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From idea to functional ETD

**From ideas to functional electronic theses and dissertations: Experience from the
University of Novi Sad, Serbia**

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Authors Note

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Abstract

This paper reviews different phases of the introduction and usage of electronic theses and dissertations (ETDs) at the University of Novi Sad, with an emphasis on specific requirements, challenges, and future directions for the development and use of ETD systems at the University.

Keywords: University of Novi Sad, theses, dissertations, ETD, students, research

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The University of Novi Sad (the University) is the second-largest state university in the Republic of Serbia. With 50,000 students and more than 5,000 instructors and researchers in 14 faculties and 3 institutes, it provides an important foundation for educational, scientific, and artistic work. To achieve excellence, the University recognized the necessity to provide wide access to varied sources of knowledge, in particular, the results of scientific work—in the form of dissertations, theses, and scientific papers. The main access points to these resources were libraries, where scientific data were collected, described, archived, and preserved.

In the digital age, open access (OA) to electronic theses and dissertations (ETDs) is a necessity; providing it is an obligation for every higher education institution in the Republic of Serbia. Although the idea of OA first appeared in the 1990s, the University had to overcome several technical, legal, and organizational obstacles and challenges until its realization. During this period, within the online public access catalog systems of the University's libraries, namely, BISIS (Vidakovic et al., 2004), Pergam, and WINISIS, metadata of doctoral dissertations defended at the University were published. Users could access basic metadata from different access points; however, only paper versions of the dissertations and theses were accessible because the technology and infrastructure for archiving full-text formats had not been established yet.

The legal obligation to provide time-limited OA to the e-formatted versions of the dissertations on the University's website was a step toward the establishment of an e-catalog of doctoral dissertations in a full-text format. Students were required to submit their PhD dissertations in an e-format as a precondition for their defense. This was the basis for the future implementation of the ETD database at the University. At first, ETDs were collected in various external storage devices (compact discs, digital versatile discs [DVDs], or hard drives). Each

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user could obtain an e-version of the ETD by sending a direct request to the librarian. Currently, the University hosts a repository with the necessary metadata and full-text ETDs, named the Digital Library of Doctoral Dissertations Defended at the University of Novi Sad (the ETDs Digital Library). In this paper, we review the development of the ETDs Digital Library from the University's point of view.

Methodology

In this case study, we implement a descriptive–analytical approach to provide as much information as possible regarding the development of the ETDs Digital Library. Yin (2018) posed the question whether a case study in this area would be a single- or a multiple-case study; we have opted for a single-case study. Here we explain the framework of the case study, present the evidence collected and our analysis of the findings, and conclude with a discussion and potential future directions. The data were mainly collected from the University's internal documentation, but we also refer to articles, reports, and online resources. This case study is intended to capture the complexity of this particular case, using primarily descriptive as well as explanatory and exploratory methods. Using these approaches, we present the life-cycle of a specific database. This paper is not a part of a wider study.

ETDs Digital Library development and use

Higher education in the Republic of Serbia developed throughout the 19th and 20th Century. At present, there are 18 universities (8 are run by the government, and 10 are private), all of which are regulated by the Law on Higher Education. Since the establishment of the University of Novi Sad in 1960, the University has paid special attention to doctoral candidates, mentorship, and doctoral thesis and dissertations. The laws dealing with higher education in all

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previous states where Serbia existed prescribed that universities should promote doctoral candidates and university libraries should hold all the doctoral theses and dissertations produced at their university in their collections. A slight difference can be observed between the University and other state universities in the Republic of Serbia; the University did not have its own building until it moved to a building specially designed and built for its needs in 2013.

The University's central library (CL) was only established in 2003. The faculties of the University had a legal obligation to store doctoral theses and dissertations in their libraries. Instead of collecting printed copies at the University, doctoral dissertations were deposited in the Matica Srpska Library, the oldest national library and the first public and scientific library in Serbia.

After the CL was founded, it began to collect doctoral theses and dissertations defended at several centers for interdisciplinary and multidisciplinary studies at the University. The collection currently has more than a 1,000 printed copies of doctoral theses and dissertations; however, there are also copies of final works at various levels of academic study. A lack of storage space and library staff has made it impossible to deposit paper versions of doctoral thesis and dissertations defended at all faculties in the CL; therefore, printed copies continue to be collected in the faculties' libraries and the Matica Srpska Library. However, the University never neglected its responsibility for the doctoral theses and dissertations and has published three bibliographies of doctoral dissertations for the periods 1960–1979, 1980–1984, and 1985–1993.

In addition, the University maintains the official registry book of promoted PhDs, which contains data on all doctoral candidates and dissertations from 1956. The registry book was

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initially maintained manually; however, eventually, all the data were retyped into an Excel file containing information on more than 3,000 PhDs.

A proposal was made to develop software to manage ETDs at the University two decades ago. The first step toward creating an ETD repository was made when the CL was established. A project named the Networked Digital Library of Theses and Dissertations was developed in 2003 at the University, led by eminent university professors. They had a vision, aid from the Provincial Government of Vojvodina, the knowledge to make a digital library, and a group of information specialists capable of making the requisite software.

As Surla et al. (2004) pointed out: “The software system of the Networked Digital Library [...] was set up for a trial period on May 15, 2003.” This database was named DIGLIB. It was intended that administrators, librarians, and authors would use it to collect metadata on the ETDs and publish them online. The CL was to test the software and coordinate with librarians from all faculties in the University’s network. Although the testing of DIGLIB was recognized as an important task, the software was not used in its full capacity. The CL stated in an internal report from July 2005 that the DIGLIB application was installed on librarians’ PCs, and metadata had begun to be input for the PhDs kept in the CL; however, the majority of the dissertations did not have an electronic version, key documentation information (KDI), or keyword documentation (a document with metadata in Serbian and English, introduced as part of the final work on this project in the 1990s).

In the Republic of Serbia, an important legal demand regarding doctoral candidates has been enabling public access to theses and dissertations for at least 15–30 days before defending. This demand was confirmed by the Law of Higher Education in 2005. In 2005, the University

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Senate made a decision to switch access to dissertations from paper to ETDs via the University's website. All candidates were required to send their doctoral dissertation to the University in PDF format. Finally, the CL was in a position to collect ETDs from the faculties and make and preserve an e-collection on DVDs. This collection now holds all theses published online in the period 2005–2021.

To unify these disparate activities, the University's Center for Information Technology (CIT) took charge of publishing ETDs on the website in OA and restricting access after 30 days. The CL would send reports to the faculties informing them when a PhD was opened or closed for inspection. When a fully signed and printed remark on a PhD was made, this would be noted by the CL in their report, and the remark was stored in the University's Archive. At the time, the main challenge faced by the University was the format of the ETDs sent to the University. During a University Senate meeting held on November 17, 2012, it was accepted that the University website would not only publish the ETDs but also the reports on the doctoral theses or dissertations.

Around that time, the University management recognized the need to establish a functional ETDs Digital Library and adopted the necessary rules and provided financial support for the development, maintenance, and adaptation of a digital library software system. During the next few years, a new software was developed. The system was to be hosted at the University's domain, with the database and Internet service in accordance with the law on measures to increase the visibility and presence of the University and its members on the Internet (passed on April 19, 2013, by the University's Senate). The CIT was appointed to define requirements for features to be provided by a future digital library, such as the following: a) a digital library in accordance with the Law on Higher Education, the Law on Protection of Privacy, and the

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Intellectual Property Law and University rules; b) a database containing metadata on doctoral dissertations defended at UNS, the candidates, members of the committee, e-versions of the dissertations, reports of the dissertation evaluation committee, data on copyright protection, author statements on the identity of the electronic and printed versions of the doctoral dissertation, information about mentors, etc.; c) distributed data entry at member institutions; d) support for the process of limited public OA on the University and faculty websites; e) support for the doctoral promotion process and generation of relevant reports (for example, the register book of promoted PhDs and the list of doctoral candidates for the ceremony of doctoral promotion); f) search of dissertations and OA to ETDs on the web portal; g) a permalink for each ETD; h) data exchange with global repositories enabled by using the Dublin Core format and AOI-PMH protocol, as well as with the Ministry of Education, Science and Technological Development central repositories (NaRDuS); and i) the University's accreditation reports and other relevant reports.

Several other requests were made regarding the development of the digital library, including a standard model for text documents in different languages and scripts, organized as a multilevel application based on Web 2.0 technologies; a multiplatform server; a standard web browser interface on the client side; and a system supporting interoperability with other platforms.

The ETDs Digital Library was developed as an extension of the University of Novi Sad current scientific research information system (CRIS UNS) (Ivanovic, D. 2010; Ivanovic, L. 2014, Ivanovic et al., 2014). The CRIS UNS is the overall research information system that archives scientific and artistic knowledge at the University and has been under development since 2008. The system uses the common European research information format (CERIF)

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compatible data model, based on the MARC 21 format. Both systems were the results of the Development of Software Infrastructure for Research Domain of the University of Novi Sad project. The main goal of the project was to improve the management of the scientific research domains of the University, the quality of achieved scientific results in the future, and the rating of the University.

Paskali and Ivanovic (2019) indicate where the most important information about the development of the ETDs Digital Library's software can be found: on system architecture and implementation (Ivanovic, 2010; Ivanovic et al., 2010; Ivanovic & Milosavljevic, 2010; Milosavljevic et al., 2011); on automatic extraction of metadata from research outputs such as titles, keywords, and abstracts (Kovacevic et al., 2011); on reporting components (Dimic-Surla & Ivanovic, 2012); on managing PhD promotions and registry of doctorates (Dimic-Surla & Ivanovic, 2015); on the possibility of exchanging metadata with other systems (Ivanovic, 2011); and on the ontology of the system (Dimic-Surla et al., 2012; Ivanovic et al., 2012).

The ETDs Digital Library was opened in December 2013, and the University's CIT informed all faculties and the CL of the change in the procedures for publishing ETDs. The administrators and librarians from all faculties were now in charge of publishing the ETDs. The system required three documents—an ETD, a report on the doctoral thesis and dissertation, and the KDI. Faculties were obliged to use the software; if they did not, their candidates could not proceed.

The ETDs Digital Library fulfilled most of the requirements of the University; however, there were some challenges in the process of the development and introduction of the system.

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To fulfill all current and future needs of a digital library of theses and dissertations at the University, defining the sufficient set of metadata was necessary. As the ETDs Digital Library was developed as an extension of the CRIS system, the basic set of metadata included the metadata prescribed by the CERIF standard and the union of metadata prescribed by the Dublin Core, in ETD-MS formats, and metadata prescribed by the University's doctoral studies rulebook (Paskali et al., 2021b). The set was completed with the metadata necessary to support the process of doctoral promotion and complete the registry book of promoted PhDs. A new set of metadata was converted in accordance with the MARC 21 format.

After data on PhDs at the University were gathered over the course of 40 years using different platforms (registry book of promoted PhDs, the University website, BISIS, DIGLIB, etc.), the initial migration of data from these systems to the ETDs Digital Library had to be resolved (Ivanovic & Surla, 2012). After the migration was performed, quality control and data cleaning were necessary, as the data originated from different sources. In addition to the consolidation of data by the ETDs Digital Library software module, the initial data quality control and cleaning were performed by librarians and CIT staff. As Beall (2005) pointed out, "the two aspects of digital library data quality are the quality of the data in the objects themselves, and the quality of the metadata associated with the objects." Data quality control and cleaning are ongoing processes performed by the administrator/librarian, librarian at the CL, the CIT, or the ETDs Digital Library development team to ensure database quality. The following techniques were used for data cleaning: removing duplicate entries and irrelevant data, managing missing values, standardizing capitalization, converting data types, clearing formatting, fixing errors, and translating language. For general errors, the CL sends the information to the system to prevent future mistakes.

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Following the new Law on Higher Education, starting from September 18, 2014, all doctoral theses and dissertations and reports on doctoral theses and dissertations were required to be in OA not only 30 days before but also after the thesis defense. To fulfill this requirement, the ETDs Digital Library was expanded with new functionalities.

In 2015, the Ministry of Education, Science and Technological Development announced that the National Repository of Dissertations Defended in Serbia (NaRDuS) was implemented. All the ETDs must be published in OA either through institutional repositories or the universities' websites and must be accessible via the platform. The University ETDs Digital Library was already prepared for data exchange; therefore, it took less than a few weeks to copy documents and links of all the defended and archived ETDs to NaRDuS. The ETDs are findable and accessible via the networked digital library of these and dissertations (NDLTD: <http://search.ndltd.org>), DART-Europe (<http://www.dart-europe.eu>), open access theses and dissertations(OATD: <https://oatd.org>), and open access infrastructure for research in Europe (OpenAire+: <https://www.openaire.eu>) portals.

During the development and usage of the ETDs Digital Library, the focus was on increasing the findability of doctoral dissertations through the improvement of the web application to search the library. Different search criteria—title, abstract, keywords, author, mentor, committee members, and the full text—were defined at the very beginning of the development of the ETDs Digital Library. Metadata are searchable in Serbian and English. Further, as Serbian has two scripts, the search query results must be accurate even when the script of the query and of the dissertation are not the same. Ivanović et al. (2019) noted that the ETDs Digital Library has “two approaches for making findable research presented in Serbian PhD dissertations findable for the ex-Yugoslav scientific community” and “an approach which

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makes accessible research presented in Serbian PhD dissertations for the English scientific community” (p. 9).

The search results can be restricted by the current status of the dissertations (all dissertations or defended/not defended dissertations only), date range (in years), and affiliation (one or more than one institution, as well as one or more scientific titles received from a certain institution) (Figure 1).

Figure 1

Search of Dissertations by Status and Institution

The screenshot shows a web-based search interface for dissertations. At the top, there are navigation links for "Send us email" and "Help". The main heading is "Dissertations Authors and board members Search based on query language". Below this, there is a search form with three rows of criteria:

Enter search terms:	Title	has all of these words:
AND	Author	last and first name is:
AND	Full text	has all of these words:

Below the search form, there is a "Restrict to:" section with several filters:

- Defended:** A dropdown menu with "Defended and non defended" selected.
- Published bet:** A dropdown menu with "Only defended" selected, followed by "and" and a date range selector.
- Affiliation:** A list of institutions with checkboxes, including:
 - University Center for Interdisciplinary and Multidisciplinary Studies and Research, University of Novi Sad
 - Faculty of Technical Sciences at Novi Sad, University of Novi Sad
 - Faculty of Sciences at Novi Sad, University of Novi Sad
 - Faculty of Philosophy at Novi Sad, University of Novi Sad
 - Faculty of Agriculture at Novi Sad, University of Novi Sad
 - Faculty of Law at Novi Sad, University of Novi Sad
 - Faculty of Technology at Novi Sad, University of Novi Sad
 - Državna naučna akademija
 - Državna naučna akademija
 - Faculty of Economics at Subotica, University of Novi Sad
 - Faculty of Medicine at Novi Sad, University of Novi Sad
 - Academy of Arts at Novi Sad, University of Novi Sad
 - Faculty of Civil Engineering at Subotica, University of Novi Sad
 - Matije Gupca Technical Faculty at Zrenjanin, University of Novi Sad
 - Faculty of Sport and Physical Education at Novi Sad, University of Novi Sad
 - Faculty of Education at Sombor, University of Novi Sad
 - Teachers' Training Faculty in Hungarian at Subotica, University of Novi Sad
 - Association of Centres for Interdisciplinary and Multidisciplinary Studies and Research, University of Novi Sad
 - Doctoral dissertations in the interdisciplinary or multidisciplinary field, University of Novi Sad

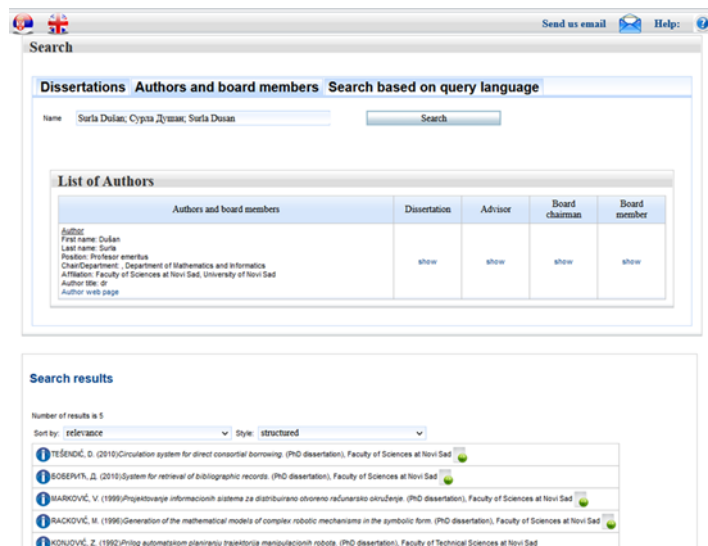
A "Search" button is located at the bottom of the form.

The system enables searches for authors and committee members. In the search results, in addition to the basic data and a list of dissertations for a given author, there is a list of dissertations for which that person was a mentor, committee member, or committee president (Figure 2).

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Figure 2

Search by the Name of Committee Members



The search results can be represented visually (word clouds) and as text (in Harvard citation style, Dublin Core, MARC 21, or ETD-MS format). Paskali and Ivanovic (2019) presented the customization of “web search pages for citizens by extending the list of available search results’ representation styles and implementation of automatic recommendations of PhD dissertations” (p. 24).

The management of the University and the CL sought to enlarge the collection of ETDs in the Digital Library by making digital copies of paper dissertations. Digitization at the University began in 2014 by purchasing robotic and duplex scanners; however, there were few skilled staff with knowledge on how to digitize. A 6-week workshop for 12 volunteers from different faculties was organized by the CL in 2014. A total of 180 dissertations were digitized and prepared for publication using ABBYY FineReader software.

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The digitization of paper PhDs was later organized in several organizational forms: a) faculty librarians digitizing material using their own scanners, b) faculty librarians digitizing material using the CL equipment, c) a third party digitizing the materials at the University CL, or d) a combination of a and b. Some faculties do not have candidates or have a very small number of defended PhDs; most of these dissertations are already in OA. Unfortunately, the two faculties with the highest number of PhDs have not yet begun the process of digitization.

The main problem with retroactive distribution of ETDs is obtaining the authors' permission to publish it in OA (Perry & Callan, 2006). The University created all the necessary documents and offered six CC licenses for doctoral candidates. Doctoral theses and dissertations that were defended before September 2014 could stay in the non-open regime, but they could also be opened if the author signed a CC license transferring their copyrights to the Digital Library. The University avoided the risk of copyright infringement actions, as the digital copies of the PhDs are archived in the ETDs Digital Library and are available on demand. Currently, in the ETDs Digital Library, there are 6,420 ETDs (approximately 2,300 are in OA).

The University respects authors' privacy, this, data about the authors were revised in accordance with the Law on Protection of Privacy (for example, birth dates were expunged from the bibliographic description of the ETD in the search results).

The PhDs of the Academy of Arts are a special case, exhibiting a mixture of doctoral theses and dissertations and doctoral artistic projects. In some cases, there are additional materials following the textual parts of the dissertation (photographs, music records, or video records). The University agreed with the ETDs Digital Library development team that these additional materials can be uploaded as ZIP files.

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When the ETDs became accessible to a wide audience through the ETDs Digital Library, it became obvious that the fight against plagiarism had to be reinforced. The first contact with a software for antiplagiarism was in 2017 when the University purchased the iThenticate software. The University was very satisfied with the possibilities offered by the program; therefore, the contract was extended. In 2020, the Ministry of Education, Science and Technological Development began to finance future licenses for all state universities in Serbia.

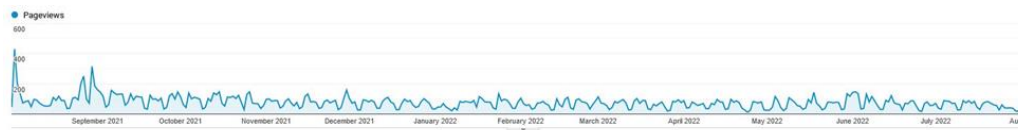
It should be pointed out that the ETDs Digital Library is compatible with the philosophy of the principles of findability, accessibility, interoperability, and reusability (FAIR) regarding data usage (Wilkinson et al., 2016), as the data in the ETDs Digital Library meet the FAIR principles (Ivanović et al., 2019). Findability is enabled by the Digital Library's web portal search options described above. In addition, the ETDs are findable and accessible via the NaRDuS, NDLTD, DART-Europe, OATD, and OpenAire+ portals.

The reusability of e-theses from the ETDs Digital Library can be confirmed by the fact that dissertations have been downloaded more than 10,000 times per month. On the University website, the webpage with ETDs that are publicly available for 30 days has been consistently in the top five most visited webpages since 2005. Google Analytics shows the number of page views from August 1, 2021 to August 1, 2022 (Figure 3). The total number of page views in the specified period was 27,331 (the average number of daily page views was 77). The majority of visitors are from Serbia (87%), with visitors from surrounding countries with similar languages comprising about 10% of the visitors.

Figure 3

Number of Page Views from August 1, 2021 to August 1, 2022

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A recent paper regarding the ETDs Digital Library usage shows that the “results obtained have also given insight into the importance of non-English scientific publications, the importance of open science for citizens and their interest in scientific results presented in PhD dissertations” (Paskali et al. 2021a, p. 115).

Discussion

Every stage of implementation of the ETDs Digital Library at the University has had specific challenges and problems—organizational, technical, and legal.

Legal challenges were overcome by passing the internal legislation at the University in accordance with the laws of the Republic of Serbia—the Law on Higher Education from different periods, the Law on the Protection of Privacy, and the Intellectual Property Law—at all stages of planning and implementing the ETD program.

Initially, the organizational problems were similar across faculties—the procedures were unclear, procedures that were previously followed were not the same for all faculties, there was a lack of administrative staff, and the largest faculties were not always willing to precisely define who would be in charge of entering metadata, among other challenges. The CL and the ETDs Digital Library development team put a lot of effort to overcome these problems through the continuous training of faculty administrators and librarians. Additionally, there were problems with organizing and implementing the digitization process at some faculties.

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During the development and use of the ETDs Digital Library, various other challenges arose, such as defining a sufficient set of metadata, migrating data from different sources, defining and improving the web search application, and ensuring the quality of the database through data quality control and cleaning. Although the ETDs Digital Library development team met most of the requirements of the CIT and CL and successfully overcame most of these challenges, improvements continue to be made in the ETDs Digital Library.

Future steps

The ETDs Digital Library has enabled greater exposure to doctoral theses and dissertations and made available postgraduate research at the University. Most of the problems that the University encountered in the two decades with this program have been solved; however new challenges can be expected. The ETDs Digital Library is a living structure, and it is changing, growing, and becoming more attractive with time. A new repository is being made for the University as part of the BE-OPEN Project (Smederevac et al., 2020). It is expected that the two repositories will be merged, and the ETDs Digital Library will become completely visible on that platform (currently, only University researchers' ETDs are visible). Moreover, the University is interested in making the ETDs Digital Library mobile friendly. An important aspect of the ETDs Digital Library is generating statistical reports for the University's needs. The implementation of these reports is planned for the next period of development. As contemporary legal demands change, the ETDs Digital Library will have to adapt as well.

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