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# TECHNODIVERSITY’S SCIENTIFIC AUDIO-VISUALS: THE STORY BEHIND THEIR RATIONALE AND DEVELOPMENT

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## HIGHLIGHTS

- Technodiversity’s scientific audio-visuals came at the end of their development process;
- A full list of 47 files is available in the Appendix and can be accessed on the YouTube.

## GRAPHICAL ABSTRACT

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## ABSTRACT

*This year, the Technodiversity project comes at the end of its implementation. Besides the dedicated e-learning platform, and Technodiversity booklet, one of the important results of the project was the production of scientific audio-visuals aimed at exemplifying and explaining the main sub-processes relevant to forest operations, in a harmonized way of presentation. The project consortium has succeeded to produce a number of 47 high-quality-media scientific audio-visuals, accounting for a total duration of close to 5.4 hours. These files cover the main description of the processes by a functiogram, the typical work cycle as of the depicted sub-process, and an audio-visual representation of the action in each sub-process by integrating video, media and voice components. A full list of the audio-visuals is available for watching on the YouTube, covering, among others, operations carried out with chainsaws, fellers, processors, harvesters, chippers, horse logging, farm tractors, cable skidders, grapple skidders, clambunk skidders, forwarders, sledge yarders, tower yarders, and processor tower yarders. The duration of the produced audio-visuals ranges from 3:59 to 11:19 minutes, averaging 6:52 minutes. This work presents the rationale behind the development, materials and methods used in their development, and the structure of audio-visuals.*

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# 1. TECHNODIVERSITY PROJECT

Technodiversity project – *Harmonizing European education in forest engineering by implementing an e-learning platform to support adaptation and evaluation of forest operations* – was setup as a transnational project aiming to harmonize the European education in forest operations. Its core idea is the diversity in forest operations techniques, from which a decision maker may select, evaluate and compare options based on objective indicators, in order to fit and set the optimal solutions as specific to the diversity in environmental, economic, social and technical conditions found across the European forests. Forest operations had the tendency to replace local techniques by standardization with less, if not at all, concerns on the differentiations in environment, climate and social needs, leading to increased damage to the stands and soils, and to a decline in knowledge about traditional solutions. Technodiversity project brings the European knowledge to the forest owners, contractors, scientists and, more importantly, to students, by building a common basis of technological knowledge and increasing the awareness and sensitivity for diversity in this field, acting this way as a bridge between regions and generations. This introductory part, as well as the rest of this paper use as a bibliographic source, where necessary, the project proposal document.

# 2. SCIENTIFIC AUDIO-VISUALS IN SHORT

A core-component of the project, supporting efficient teaching and learning, was de development of scientific audio-visuals to enable the interaction with the most commonly used forest techniques, to present them from an organized, system perspective, and to explain their features, advantages and limitations. From this point of view, the project aimed at covering the diversity in forest techniques, as well as the diversity in the forest environments and management systems in which they are typically used. Although the main focus was on explaining by video footage, speech and interactive media components the typical functions, structure of the work cycles, and the advantages and limitations of forest techniques, the scientific audio-visuals were also designed in a way that supported the explanation of important variations in their use.

We all know that knowledge and practical skills related to forest operations are best gained by field experiences, where the students may interact with the forest, machines and ways of doing the work. By observing, they experience these by all their biological sensors. However, safety concerns are sometimes in question, as well as a limited possibility to see a process form end to end. Often, these are coupled with limited possibilities of getting schematic representations and structured explanations on that process.

In the near future, the real-life experience used in learning forest operations is unlikely to change significantly, and it remains a good approach to teaching and learning. However, our experiences in the last years of pandemic have also shown us the limitations that such critical situations may bring in teaching and learning a technically-focused discipline, and we faced the need to adapt quickly in our teaching strategies. That is, we had to drop face-to-face attendance and field experiences, and to rely on the virtual world of teaching by computers and the Internet. Then, as much as we would like to commit ourselves to teaching forest operations, at the end of the day, we may easily find that some real-world examples of harvesting techniques are not accessible to the teachers to show them to the students by field experiences.

From these points of view, the developed scientific audio-visuals have to main purposes: to fill the gap of real-world examples available for teaching activities, and to provide an important resource for learning which makes all the necessary information and explanations readily available in a short film for each technique. They act as a surrogate to field experience, enable a comprehensive learning of forest techniques, and are of help to other interested parties such as the forest operations professionals.

# 3. DEVELOPMENT OF SCIENTIFIC AUDIO-VISUALS

The process of developing the scientific audio-visuals may be largely divided in *gathering initial data*, *prototyping*, *checking & refinement*, and *final production*, as seen by the information shown in **Figure 1**. The first step was that of using a list of relevant processes, as an initial screening step for getting the raw media files required for the scientific audio-visuals. This list included a number of 45 processes depicting the variation from manual to fully mechanized techniques, and the diversity in tools and machines used in operations, as well as the assignment of the project partners in charge of providing the media files required for development. Roughly at the same time, a common (template) script was developed and discussed in the project's consortium for a general agreement on the organization of the scientific audio-visuals, features to be included, and the characteristics and contents of the raw video files to be collected and used for development.

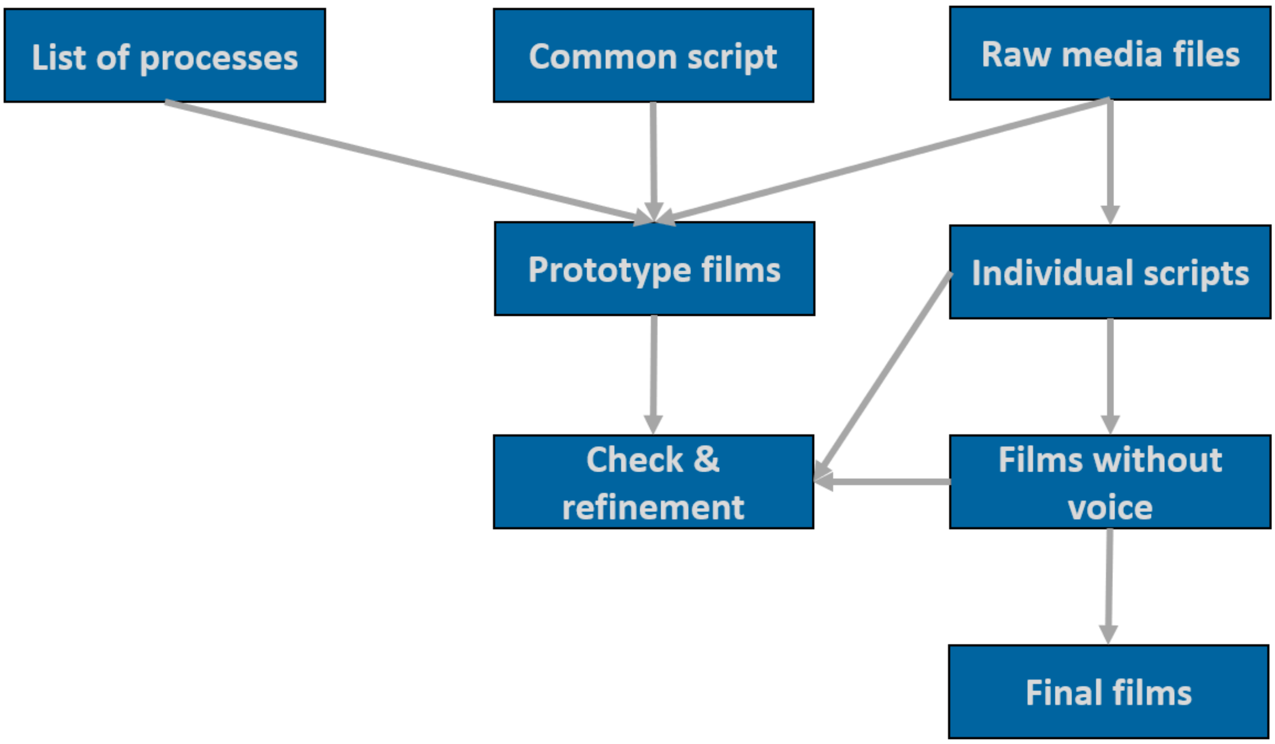

**Figure 1. Steps used in the development of scientific audio-visuals**

Then the necessary raw video files were procured and, along with the general specifications of the template script and the list of processes, the first prototypes of scientific audio-visuals were developed. Essentially, the prototypes were developed by considering several versions of a given process, then they went to a screening process, following the process of checking in the consortium and providing the feedback on improvement potential.

Once an agreement was reached on the best prototype, individual scripts were developed for all the processes based on the available media files. These files had two versions (word and excel) and were developed in two languages (English and Romanian), and they supported the development of films without speaking voice. As of the organization of files, a screening of the available raw media files was done to identify relevant segments in the videos and to match their logic with that intended to be depicted and explained in the final films without voice. This required a careful screening and determination of sequence order and duration, mainly by exact timing of the film sequences and matching with the intended text. Name of the sequences, durations, transitions, media components and their behavior were exactly specified in the excel version of the scripts.

Then, the development of the media components was in place. Microsoft PowerPoint was used to depict and animate the functiograms of the processes, to describe and animate the structure of the work cycles, and to point out in the effective video description part of each process the place of action, the functions observed, and the succession of work elements in a work cycle. These required a careful and detailed development of the media components in order to exactly fit with the visual action from the selected and used raw media files. At this point, intro- and outro short animated films were produced as well, to resemble the logic of the project (intro), and to point out the country from which the media file was gathered, resembling therefore the process characteristics as implemented in that country (outro); pointing out the country of origin was a requirement following the revision of scientific audio-visuals by PhD- and master-level students. The final part of the outro animated sequence was designed to describe the consortium, financing mechanism and terms of use of the scientific audio-visuals. A depiction of the general logic and sequence of the films (version without the voice) is given in **Figure 2**.


**Figure 2. An example of the main components in a voiceless audio-visual. The example stands for mechanized harvesting of logs in coniferous forests and the raw media files were collected in Sweden.**

Based on the developed components, raw media files and individual scripts, the scientific audio-visuals were put together by the use of Adobe Premiere Pro ® software, then the resulting files were checked again for feedback from the consortium and from the master level students. All the checking and refining processes were supported by Google Drive ® where the relevant files were uploaded and made accessible to the interested parties. In parallel, the English versions of the scripts were checked and improved within the consortium, by mainly looking for improvements in the logic and technical vocabulary. Then, the script files, video files and the references to the Technodiversity's Glossary were submitted for English screening to a university-level English professor. Following the final corrections, the scripts were ready for integration in the form of a voice in the scientific audio-visuals.

For voice integration, the consortium had two important options, each of them with advantages and limitations. The first option was that of using a natural human voice as recorded when reading the scripts. Although this option would have been added a "human touch" to the scientific audio-visuals, and a more natural way of speaking and depicting the processes by voice, it had some foreseen limitations related to the exact matching with the context shown in the audio-visuals, as well as with a limited ability to alter the speed of speech. In addition, it would have been required a high amount of time spent to put together the media files by breaking all the script in individual sentences from which to produce high quality audio files. In addition, this option would have been implied the use of rather expensive equipment and likely the need to run several times the recording procedure to get to the best phrasing in the audio files. The second option, which was used to develop the final audio-visuals, was that of using AI-powered text-to-speech software. A commercial license of the NaturalReader ® online software was purchased in order to use segments of relevant text to produce the audio files needed. Mainly, this software enables the user to upload text in an on-line platform, alter the intonation, speaking pace and, once satisfied with the outcome as it can be listened by running online, to download the corresponding audio files. Under a commercial license, the software also features several voices in most languages, as well as the possibility to create new voices or to run the featured voices in several speaking contexts. By a random approach, a female voice was chosen and used to convert the text into audio files. Then, the files were matched to the video sequence of the audio-visuals using Adobe Premiere Pro ®, which was also a commercial license purchased for the project.

Once the final versions of the audio-visuals were ready, they were uploaded on the internal Google Drive ® storing platform for checking in the consortium. Following this internal check, the final audio-visuals were uploaded on the YouTube, under a public visibility clause. The links to the YouTube files is provided in **Appendix A**.

## 3. SUMMARY STATISTICS OF THE SCIENTIFIC AUDIO-VISUALS

In total, 47 high-quality scientific audio-visuals were produced in the lifetime of the project. Of course, this list can be extended in the future with integration of new processes. These audio-visuals cover the main description of the processes by a functiogram, the typical work cycle as of the depicted sub-process, and an audio-visual representation of the action in each sub-process by integrating video, media and speech components. Among others, they cover operations carried out with chainsaws, fellers, processors, harvesters, chippers, horse logging, farm tractors, cable skidders, grapple skidders, clambunk skidders, forwarders, sledge yarders, tower yarders, and processor tower yarders. The duration of the produced audio-visuals ranges from 3:59 to 11:19 minutes, averaging 6:52 minutes, of which the standard intro and outro parts account for less than 40 seconds. The processes shown in the final audio-visuals resemble well the European diversity in forests and forest techniques since they come from the northern (Sweden), eastern (Romania), southern (Croatia), western (France) and central Europe (Austria).

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## APPENDIX A

**Table A1. List of scientific audio-visuals and their main characteristics**

| Name of the audio-visual | Link to YouTube | Length (minutes) | Length (seconds) |
|---|---|---|---|
| 1.M_10-23 MECHANIZED HARVESTING OF LOGS - BROADLEAVED TREES | https://youtu.be/CVQuj0p7T3A | 07:00 | 420 |
| 2.M_10-11 MOTOR-MANUAL FELLING WITH CHAINSAW | https://youtu.be/a301x5qXDRg | 10:18 | 618 |
| 3.M_10-12 MOTOR-MANUAL HARVESTING OF TREE LENGTHS – BROADLEAVED TREES | https://youtu.be/Q4Pxu1VKOMw | 08:01 | 481 |
| 4.M_10-13 MOTOR-MANUAL HARVESTING OF LOGS – BROADLEAVED TREES | https://youtu.be/o3duB5-p9Zs | 08:40 | 520 |
| 5.M_11-21 PRE-SKIDDING OF FULL TREES WITH A CABLE SKIDDER – CONIFEROUS TREES | https://youtu.be/BRlSFeMa3TE | 07:37 | 457 |
| 6.M_10-11 MOTOR-MANUAL | https://youtu.be/81joNUS3mX4 | 05:06 | 306 |

| Name of the audio-visual | Link to YouTube | Length (minutes) | Length (seconds) |
|---|---|---|---|
| FELLING WITH CHAINSAW - CONIFEROUS TREES | | | |
| 7.M_11-21 PRE-SKIDDING OF FULL TREES WITH ANIMALS – BROADLEAVED TREES | https://youtu.be/YAdp_9ELYN8 | 05:00 | 300 |
| 8.M_21-23 MECHANIZED PROCESSING ON THE TRAIL – BROADLEAVED TREES | https://youtu.be/ivIWZDT1LD8 | 06:03 | 363 |
| 9.M_21-23 MECHANIZED PROCESSING ON THE TRAIL – CONIFEROUS TREES | https://youtu.be/JfOeIjZfpCY | 05:49 | 349 |
| 10.M_22-23 MECHANIZED PROCESSING ON THE TRAIL – BROADLEAVED TREE LENGHTS | https://youtu.be/ddaOJtmpOIE | 05:12 | 312 |
| 11.M_11-21 PRE-SKIDDING OF FULL TREES WITH A CABLE SKIDDER – BROADLEAVED TREES | https://youtu.be/dw7iCzb7Zc8 | 05:02 | 302 |
| 12.M_11-31 PRE-SKIDDING AND SKIDDING OF FULL TREES WITH A CABLE SKIDDER – BROADLEAVED TREES | https://youtu.be/OvOJfF5uhzk | 09:17 | 557 |
| 13.M_10-21 MECHANIZED FELLING WITH A FELLER – CONIFEROUS TREES | https://youtu.be/UgCacX6fuow | 05:37 | 337 |
| 14.M_11-31 PRE-SKIDDING AND SKIDDING OF FULL TREES WITH A YARDER – BROADLEAVED TREES | https://youtu.be/6ZGfwT-F_bc | 05:03 | 303 |
| 15.M_11-31 PRE-SKIDDING AND SKIDDING OF FULL TREES WITH A YARDER - CONIFEROUS TREES | https://youtu.be/Of55dmSvP68 | 06:08 | 368 |
| 16.M_12-32 PRE-SKIDDING AND SKIDDING OF TREE LENGTHS WITH A YARDER - BROADLEAVED TREE LENGTHS | https://youtu.be/qCYZrJ6Oqlg | 05:03 | 303 |
| 17.M_12-32 PRE-SKIDDING AND SKIDDING OF TREE LENGTHS WITH A YARDER - CONIFEROUS TREES LENGTHS | https://youtu.be/KETJvM0gecs | 07:03 | 423 |
| 18.M_13-33 PRE-SKIDDING AND SKIDDING OF LOGS WITH A YARDER - CONIFEROUS LOGS | https://youtu.be/ATTF-_2lkPg | 06:23 | 383 |
| 19.M_10-22 MECHANIZED HARVESTING OF TREE LENGTHS – CONIFEROUS TREES | https://youtu.be/lplQ4wRkrpE | 03:59 | 239 |
| 20.M_13-23 PRE-SKIDDING OF LOGS WITH A CABLE SKIDDER – | https://youtu.be/yBjIiX3Alg0 | 06:16 | 376 |

| Name of the audio-visual | Link to YouTube | Length (minutes) | Length (seconds) |
|---|---|---|---|
| BROADLEAVED LOGS | | | |
| 21.M_21-31 MECHANIZED SKIDDING OF FULL TREES WITH A GRAPPLE SKIDDER - CONIFEROUS TREES | https://youtu.be/Bmj_rPZw_rQ | 06:08 | 368 |
| 22.M_23-33 MECHANIZED FORWARDING OF LOGS WITH A WINCH-ASSISTED FORWADER – CONIFEROUS LOGS | https://youtu.be/frgoYD91Zow | 06:28 | 388 |
| 23.M_23-33 MECHANIZED FORWARDING OF LOGS WITH A FORWADER – BROADVELAVED LOGS | https://youtu.be/xq495qDlfvo | 08:12 | 492 |
| 24.M_22-32 MECHANIZED FORWARDING OF TREE LENGTHS WITH A FARM TRACTOR AND A TRAILER - BROADLEAVED TREE LENGTHS | https://youtu.be/lI2EL6ExgFg | 10:44 | 644 |
| 25.M_31-33 MECHANIZED PROCESSING ON THE FOREST ROAD – CONIFEROUS TREES | https://youtu.be/b8XjA2T76Lc | 05:53 | 353 |
| 26.M_31-33 MECHANIZED PROCESSING ON THE FOREST ROAD – BROADLEAVED TREES | https://youtu.be/b8XjA2T76Lc | 05:34 | 334 |
| 27.M_10-23 MECHANIZED HARVESTING OF LOGS – CONIFEROUS TREES | https://youtu.be/nHUjErlXqDU | 07:24 | 444 |
| 28.M_31-33 MECHANIZED PROCESSING ON THE FOREST ROAD WITH A PROCESSOR TOWER YARDER – CONIFEROUS TREES | https://youtu.be/0MJrXp7CEig | 06:05 | 365 |
| 29.M_32-33 MECHANIZED PROCESSING ON THE FOREST ROAD WITH A PROCESSOR TOWER YARDER – CONIFEROUS TREE LENGTHS | https://youtu.be/zr2czmJBJHs | 05:54 | 354 |
| 30.M_31-34 MECHANIZED CHIPPING OF FULL TREES ON THE FOREST ROAD – BROADLEAVED AND CONIFEROUS TREES | https://youtu.be/gYVobneP5iM | 04:28 | 268 |
| 31.M_23-33 MECHANIZED FORWARDING OF LOGS WITH A FORWADER – CONIFEROUS LOGS | https://youtu.be/6AXv94akPpo | 10:29 | 629 |
| 32.M_33-34 MECHANIZED CHIPPING OF LOGS AT THE FOREST ROAD - BROADLEAVED LOGS | https://youtu.be/uU1xseTHpOU | 05:35 | 335 |

| Name of the audio-visual | Link to YouTube | Length (minutes) | Length (seconds) |
|---|---|---|---|
| 33.M_10-33 MECHANIZED FELLING, SKIDDING AND PROCESSING AT THE FOREST ROAD WITH A HARSKIDDER - BROADLEAVED AND CONIFEROUS TREES | https://youtu.be/QRp0c2yJY28 | 08:49 | 529 |
| 34.M_21-23 MECHANIZED PROCESSING OF FULL TREES ON THE TRAIL - BROADLEAVED AND CONIFEROUS TREES | https://youtu.be/gzqQATBWccY | 06:24 | 384 |
| 35.M_31-32 MOTOR-MANUAL DELIMBING OF FULL TREES WITH A CHAINSAW AT THE FOREST ROAD – BROADLEAVED TREES | https://youtu.be/hGuImkUOa9U | 04:13 | 253 |
| 36.M_32-33 MOTOR-MANUAL CROSS-CUTTING OF TREE LENGTHS WITH A CHAINSAW AT THE FOREST ROAD – BROADLEAVED TREE LENGTHS | https://youtu.be/-2jjbGcKc0w | 05:18 | 318 |
| 37.M_23-33 MECHANIZED FORWARDING OF LOGS WITH A FARM TRACTOR AND A TRAILER – BROADLEAVED LOGS | https://youtu.be/2jGDuoSfP9Q | 09:35 | 575 |
| 38.M_13-33 PRE-SKIDDING AND SKIDDING OF LOGS WITH A CABLE SKIDDER – BROADLEAVED LOGS | https://youtu.be/jOnJX5JjA14 | 09:11 | 551 |
| 39.M_22-32 SKIDDING OF TREE LENGTHS WITH A CLAM-BUNK SKIDDER – BROADLEAVED TREE LENGTHS | https://youtu.be/xUJ7cCC1b7I | 09:03 | 543 |
| 40.M_13-33 PRE-SKIDDING AND SKIDDING OF LOGS WITH A FARM TRACTOR EQUIPPED WITH A WINCH – BROADLEAVED LOGS | https://youtu.be/t-ttzoMZQo0 | 10:32 | 632 |
| 41.M_13-23 PRE-SKIDDING OF LOGS WITH A FARM TRACTOR EQUIPPED WITH A WINCH – BROADLEAVED LOGS | https://youtu.be/AB-AFpSkkmg | 06:20 | 380 |
| 42.M_21-31 SKIDDING OF FULL TREES WITH A CABLE SKIDDER – BROADLEAVED TREES | https://youtu.be/bXnjGC_zKiY | 07:49 | 469 |
| 43.M_22-32 SKIDDING OF TREE LENGTHS WITH A CABLE SKIDDER – BROADLEAVED TREES LENGTHS | https://youtu.be/PxSbLT0WvFI | 06:33 | 393 |
| 44.M_11-12 MOTOR-MANUAL DELIMBING OF FULL TREES – CONIFEROUS TREES | https://youtu.be/54eGc6-yyas | 05:17 | 317 |

| Name of the audio-visual | Link to YouTube | Length (minutes) | Length (seconds) |
|---|---|---|---|
| 45.M_13-23 PRE-SKIDDING OF LOGS WITH ANIMALS – BROADLEAVED LOGS | https://youtu.be/_zEHYHWXOBU | 04:35 | 275 |
| 46.M_13-33 PRE-SKIDDING AND SKIDDING OF LOGS WITH A YARDER – BROADLEAVED LOGS | https://youtu.be/UL8SW_05TLk | 11:19 | 679 |
| 47.M_32-33 MECHANIZED PROCESSING OF TREE LENGTHS AT THE FOREST ROAD – CONIFEROUS TREE LENGTHS | https://youtu.be/QL5JeyEye5E | 06:21 | 381 |
| **TOTAL** | | **5.381 hours** | **19370 seconds** |

## EXTENDED ABSTRACT – REZUMAT EXTINS

***Titlu în română:*** *Materialele audiovizuale ale proiectului Technodiversity: povestea din spatele rațiunilor și dezvoltării lor*

***Rezumat:*** *Anul acesta, proiectul Technodiversity ajunge la finalul implementării sale. Pe lângă platforma e-learning dedicată și cartea Technodiversity, unul dintre rezultatele importante ale proiectului a fost producerea de materiale audiovizuale științifice menite să exemplifice și să explice principalele sub-procese relevante pentru operațiile forestiere de exploatare a lemnului, într-un mod armonizat de prezentare. Consorțiul proiectului a reușit să producă un număr de 47 de materiale audiovizuale științifice de înaltă calitate, având o durată totală de aproape 5,4 ore. Aceste fișiere acoperă descrierea principalelor procese printr-o diagramă funcțională, ciclul de muncă tipic pentru (sub)procesul descris și o reprezentare audio-vizuală a acțiunii în fiecare proces, prin integrarea componentelor video, grafice și audio. O listă completă a materialelor audiovizuale este disponibilă pentru vizionare pe YouTube, care acoperă, printre altele, operațiile efectuate cu ferăstraie mecanice, mașini multifuncționale de recoltare, tocătoare, atelaje, tractoare agricole, tractoare forestiere și funiculare. Durata materialelor audio-vizuale produse variază de la 3:59 la 11:19 minute, cu o medie de 6:52 minute. Această lucrare prezintă rațiunea din spatele dezvoltării, materialele și metodele utilizate în dezvoltarea lor și structura materialelor audiovizuale.*

***Cuvinte cheie:*** *tehnici forestiere, sub-procese, e-learning, materiale audio-vizuale, media, funcții, ciclu de muncă, acțiune, descriere.*