	N.N.	Klassisches Spezial-Maissäge		Sämaschine;E	Schemazeichr	schwarzweiß
704674	Krinner, L.	Klemmmechanismus für Flac		Gülle- und Ent	Schemazeichr	schwarzweiß
701132	N.N.	Kolbenpresse zum Brikettier		Erntetechnik;I	Schemazeichr	schwarzweiß
701144	N.N.	Kollergangpresse zum Presse		Erntetechnik;I	Schemazeichr	schwarzweiß
14643	Estler, M.	Konservierende Bodenbearb		Konservieren	Schemazeichr	schwarzweiß
700932	N.N.	Laden - Transport - Einlager		Ernteverfahre	Schemazeichr	schwarzweiß
15209	Auernhamme	Landwirtschaftliches BUS-Sy		Landwirtschaf	Schemazeichr	schwarzweiß
708015	N.N.	Laufbrett am Kastenwagen a		Arbeitsplatz;A	Schemazeichr	schwarzweiß
701568	Rittel, L.	Liebeboxenlaufstall für 60 K		Liegeboxenlau	Schemazeichr	schwarzweiß

AgTec-Metadata allow further helpful analyses and applications !!!

… Data Mining

- Data mining as a sub-concept of knowledge discovery in databases (KDD) enables the discovery of new cross connections and trends in mass data (Big Data)
- The metadata of the AgTecCollection as well as other repositories offer a variety of approaches such as:
  - Authors' fields of work and publication activities
  - Trends in the development of agricultural technology as a whole
  - Differences between development and practical application
  - Time lag of specific techniques between first results and full acceptance
  - others
- Expectations of new research approaches can be evaluated and classified much more realistically

id	authors	title	abstract	it-keywords	type	color
13995	Schön, H.	Funktionen eines Melkrobot		Automatische	Schemazeichr	schwarzweiß
13965	Schön, H.; Ba	Funktionsbereiche im Anbin		Funktionsbere	Schemazeichr	schwarzweiß
701145	N.N.	Funktionsprinzip einr Aufsan		Futtererntete	Schemazeichr	schwarzweiß
702926	N.N.	Funktionsprinzip und Arbeits		Bodenbearbe	Schemazeichr	schwarzweiß
14285	Estler, M.	Funktionsprinzip von Schäl-		Flügelschargru	Schemazeichr	schwarzweiß
701794	N.N.	Funktionsschema der elektr		Tieridentifika	Schemazeichr	schwarzweiß
701126	N.N.	Funktionsskizze der Compac		Erntetechnik;	Schemazeichr	schwarzweiß
701796	N.N.	Förderbandverteiler mit sch		Fütterungstec	Schemazeichr	schwarzweiß
14515	N.N.	Großmelkstände		Melkstand	Schemazeichr	schwarzweiß
701703	N.N.	Grundform einer Vorratsrau		Futtervorlage	Schemazeichr	schwarzweiß
14389	N.N.	Hauptbaugruppen und Bewe		Quaderballen	Schemazeichr	schwarzweiß
14388	N.N.	Hauptbaugruppen und Bewe		Quaderballen	Schemazeichr	schwarzweiß
702752	N.N.	Heckanbaugerät		Traktor;Beetp	Schemazeichr	schwarzweiß
701130	N.N.	Hydr. Einrichtung zum Aussc		Erntetechnik;	Schemazeichr	schwarzweiß
697265	Logos, J. N.	Hydrostatisches Getriebe 'D		Traktor;Antrie	Schemazeichr	schwarzweiß
708555	N.N.	Kettenwandler in einem Get		Traktor;Antrie	Schemazeichr	schwarzweiß
710763	N.N.	Klassisches Spezial-Maissäge		Sämaschine;E	Schemazeichr	schwarzweiß
704674	Krinner, L.	Klemmmechanismus für Fla		Gülle- und Ent	Schemazeichr	schwarzweiß
701132	N.N.	Kolbenpresse zum Brikettier		Erntetechnik;	Schemazeichr	schwarzweiß
701144	N.N.	Kollergangpresse zum Presse		Erntetechnik;	Schemazeichr	schwarzweiß
14643	Estler, M.	Konservierende Bodenbearb		Konservieren	Schemazeichr	schwarzweiß
700932	N.N.	Laden - Transport - Einlager		Ernteverfahre	Schemazeichr	schwarzweiß
15209	Auernhamme	Landwirtschaftliches BUS-Sy		Landwirtscha	Schemazeichr	schwarzweiß
708015	N.N.	Laufbrett am Kastenwagen :		Arbeitsplatz;A	Schemazeichr	schwarzweiß
701568	Rittel, L.	Liebeboxenlaufstall für 60 K		Liegeboxenla	Schemazeichr	schwarzweiß

Results and findings allow for scientifically sound documentation and more adapted research strategies → learning from the past !!!

… AI for Auto Keywording

- In addition to the ID of an object, the associated keywords take a central position in the metadata (true for any repository)
- Artificial intelligence can derive synonymous criteria from a training set for a test set and thus perform an automatic keyword generation
- Because in the AgTecCollection the associated keywords of an object correspond to the classification, automatic classification in the archive is even possible

Training set

ID	Authors	Title	Keywords	Type	Colour	…
714785	Schwarz	AGRIPLAI	Working time requirements;Working m	Overvie	black a	…
722402	Brenner,	Piston pic	Maize;Maize picking attachment;Reble	Photogr	colour	…
724292	N. N.		Braking system;Regulations;Two-axle t	Overvie	black a	…
729048	Schön, H	Injured b	Workforce;Occupational safety;Occup	Overvie	monoc	…
729099	Thomé,	Dimensio	Workplace;Driver's cab;Ergonomics	Overvie	monoc	…
729100	Schön, H	Requirem	Workplace;Driver's cab;Tractor	Overvie	monoc	…
729533	Schön, H	Possibiliti	Precision Livestock Farming;Sensor tec	Overvie	colour	…
1240166	N. N.	Cranksha	Internal combustion engine;Diesel engi	Photogr	colour	…
1240268	Renius, T.		Tractor;Area output;Energy requiremer	Overvie	monoc	…
1240397	N. N.	Small Mu	Ground pressure;Ground trough;Measu	Photogr	colour	…
1240807	N. N.	Knotter	Harvesting technology;Baler;High press	Photogr	colour	…
1465155	Grimm, I	Labour re	Slurry and manure removal technology;	Schema	black a	…

Test set

ID	Authors	Title	Keywords	Type	Colour	…
1465475		Stall part	Stable system;Dairy cattle farming;Cato	Schema	black a	…
1566994	Schön, H	Characte	Stable system;Dairy cattle husbandry;T	Schema	black a	…
1566997	Schön, H	Comparis	Stable system;Dairy cattle farming;Teth	Schema	black a	…
1566998	Auernha	Model: F	Feeding technology;Front loader;Work	Schema	black a	…
1567001	Strehler,	Planning	Storage technology;Drying technology;S	Schema	black a	…
1567004	Schön, H	Stable mi	Milking technology;Tethered stall;Tube	Schema	black a	…
1567404	Pen, C.	Working	Agricultural labour science;Working tim	Schema	black a	…
1570801	Auernha	Data pro	Information technology;Data processin	Mapping	black a	…
1572452	Auernha	Synoptica	Information technology;Climate;Weath	Mapping	black a	…
1572652	Estler, M	Land app	Crop production;Soil;Soil pressure;Soil	Schema	colour	…
1573427	Auernha	Synoptica	Information technology;Climate;Weath	Mapping	black a	…
1573467	Keller, H	Site plan	Research;Teaching;Agricultural enginee	Mapping	black a	…

Auto-keywording enables easy integration of digitized and digital objects into a repository → help for the future !!!

Digital Twin

- Metadata are also the basis for a digital twin
- If they are integrated on a powerful IT platform into storage and retrieval software available there, then:
  - the original metadata system,
  - a linguistically adapted metadata system or
  - a metadata systems with different languages

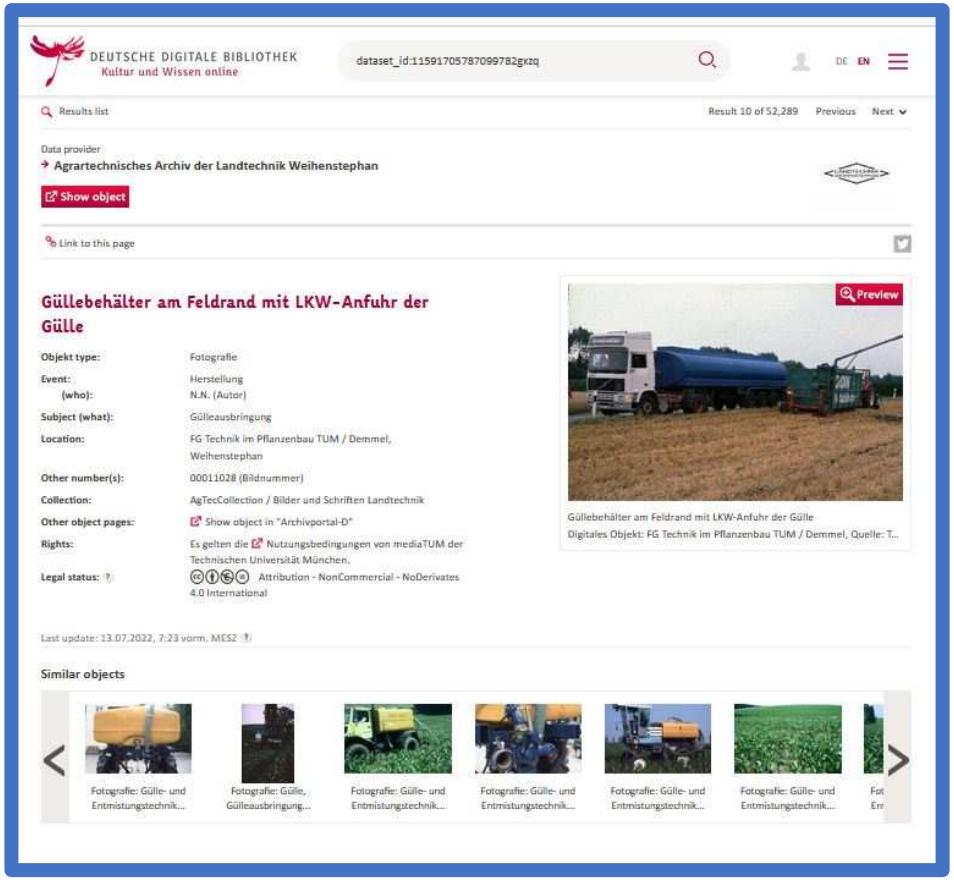
  together with a modified or specifically adapted interface, be made available
- The linguistic adaptation takes place for “object group, title, keywords, type and color”
- The original objects are always referenced via links, updates ensure current adaptations and extensions

ID	*Autoren*	*Titel*	*Schlagworte*	*Typ*	*Farbe*	*...*
714785	Schwarzer, J.	AGRIPLAN - A	Arbeitszeitbed	Übersicht	schwarzweiß	...
722402	Brenner, W.	Kolbenpflücke	Mais;Maispflü	Fotografie	farbig	...
724292	N. N.		Bremssystem;	Übersicht	schwarzweiß	...
729048	Schön, H.;Had	Verletzte Körp	Arbeitskraft;A	Übersicht	einfarbig	...
729099	Thomé, F.-J.	Maße für Eins	Arbeitsplatz;F	Übersicht	einfarbig	...
729100	Schön, H.; Thc	Anforderung a	Arbeitsplatz;F	Übersicht	einfarbig	...
729533	Schön, H.	Possibilities fc	Precision Live	Übersicht	farbig	...
1240166	N. N.	Kurbelwelle	Verbrennungs	Fotografie	farbig	...
1240268	Renius, T.		Traktor;Fläche	Übersicht	einfarbig	...
1240397	N. N.	Kleine Münch	Bodendruck;B	Fotografie	farbig	...
1240807	N. N.	Knoter	Erntetechnik;I	Fotografie	farbig	...
1465155	Grimm, K.;Lan	Arbeitsaufwar	Gülle- und Ent	Schemazeichr	schwarzweiß	...
1465475		Boxenabtrenr	Stallsystem;M	Schemazeichr	schwarzweiß	...
1566994	Schön, H.	Merkmale ver	Stallsystem;M	Schemazeichr	schwarzweiß	...
1566997	Schön, H.	Vergleich vers	Stallsystem;M	Schemazeichr	schwarzweiß	...
1566998	Auernhamme	Modell: Buller	Fütterungstec	Schemazeichr	schwarzweiß	...
1567001	Strehler, A.	Planungsbeisp	Lagertechnik;'	Schemazeichr	schwarzweiß	...
1567004	Schön, H.	Stabiles Melk-	Melktechnik;A	Schemazeichr	schwarzweiß	...
1567404	Pen, C.	Arbeitsprinzip	Landwirtschaf	Schemazeichr	schwarzweiß	...
1570801	Auernhamme	Datenverarbe	Informationst	Kartierung	schwarzweiß	...
1572452	Auernhamme	Synoptical me	Informationst	Kartierung	schwarzweiß	...
1572652	Estler, M.	Landtechnisch	Pflanzenprodu	Schemazeichr	farbig	...
1573427	Auernhamme	Synoptisches	Informationst	Kartierung	schwarzweiß	...
1573467	Keller, H.	Lageplan Weil	Forschung;Lel	Kartierung	schwarzweiß	...

The repository is made available to a wider circle of users via the copyright !!!

First Digital Twin of the AgTecCollection in the “German Digital Library (DDB)” 2022

- The German Digital Library (DDB) provides access to Germany's digitized cultural and scientific heritage
- Collections are included as digital twins, access to the original objects is done via links
- Search is carried out according to DDB's own algorithms (similar to those of mediaTUM)
- In the object presentation, "related objects" are additionally listed, providing the user with much more comprehensive information



The "Digital Twin DDB" confirms the method and opens valuable additional information !!!

Digital Twin adopted to Regional Requirements

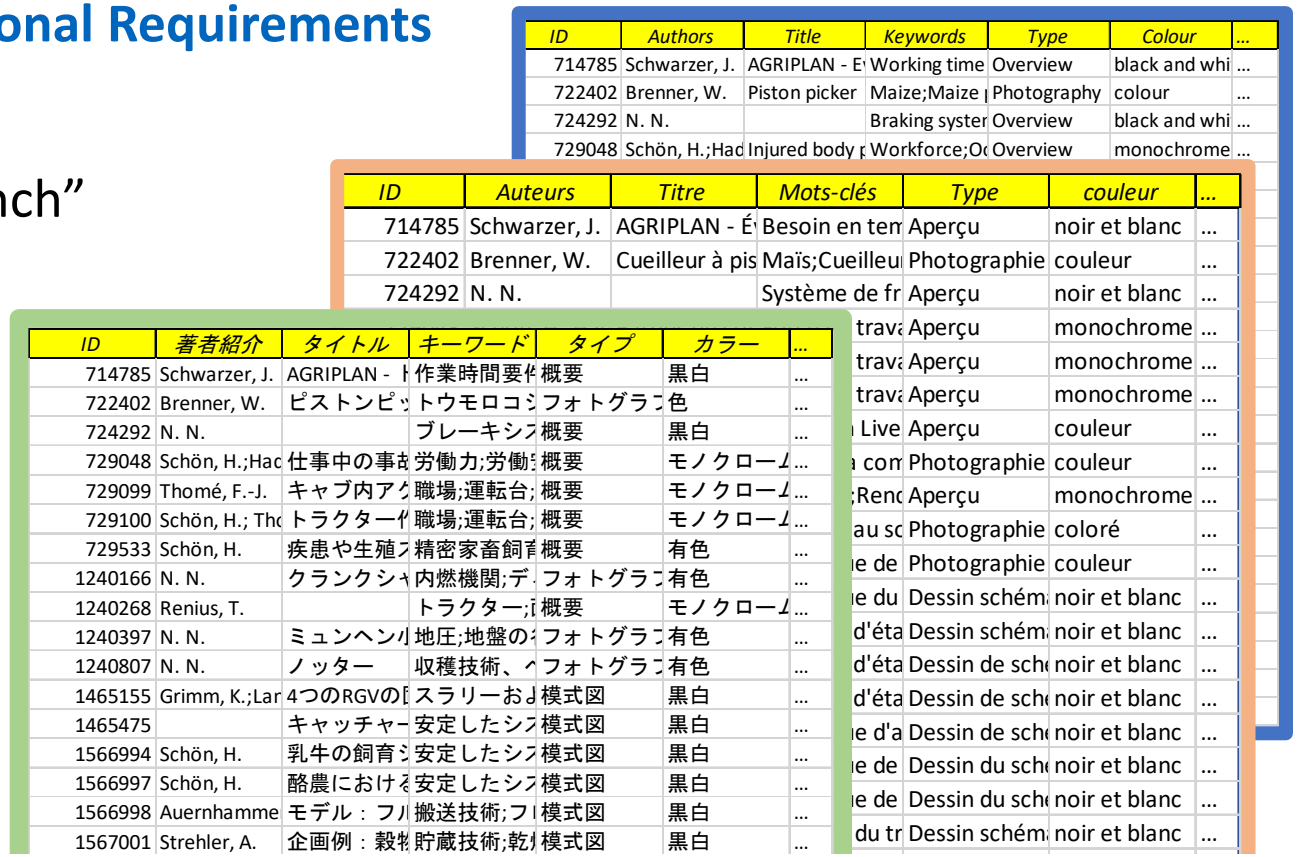
- But the digital twin of the AgTecCollection in the DDB remains still in the German-speaking area
- It is thus still very similar to the original version, but has a very helpful enhancement in the presentation of results
- A much more extensive regional adaptation would be possible through translations in the metadata columns, which can currently be carried out quickly and with high precision by suitable programs (e.g. DEEPL), shown here with the exclusive "English language"

ID	Authors	Title	Keywords	Type	Colour	...
714785	Schwarzer, J.	AGRIPLAN - E	Working time	Overview	black and whi	...
722402	Brenner, W.	Piston picker	Maize;Maize	Photography	colour	...
724292	N. N.		Braking syster	Overview	black and whi	...
729048	Schön, H.;Had	Injured body	Workforce;O	Overview	monochrome	...
729099	Thomé, F.-J.	Dimensions fo	Workplace;Dr	Overview	monochrome	...
729100	Schön, H.; Tho	Requirements	Workplace;Dr	Overview	monochrome	...
729533	Schön, H.	Possibilities fo	Precision Live	Overview	coloured	...
1240166	N. N.	Crankshaft	Internal comb	Photography	coloured	...
1240268	Renius, T.		Tractor;Area	Overview	monochrome	...
1240397	N. N.	Small Munich	Ground pressu	Photography	coloured	...
1240807	N. N.	Knotter	Harvesting tec	Photography	coloured	...
1465155	Grimm, K.;Lan	Labour requir	Slurry and ma	Schematic dra	black and whi	...
1465475		Stall partition	Stable system	Schematic dra	black and whi	...
1566994	Schön, H.	Characteristic	Stable system	Schematic dra	black and whi	...
1566997	Schön, H.	Comparison o	Stable system	Schematic dra	black and whi	...
1566998	Auernhamme	Model: Feedir	Feeding techn	Schematic dra	black and whi	...
1567001	Strehler, A.	Planning exan	Storage techn	Schematic dra	black and whi	...
1567004	Schön, H.	Stable milking	Milking techn	Schematic dra	black and whi	...
1567404	Pen, C.	Working princ	Agricultural la	Schematic dra	black and whi	...
1570801	Auernhamme	Data processi	Information t	Mapping	black and whi	...
1572452	Auernhamme	Synoptical me	Information t	Mapping	black and whi	...
1572652	Estler, M.	Land applicati	Crop producti	Schematic dra	coloured	...
1573427	Auernhamme	Synoptical me	Information t	Mapping	black and whi	...
1573467	Keller, H.	Site plan Weih	Research;Tea	Mapping	black and whi	...

This would be a basic version for the whole scientific AgTec community !!!

Digital Twin adopted to Regional Requirements

- And of course also in "French"
- Or in "Japanese
- Or even further in all languages, which are spoken on a continent (Europe, Africa, South America, Australia and New Zealand, Middle



ID	Authors	Title	Keywords	Type	Colour	...
714785	Schwarzer, J.	AGRIPLAN - E	Working time	Overview	black and whi	...
722402	Brenner, W.	Piston picker	Maize;Maize p	Photography	colour	...
724292	N. N.		Braking syster	Overview	black and whi	...
729048	Schön, H.;Had	Injured body p	Workforce;Oc	Overview	monochrome	...

ID	Auteurs	Titre	Mots-clés	Type	couleur	...
714785	Schwarzer, J.	AGRIPLAN - É	Besoin en tem	Aperçu	noir et blanc	...
722402	Brenner, W.	Cueilleur à pis	Maïs;Cueilleu	Photographie	couleur	...
724292	N. N.		Système de fr	Aperçu	noir et blanc	...
				trava	Aperçu	monochrome ...
				trava	Aperçu	monochrome ...
				trava	Aperçu	monochrome ...
				Live	Aperçu	couleur ...
				com	Photographie	couleur ...
				;Renc	Aperçu	monochrome ...
				au sc	Photographie	coloré ...
				e de	Photographie	couleur ...
				e du	Dessin schém	noir et blanc ...
				d'éta	Dessin schém	noir et blanc ...
				d'éta	Dessin de sch	noir et blanc ...
				d'éta	Dessin de sch	noir et blanc ...
				e d'a	Dessin de sch	noir et blanc ...
				e de	Dessin du sch	noir et blanc ...
				e de	Dessin du sch	noir et blanc ...
				du tr	Dessin schém	noir et blanc ...

ID	著者紹介	タイトル	キーワード	タイプ	カラー	...
714785	Schwarzer, J.	AGRIPLAN -	作業時間要	概要	黒白	...
722402	Brenner, W.	ピストンピッ	トウモロコシ	フォトグラフ	色	...
724292	N. N.		ブレーキシス	概要	黒白	...
729048	Schön, H.;Hac	仕事中の事故	労働力;労働	概要	モノクローム	...
729099	Thomé, F.-J.	キャブ内アク	職場;運転台;	概要	モノクローム	...
729100	Schön, H.; Tho	トラクター作	職場;運転台;	概要	モノクローム	...
729533	Schön, H.	疾患や生殖ス	精密家畜飼育	概要	有色	...
1240166	N. N.	クランクシャ	内燃機関;デ	フォトグラフ	有色	...
1240268	Renius, T.		トラクター;[	概要	モノクローム	...
1240397	N. N.	ミュンヘン小	地圧;地盤の	フォトグラフ	有色	...
1240807	N. N.	ノッター	収穫技術、ヘ	フォトグラフ	有色	...
1465155	Grimm, K.;Lar	4つのRGVの[	スラリーおよ	模式図	黒白	...
1465475		キャッチャー	安定したシス	模式図	黒白	...
1566994	Schön, H.	乳牛の飼育シ	安定したシス	模式図	黒白	...
1566997	Schön, H.	酪農における	安定したシス	模式図	黒白	...
1566998	Auernhamme	モデル：フル	搬送技術;フ	模式図	黒白	...
1567001	Strehler, A.	企画例：穀物	貯蔵技術;乾	模式図	黒白	...

Knowledge from the previous developments in agricultural technology would be regionally available where it is needed most urgently !!!

Outline

1. What to do when…
2. mediaTUM® and Digitalization
3. Indexing and Publication
4. Downloads and User Interfaces
5. Further Challenges

6. Conclusions

Conclusions

- A large proportion of the scientific basis of agricultural engineering is still available today exclusively in analog form
- Only a digitalization can preserve this knowledge from a possible final loss for the future
- With the AgTecCollection, a successful project was generated that comprehensively documents the development of agricultural technology
- The metadata now available as Big Data opens up a wide range of new possibilities
- First and foremost, digital twins and digital hybrid twins could be used to quickly and easily adapt the available digital knowledge to regional requirements

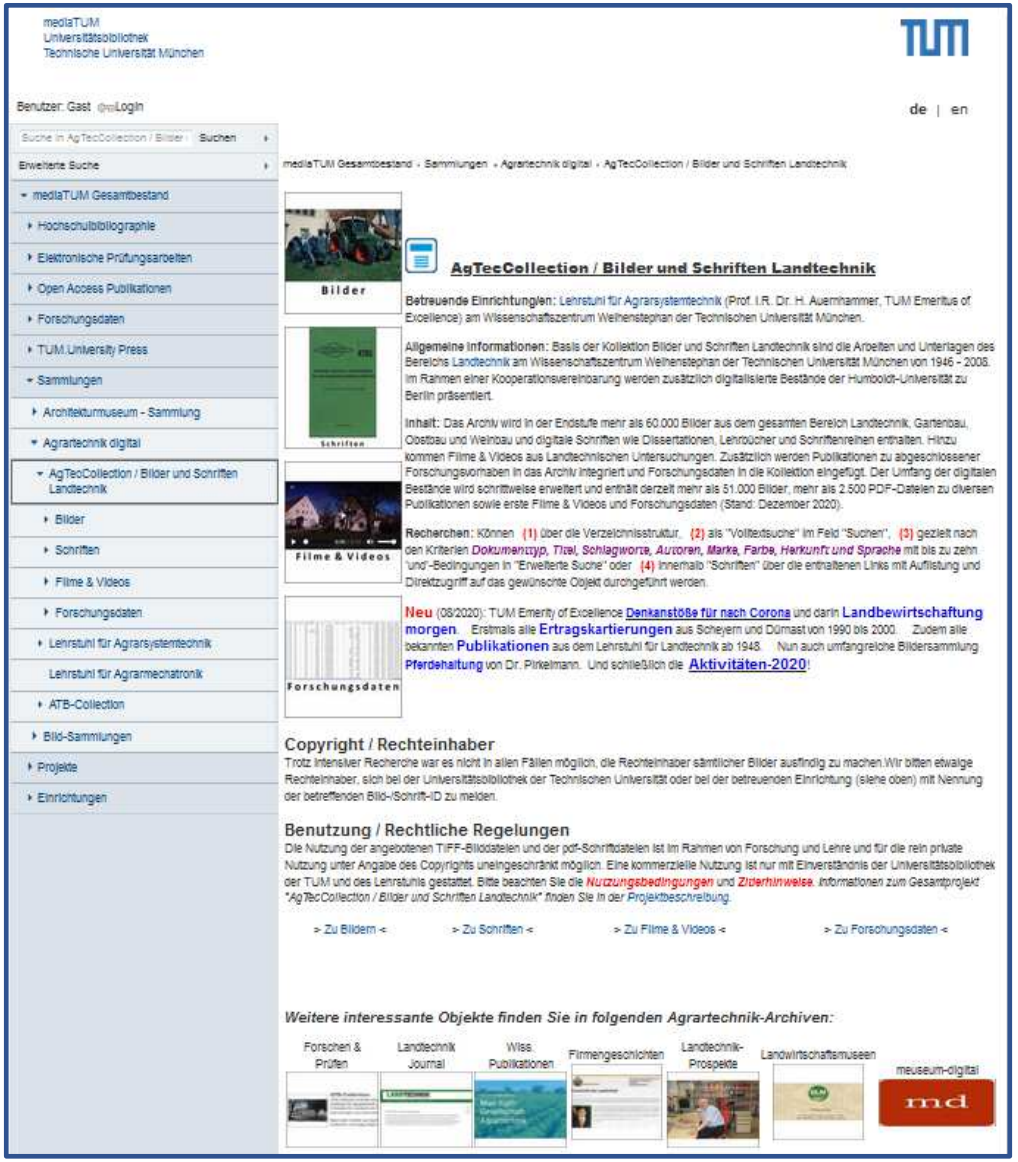
Repository AgTecCollection

Acknowledgements: The staff at my former chair of agricultural engineering and the always helpful team at mediaTUM®

https://mediaTUM.ub.tum.de/agteccollection

https://mediatum.ub.tum.de/?id=1689789

Thank you very much for your attention !

And don't forget:

“Those who cannot learn from history are doomed to repeat it” (Santayana, 1905)