

TOWARDS LINKED STAGE GRAPH 2.0 A KG-BASED RESEARCH RESOURCE FOR THE PERFORMING ARTS

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DHd 2024, Passau, Germany
01.03.2024

PERFORMING ARTS HISTORY RESEARCH

MOTIVATION

- Performing Arts is a form of art and social institution
- Embedded into our societies for thousands of years
- Merges the historic and the modern, reinventing itself time and time again
- Historical plays persist to this day, finding new life through reinterpretation on modern stages.



PERFORMING ARTS HISTORY RESEARCH

MOTIVATION

- Theatre never exists in isolation and is always embedded in the context of the respective culture and society.
- Shaped by societal and political events or by technological advancements
- Influences creative possibilities and limitations on stage.



PERFORMING ARTS HISTORY RESEARCH

MOTIVATION

RESEARCH

- Which theatres produced the works of Bertolt Brecht during the late 1920s?
- Which actors were on stage during WWII in Germany?
- Which playwrights are the most interpreted on modern stages?
- How close is the performing arts work to the literary source? [1,2,3]



PERFORMING ARTS HISTORY RESEARCH PROBLEM

- KGs are often used to represent historical theatre data, but
 - platforms are often closed
 - data models and ontologies are often not shared
- Proprietary software
- Barriers impeding the discoverability, accessibility, interoperability, and reusability of performing arts research data.



PERFORMING ARTS HISTORY RESEARCH PROBLEM

There is no commonly accepted ontology for historical performing arts data.



PERFORMING ARTS HISTORY RESEARCH GOAL

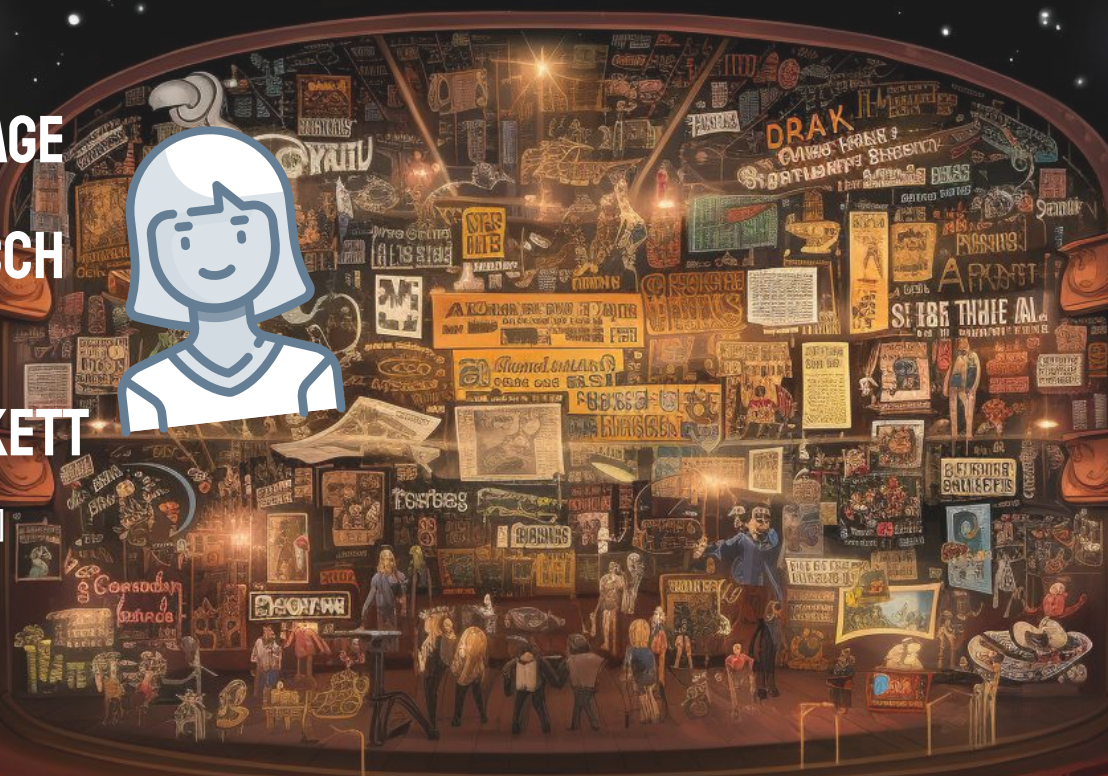
- Requirements for data representation and exploration
- Data sources and modules
- Lessons learned from the ongoing process of creating an application-driven and efficient data model on the use case of Linked Stage Graph
- Invitation to collaborate and share models and ideas



IPSEN STAGE
PINA BAUSCH
ARCHIVE
STAGING BECKETT



[4,5,6]



IPSEN STAGE
PINA BAUSCH
ARCHIVE
STAGING BECKETT

[4,5,6]



ABBY THEATER PLATFORM

BAM HAMM DIGITAL
ARCHIVE

FID

RE-COLLECTING
THEATRE HISTORY

[7,8,9,10]

IPSEN STAGE
PINA BAUSCH
ARCHIVE
STAGING BECKETT

[4,5,6]



ONSTAGE



AUSSTAGE



ABBY THEATER PLATFORM

BAM HAMM DIGITAL
ARCHIVE

FID

RE-COLLECTING
THEATRE HISTORY

[7,8,9,10]

SWISS PERFORMING ARTS
PLATFORM

[11,12,13]



LINKED STAGE GRAPH 02

LINKED STAGE GRAPH

- Knowledge Graph containing archival data of the Stuttgart State Theatres
- Public SPARQL endpoint + visualizations
- Timeframe: 1890s - 1940s
- Images and metadata about performance events, on-stage and back-stage moments
- Provided by the Baden-Wuerttemberg State Archives



LINKED STAGE GRAPH

LIMITATIONS

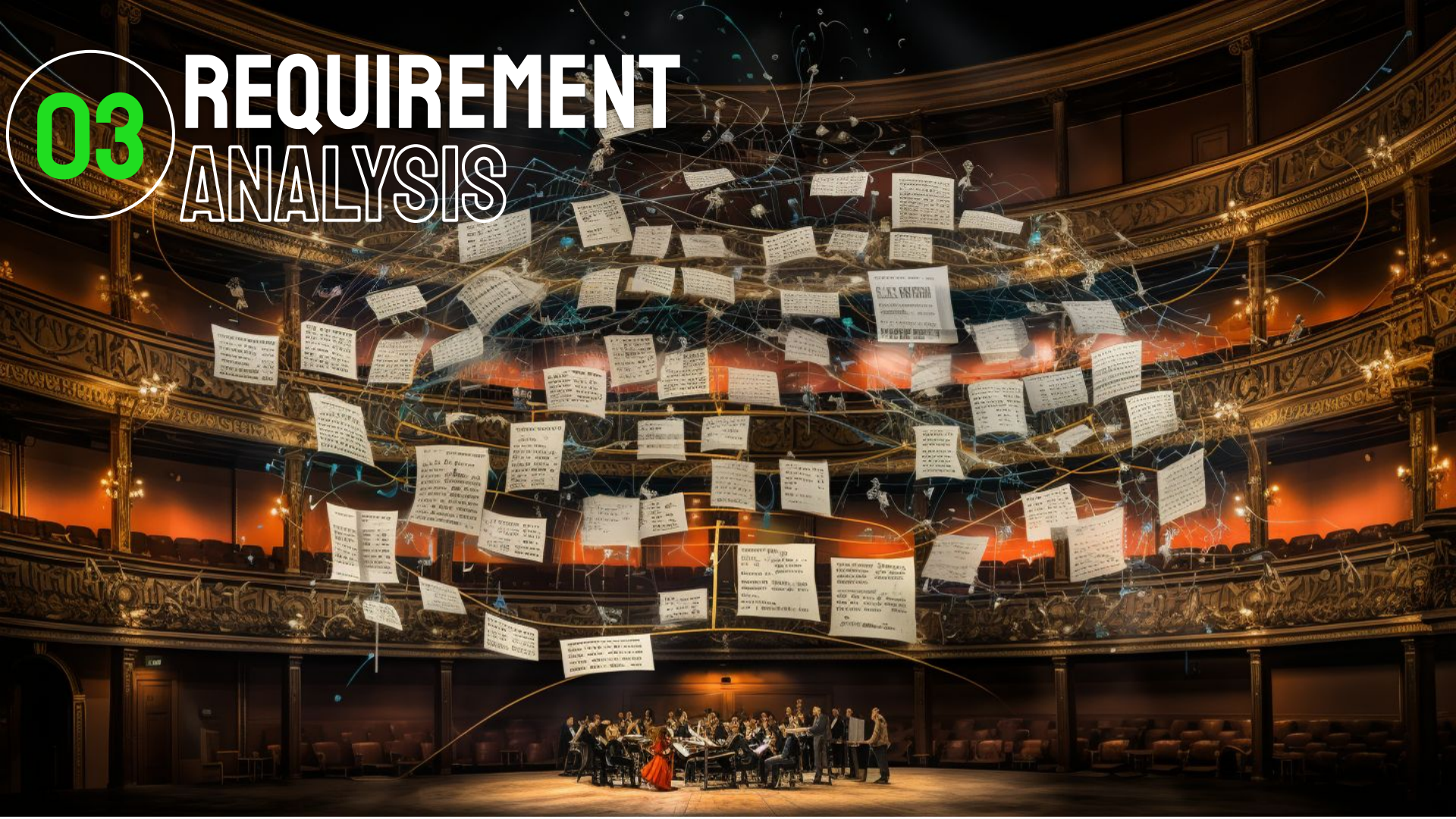
- Simple conversion from EAD-XML to RDF
- Much noise in the data
- Lacks a meaningful, interoperable, and reusable ontology.

What do we need to create an open research resource, which enables an **efficient** and **scientifically accurate** exploration of historical performing arts data?



03

REQUIREMENT ANALYSIS



REQUIREMENTS

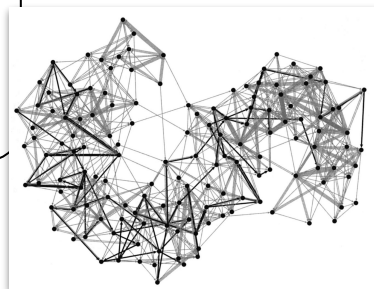
REQ1 CONTEXT

Provide as much context as possible. No entity in the performing arts exists on its own (e.g. archival object, performance, person, role, stage prop...).

REQ2 PERSPECTIVE

Provide different perspectives on performing arts data (holistic view).

- What were theatre networks?
- How did trends and patterns develop?
- How were plays distributed?



REQUIREMENTS

REQ3 INTEROPERABILITY

Enable the interconnection between disciplines (Gewerke), datasets, regional/international efforts.

REQ4 PERSONS AND FUNCTIONS

All persons on, behind and in front of the stage of a performance and their functions are relevant.

- Who worked with whom?
- Which persons took on various functions throughout their career?
- Who worked in which institution?
- Who appeared on stage and in which order?



REQUIREMENTS

REQ5 CHANGE

Theater is dynamic and change over time should be revealed in terms of persons, occupations, work interpretations, stage design, etc.

REQ6 EVENTS

Performing arts data is (usually) event-based. Distinguish between a work and the performance as an event.



REQUIREMENTS

REQ7 STAGE ELEMENTS

Objects on stage are relevant for historiographical theatre research.

REQ8 QUERYING

A data model that represents performing arts data should be lightweight to enable intuitive querying for domain experts.





REQUIREMENTS

REQ9 PROVENANCE

It has to be possible to verify research results, e.g. biographical data has to be linked to their data source.

REQ10 DATA QUALITY

The quality of the data used in performing arts research has to be clear.

REQUIREMENTS

TAKE-AWAYS

- We need an expressive, efficient and lightweight data model to represent performing arts data.
- Representation of the performing arts event and the work.
- Interconnect data sources to provide context and perspective.
- We need a distinction between a performance event and the literary source/template.
- We have to preserve the original data structure provided by the archive.



04

APPROACH



The background of the slide features a collage of vintage newspaper clippings, including headlines like "B...", "POLI...", "WHI...", and "L...". Overlaid on this is a complex network diagram consisting of numerous black dots connected by thin black lines, creating a web-like structure. In the center, two women in 1940s-style dresses are captured in a dynamic, dancing pose, their arms raised and bodies angled towards each other. The overall color palette is a muted, sepia-toned brown.

04.01

APPROACH DATA SOURCES AND MODULES

TOWARDS LINKED STAGE GRAPH 2.0

DATA SOURCES AND MODULES

LINKED STAGE GRAPH

METADATA

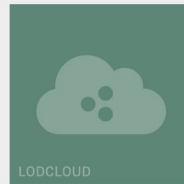
Performing arts events,
genre, production type,
some persons , dates,
images

Was ihr wollt (William Shakespeare)

<http://slod.fiz-karlsruhe.de/labw-2-2599390>

dcterms:description

Schauspiel
Art und Datum der Aufführung: Neuinszenierung, 11.03.1923
Inszenierung: Curt Elwenspoek
Bühnenbild: Felix Czossek
Kostüme: Ernst Pils



rdfs:label

Was ihr wollt (William Shakespeare)

schema:genre

Schauspiel

schema:keywords

Neuinszenierung

dcterms:date

11. März 1923



TOWARDS LINKED STAGE GRAPH 2.0

DATA SOURCES AND MODULES

LINKED STAGE GRAPH

METADATA

Performing arts events,
genre, production type,
some persons , dates,
images

Was ihr wollt (William Shakespeare)

<http://slod.fiz-karlsruhe.de/labw-2-2599390>

dcterms:description

Schauspiel

Art und Datum der Aufführung: Neuinszenierung, 11.03.1923

Inszenierung: Curt Elwenspoek

Bühnenbild: Felix Cziossek

Kostüme: Ernst Pils



Linked Stage Graph

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firstname.lastname@bw-lit.de

Abstract. Archives today are publishing their cultural heritage data on the Web for exploration. However, for archive services the traditional archival structure often are not intuitive and difficult to understand, and their challenges data access and consumption. To tackle this problem, *Linked Stage Graph* was developed, a knowledge graph (KG) on the foundation of internal data about the Stuttgart State Theatre. The data was made available by the Baden-Württemberg State Archives for the Catalogue de Viesarchiv. This demo paper contributes the KG, a SPARQL endpoint, named entity recognition and linking to existing authoritative KGs as well as a dedicated user interface for exploration.

Keywords: cultural heritage · linked data · knowledge graph · UI.

1 Introduction

Digitizing cultural heritage has been a major task for galleries, libraries, archives and museums (GLAM) for many years now. As a result, a number of Web-based platforms have been developed with the goal to make researchers to access and analyze the data scientifically as well as to allow the general public to explore the data. However, many archival web platforms present their content organized in a way familiar only to archive experts but users who are unfamiliar with archival practice to structure information often find it challenging to access and explore the provided content [1,2].

The Baden-Württemberg State Archives in Germany recognized this issue and opened up their data to the Catalogue de Viesarchiv, the first German year, bringing together GLAM institutions as data providers and computer scientists, designers, digital humanists to develop creative and user-centered solutions on the foundation.

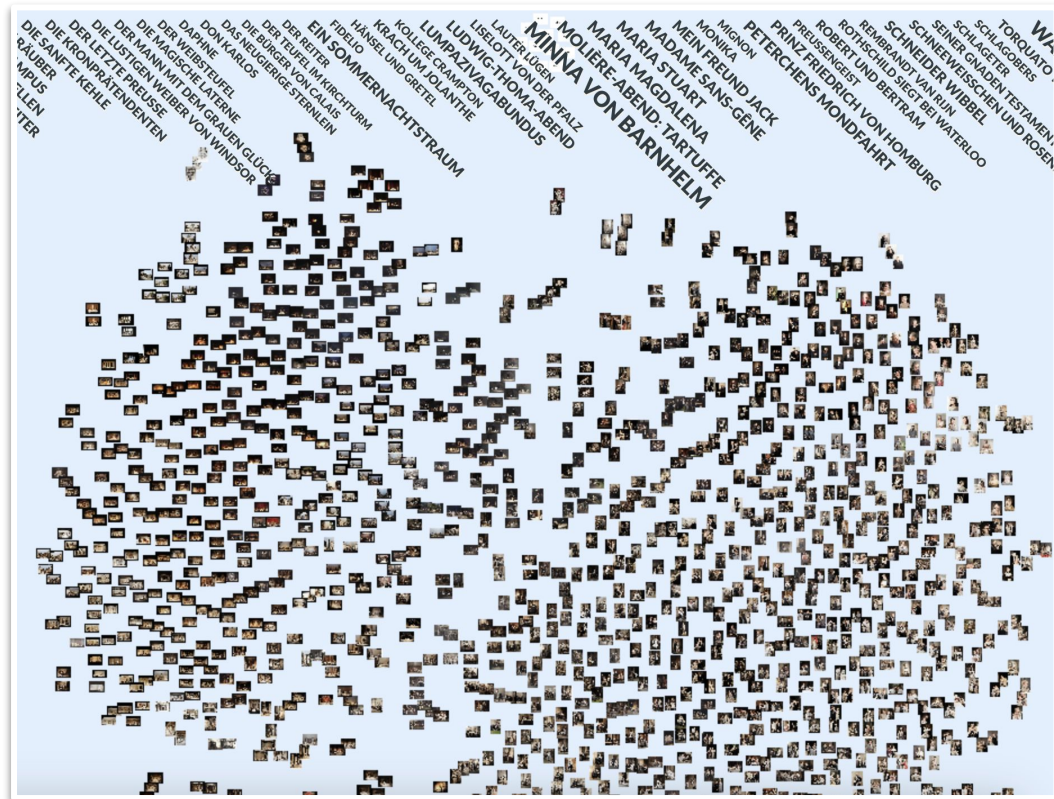
[14] T. Tietz, J. Waitelonis, K. Zhou, P. Felgentreff, N. Meyer, A. Weber, H. Sack: **Linked Stage Graph**, In Proc. of the 15th Int. Conf. on Semantic Systems (SEMANTiCS 2019), Poster & Demo Track

TOWARDS LINKED STAGE GRAPH 2.0

DATA SOURCES AND MODULES

LINKED STAGE GRAPH IMAGES

7.000 images of actors,
performances, stage
designs, off stage work,
theatre buildings



PERSON FILES AND CONTRACTS



The image shows a person's workspace with two computer monitors. The left monitor displays a Google Drive interface with a folder named "Personenlisten_Cyberlex". The right monitor displays a spreadsheet titled "Personenlisten_Cyberlex" with columns for "Jahr", "Typ", "Ereignisse", "Bucheinde", "Ort", "Verh.", "Vorname", "Geb.", "Vername", "Tätigkeit (Jahr)", and "Tätigkeit (Jahr)". The spreadsheet lists various historical figures and their activities. The person's hand is visible at the bottom left, pointing at the left monitor.

TOWARDS LINKED STAGE GRAPH 2.0

DATA SOURCES AND MODULES

PERSON FILES AND CONTRACTS

Persons involved in
Stuttgart Theatres.
Provided by
Baden- Wuerttemberg
State Archives.

- 2800 persons
- Earliest entrance year: 1780
- Latest exit year: 1983
- Wikidata/GND entities: 562/694
- Occupations: 285 (distinct)
- Birth place: 926 entries
- Death place: 28 entries



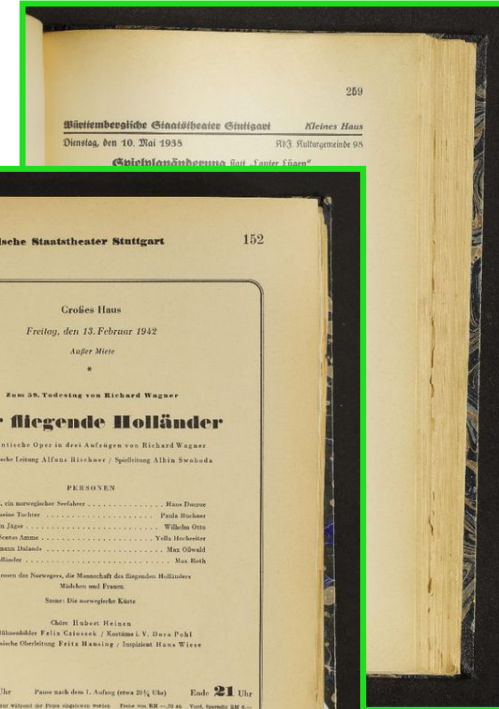
TOWARDS LINKED STAGE GRAPH 2.0

DATA SOURCES AND MODULES

THEATRE PROGRAMS

Programs (scanned documents) from 1807 to 1946.

Württembergische
Landesbibliothek



TOWARDS LINKED STAGE GRAPH 2.0

DATA SOURCES AND MODULES

THEATRE PROGRAMS

Programs (scanned documents) from 1807 to 1946.

Württembergische
Landesbibliothek

Württembergische Staatstheater Stuttgart *Kleines Haus*
Sonntag, den 25. Dezember 1938 *Hauptmiets E 11*

In neuer Inszenierung
Ein Sommernachtstraum
von William Shakespeare
Musik von Ernst Roters (op. 14, 1920)
Inszenierung: Walther Friedrich Peters • Musikalische Leitung: Hellmuth Löffler

Personen:

Theseus, Herzog von Athen	Gerhard Geisler
Egeus, Vater der Hermia	Roderich Arndt
Lysander	Heinz Rassaerts
Demetrius, Liebhaber der Hermia	Herbert Schneider
Philostrot, Aufseher der Lustbarkeiten am Hofe des Theseus	Erik Haffner
Squenz, der Zimmermann	Paul Dätel
Schnock, der Schreiner	Heinrich Pintakly
Fettel, der Weber	Herbert Herbe
Glaut, der Bälgenflüder	Kurt Morgell
Schnauz, der Kesselflüder	Artur Arwander
Schluder, der Schneider	Walter Thureau
Hippolyta, Königin der Amazonen, mit Theseus verlobt	Käthe Jiter
Hermia, Tochter des Egeus, in Lysander verliebt	Hanna Große
Helena, in Demetrius verliebt	Hilde Ebert
Oberon, König der Elfen	Waldemar Leitgeb
Titania, Königin der Elfen	Wac Gouza a. G.

Musik von Ernst Roters (op. 14, 1920)
Inszenierung: Walther Friedrich Peters
Leitung: Hellmuth Löffler
Personen:
Theseus, Herzog von Athen
Gerhard Geisler
Egeus, Vater der Hermia
Roderich Arndt
Heinz Rassaerts
Tysander
Demetrius Liebhaber der Hermia
Herbert Schneider
Erik Haffner



TOWARDS LINKED STAGE GRAPH 2.0

DATA SOURCES AND MODULES

Württembergische Staatstheater Stuttgart

Kleines Haus

Sonntag, den 25. Dezember 1938

Hauptmiets E 11

In neuer Inszenierung

Ein Sommernachtstraum

von William Shakespeare

Musik von Ernst Rofers (op. 14, 1920)

Inszenierung: Walther Friedrich Peters • Musikalische Leitung: Hellmuth Löffler

Personen:

Theseus, Herzog von Athen	Gerhard Geister
Egeus, Vater der Hermia	Roderich Arndt
Lysander	Heinz Rassaerts
Demetrius	Herbert Schneider
Philostrot, Aufseher der Lustbarkeiten am Hofe des Theseus	Erst Hofner
Squenz, der Zimmermann	Paul Tätzl
Schnod, der Schreiner	Heinrich Pinstagly
Zettel, der Weber	Herbert Herbe
Flaut, der Fälgensfälder	Kurt Horgell
Schnauz, der Kesselfälder	Artur Anwander
Schlader, der Schmelzer	Walter Chureau
Hippolyta, Königin der Amazonen, mit Theseus verlobt	Käthe Jtzer
Hermia, Tochter des Egeus, in Lysander verliebt	Hanna Großje
Helena, in Demetrius verliebt	Hidde Ebert
Oberon, König der Elfen	Woldemar Leißgeb
Titania, Königin der Elfen	Inge Contralt a. G.
Puck	Serry Dittich
Eine Elfe	Helene Krölicher
Spinnweb	Gaby Heinig
Bohnenlute	Margarete Stein
Senjsame	Hannelore Bücheler

Elfen

Szene: Athen und ein nahegelegener Wald

Tanzinszenierung: Lina Gerzer

Bühnenbilder: Axel Bopp / Kostüme: Ernst Pils

Technische Einrichtung: Fritz Hansing / Spielwart: Julius Carty

Anfang **19¹/₂** Uhr Pause etwa 21¹/₂ Uhr Ende **22¹/₄** Uhr
Zusatzkommende können nur während der Pause
eingelassen werden

Preise der Plätze von RM. —.90 an Vorderer Sperris RM. 5.—

Vertikaler in RM. —.35 und an der Tageskassette und abends beim Theaterbeginn konnte in der Vorverkaufsstelle der Buchhandlung
6. 11111, Königsstraße 38, zu haben



TOWARDS LINKED STAGE GRAPH 2.0

DATA SOURCES AND MODULES

Württembergische Staatstheater Stuttgart *Kleines Haus*

Sonntag, den **25. Dezember 1938** *Sonntags F 11*

In neuer Inszenierung

Ein Sommernachtstraum

von **William Shakespeare**

Musik von Ernst Katers (op. 14, 1920)

Inszenierung: Walther Friedrich Peters • Musikalische Leitung: Hellmuth Löffler

Personen:

Theseus, Herzog von Athen	Gerhard Geister
Egeus, Vater der Hermia	Roderich Arndt
Lysander Liebhaber der Hermia	Heinz Rassaerts
Demetrius Philostrate, Aufseher der Süßbäckerin am Hofe des Theseus	Herbert Schneider
Squenz, der Zimmermann	Erst Göttinger
Schnod, der Schreiner	Paul Tätzl
Zettel, der Weber	Heinrich Pinstaghty
Klaut, der Balsamfäßer	Herbert Herbe
Schnauz, der Kesselfläßer	Kurt Horgell
Schlauer, der Schneider	Artur Bruns
Hippolyta, Königin der Amazonen, mit Theseus verlobt	Walter Ehrhard
Hermia, Tochter des Egeus, in Lysander verliebt	Käthe Jtzer
Helena, in Demetrius verliebt	Hanna Große
Oberton, König der Elfen	Hilde Ebert
Titania, Königin der Elfen	Woldemar Leitzgeb
Puck	Inge Conradi u. G.
Eine Elfe	Serry Dietrich
Spinnweb	Helene Krölicher
Bohnenkäte Elfen	Gaby Heinig
Senjsame	Margarete Stein
	Hannelore Bücheler

Elfen

Szene: Athen und ein nahegelegener Wald

Tanzinszenierung: Lina Gerzer

Bühnenbilder: Axel Bopp / Kostüme: Ernst Pils

Technische Einrichtung: Fritz Hansing / Spielwart: Julius Carty

Anfang **19¹/₂ Uhr** *Pause etwa 21¹/₂ Uhr* *Zusätzkommende können nur während der Pause eingelassen werden* *Ende etwa 22¹/₄ Uhr*

Preise der Plätze von RM. —.90 an *Vorderer Sperrplatz RM. 5.—*

Vertikaler in RM. —.35 und an der Tageskasse und abends beim Theaterbeginn konnte in der Vorverkaufsstelle der Buchhandlung 11111, Königsplatz 38, zu haben


Ein Sommernachtstraum (William Shakespeare)

<http://siod.fiz-karlsruhe.de/labw-2-2599048> AN ENTITY OF TYPE: Archiv

dc:terms:description

Schauspiel
Art und Datum der Aufführung: Neuinszenierung, 25.12.1938
Inszenierung: Walther Friedrich Peters
Bühnenbild: Axel Bopp
Kostüme: Ernst Pils

Fehlt



Fehlt

TOWARDS LINKED STAGE GRAPH 2.0

DATA SOURCES AND MODULES

Württembergische Staatstheater Stuttgart *Kleines Haus*
 Sonntag, den **25. Dezember 1936** *Sonntagsmiete F 11*

In neuer Inszenierung
Ein Sommernachtstraum
 von **William Shakespeare**
 Musik von Ernst Rofers (op. 14, 1920)

Inszenierung: Walther Friedrich Peters • Musikalische Leitung: Hellmuth Löffler

Personen:

Theseus, Herzog von Athen	Gerhard Weiser
Egeus, Vater der Hermia	Roderich Arndt
Lysander	Heinz Kasperer
Demetrius, Liebhaber der Hermia	Herbert Schneider
Philoftrat, Aufseher der Lustbarkeiten	Ernst Haffner
Squenz, der Zimmermann	Paul Dattel
Schnod, der Schreiner	
Zettel, der Weber	
Klant, der Balgenschläger	
Schnauz, der Kesselschläger	
Schlader, der Schneider	
Hippolyta, Königin der Amazonen	
Hermia, Tochter des Egeus, in Lysander verliebt	
Helena, in Demetrius verliebt	
Oberton, König der Elfen	
Citania, Königin der Elfen	
Puck	
Eine Elfe	
Spinnweb	
Bohnenkote	
Senfame	

Szene: Athen und ein nahegelegener Wald
 Tanzinszenierung: Lina Gerzer
 Bühnenbilder: Axel Bopp / Kostüme: Ernst Pils
 Technische Einrichtung: Fritz Hänsing / Spielwart: Julius Carly

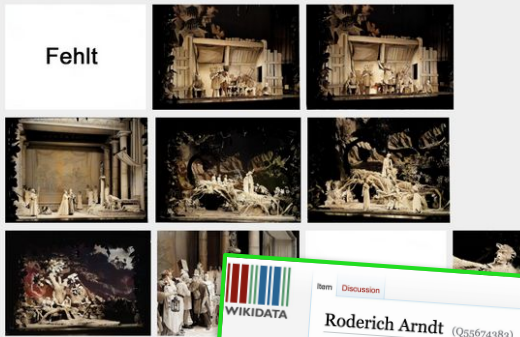
Anfang **19¹/₂ Uhr** Pause etwa 21¹/₂ Uhr Ende **22¹/₄ Uhr**
 Zutrittskommende können nur während der Pause eingelassen werden
 Preise der Plätze von RM. —.90 an
 Vorderer Sperrflüß RM. 5.—

Vertikbücher in RM. —.35 und an der Tageskassette und abends beim Theaterbeginn konnte in der Vorverkaufsstelle der Buchhandlung 22 11 1, Königstraße 38, zu haben

Ein Sommernachtstraum (William Shakespeare)
<http://siod.fiz-karlsruhe.de/labw-2-2599048>
 AN ENTITY OF TYPE: Archiv

dc:terms:description
 Schauspiel
 Art und Datum der Aufführung: Neuinszenierung, 25.12.1936
 Inszenierung: Walter Friedrich Peters
 Bühnenbild: Axel Bopp
 Kostüme: Ernst Pils

Fehlt



Roderich Arndt
 Beruf: Schauspieler
 Geburtsdatum: 1876-05-23
 Eintritt: 1936, Austritt: 1961
 labw-2-322795

WIKIDATA

Item Discussion

Roderich Arndt (Q53674383)

actor (1876-1963)

+ In more languages

Language	Label	Description
English	Roderich Arndt	actor (1876-1963)
German	Roderich Arndt	No description defined
French	Roderich Arndt	No description defined
Bavarian	No label defined	No description defined

All entered languages

Statements

Instance of

human

+ 1 reference

TOWARDS LINKED STAGE GRAPH 2.0

DATA SOURCES AND MODULES

- Goal is to create a linked open research resource based on diverse data sources
- Interconnection between various sources and enrichment via GND, Wikidata
- Enabling both an efficient and scientifically accurate exploration of historical performing arts data



The background image features two women in mid-air, appearing to be jumping or dancing. They are wearing light-colored, short-sleeved dresses. The background is a collage of newspaper clippings, with some legible text including "B...", "FOLIOSEPA", "L'Espresso", "WII", and "Le Espresso". Overlaid on the entire image is a complex network of black lines connecting various points, resembling a data network or a molecular structure. The overall color palette is sepia-toned, giving it a vintage or historical feel.

04.02

APPROACH DATA MODEL

LINKED STAGE GRAPH DATA MODEL

WORK - PERFORMANCE

IN LINKED STAGE GRAPH I.O.:

All information about a single performance event, the literary source and the archival objects are merged (as provided by the archive)

Was ihr wollt (William Shakespeare)

<http://slod.fiz-karlsruhe.de/labw-2-2599390>

dcterms:description

Schauspiel
Art und Datum der Aufführung: Neuinszenierung, 11.03.1923
Inszenierung: Curt Elwenspoek
Bühnenbild: Felix Czossek
Kostüme: Ernst Pils



rdfs:label

Was ihr wollt (William Shakespeare)

schema:genre

Schauspiel

schema:keywords

Neuinszenierung

dcterms:date

11. März 1923



LINKED STAGE GRAPH DATA MODEL

WORK - PERFORMANCE

PROBLEM:

- A performance may significantly differ from its literary source/template
- Is a creative work on its own.



LINKED STAGE GRAPH DATA MODEL

WORK - PERFORMANCE

PROBLEM:

- A performance may significantly differ from its literary source/template
- Is a creative work on its own.
- Shakespeare authored "The Twelfth Night" (literary source)
- Didn't provide creative input to the German play "Was ihr Wollt", performed on March 11, 1923.



LINKED STAGE GRAPH DATA MODEL

SPA

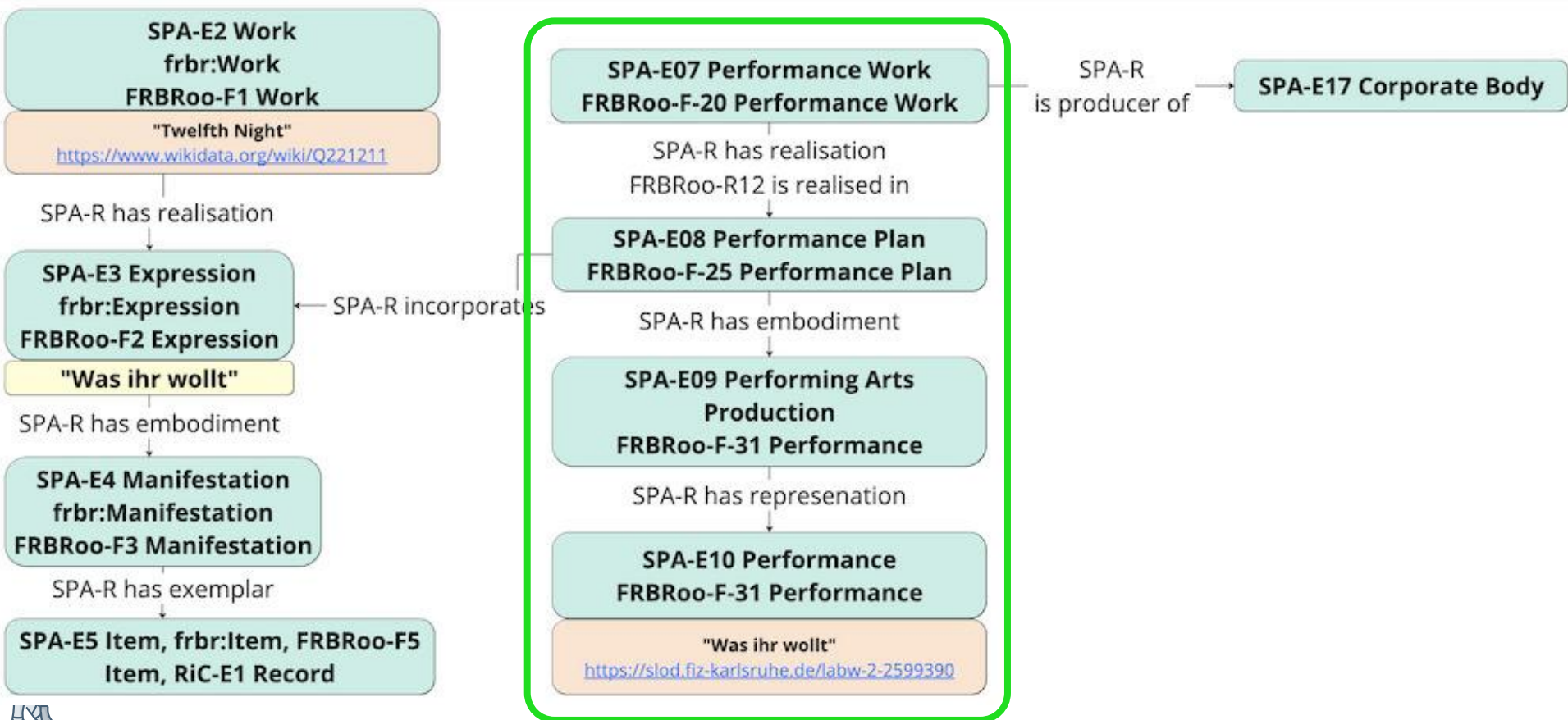
- The **Swiss Performing Arts (SPA)** data model is the best documented data model that is available in the performing arts domain:
 - Event based and
 - Emphasizes the importance of differentiating the literary source and the performance event itself
 - Aligned with CIDOC-CRM, FRBR and FRBRoo
- The SPA model is not intended for historical performing arts data specifically which often contains sparse metadata, is heterogeneous and depends on varying digitization and storing techniques.



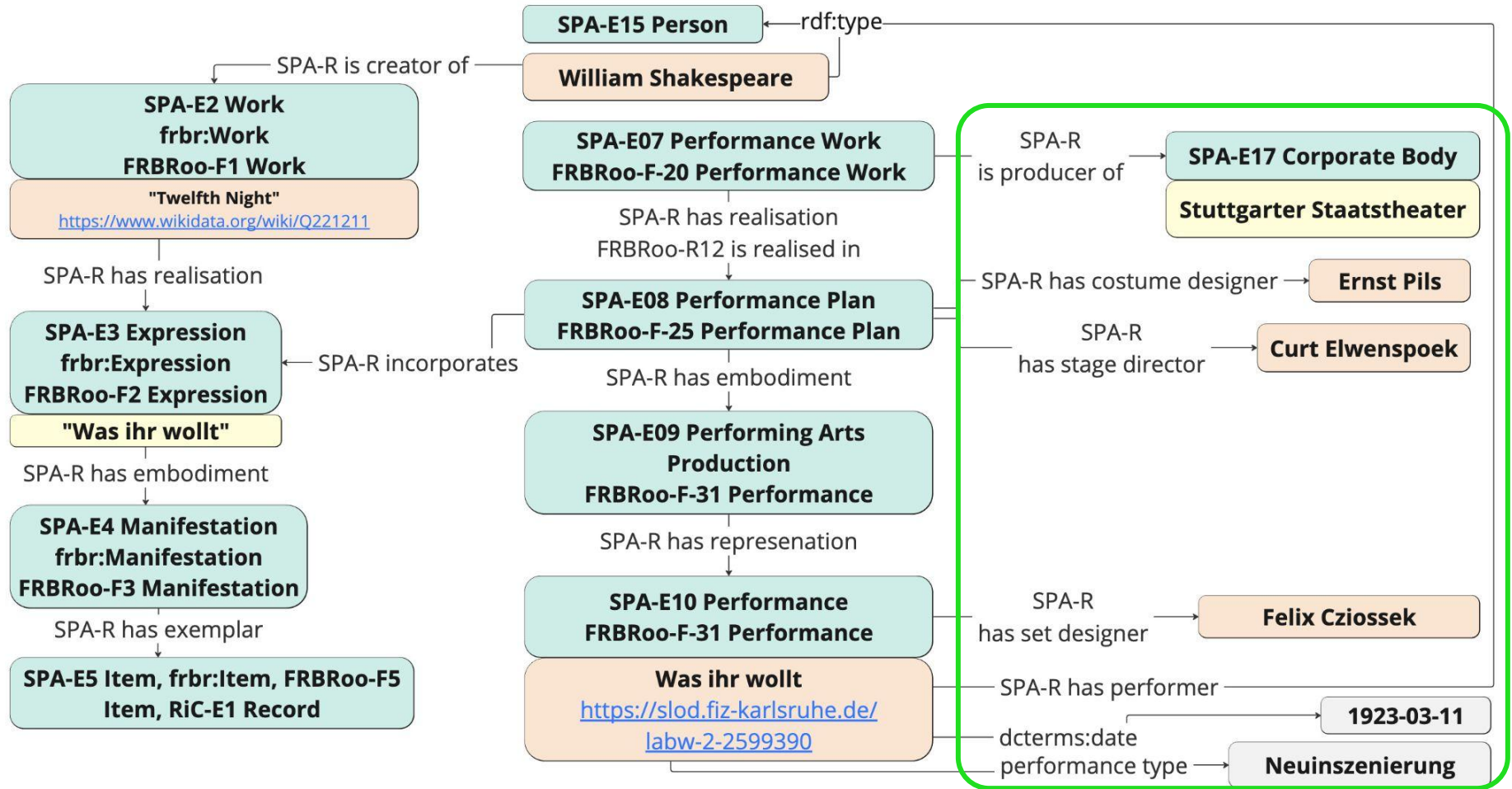
LINKED STAGE GRAPH DATA MODEL



LINKED STAGE GRAPH DATA MODEL



LINKED STAGE GRAPH DATA MODEL



LINKED STAGE GRAPH DATA MODEL

SPA

- Detailed differentiation between performance work, plan, production, event
 - real-world representation of the entities
 - highly complex
- Assumes rich metadata about performances



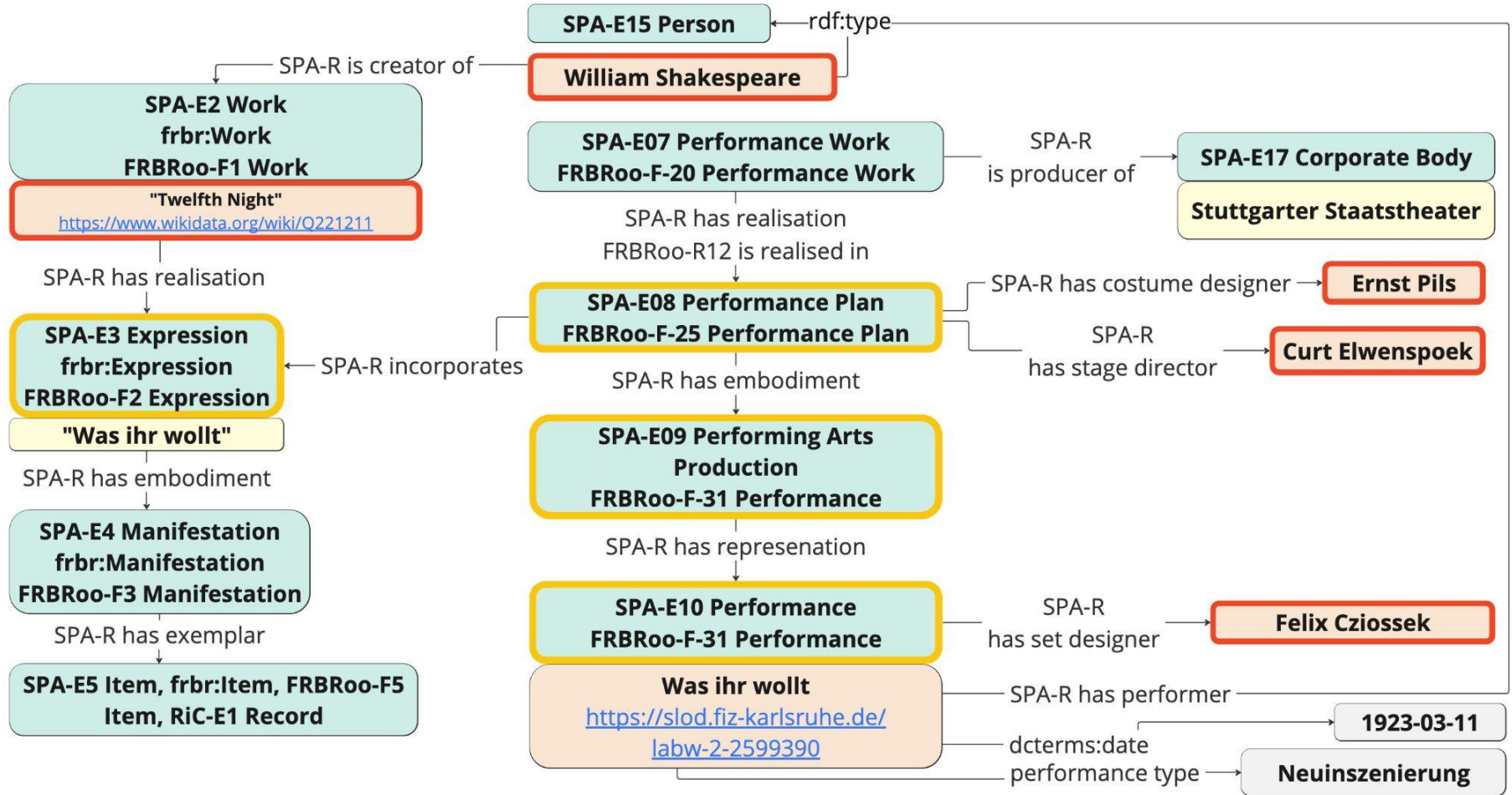
LINKED STAGE GRAPH DATA MODEL

COMPETENCY QUESTION:

Find all persons involved in a performance event which is based on a literary work by William Shakespeare.



LINKED STAGE GRAPH DATA MODEL



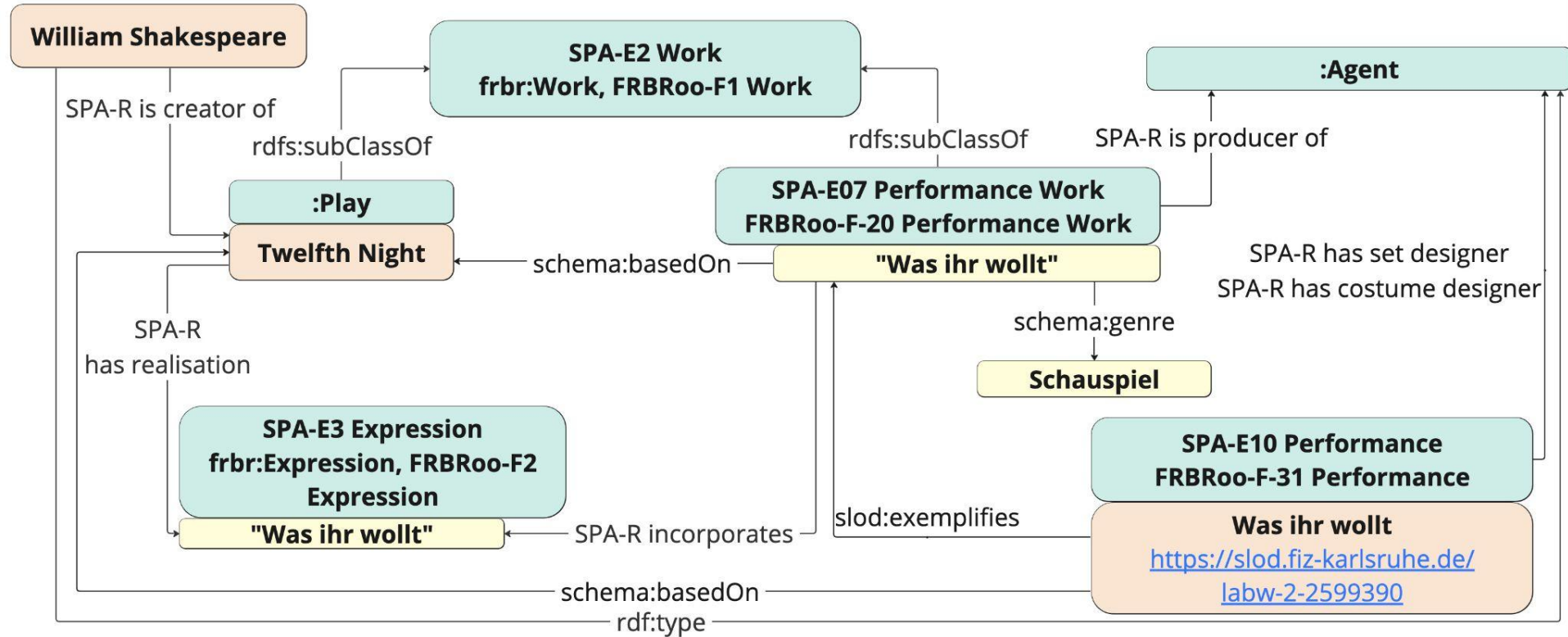
LINKED STAGE GRAPH DATA MODEL

SPA ADAPTATION

- Utilizes essential parts of the SPA model
- Extends SPA data model by providing a set of direct relations between entities of different granularities
 - Allows for omitting Performance Plan and Performing Arts Production
 - Allows for more flexibility
 - Lightweight simplified version to improve query efficiency and exploration capability



LINKED STAGE GRAPH DATA MODEL



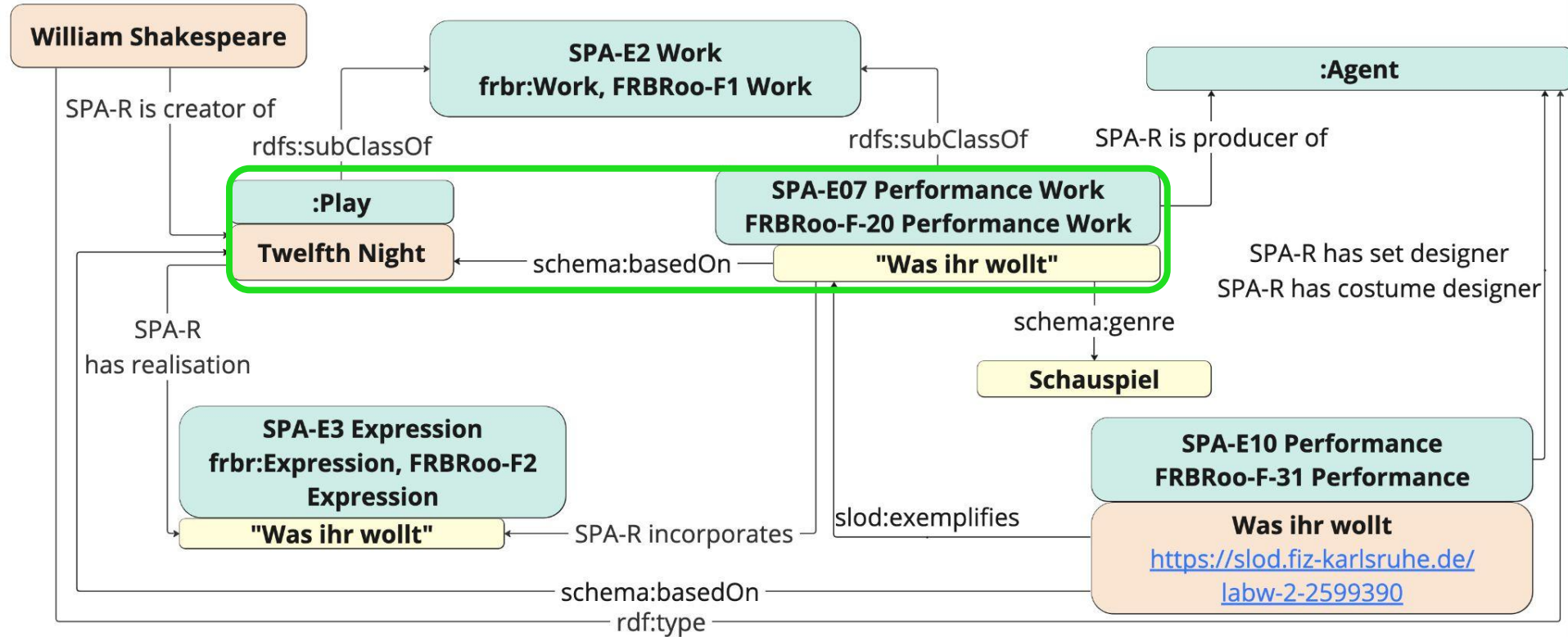
LINKED STAGE GRAPH DATA MODEL

COMPETENCY QUESTION:

Which literary source is a performance work based on?



LINKED STAGE GRAPH DATA MODEL



LINKED STAGE GRAPH DATA MODEL

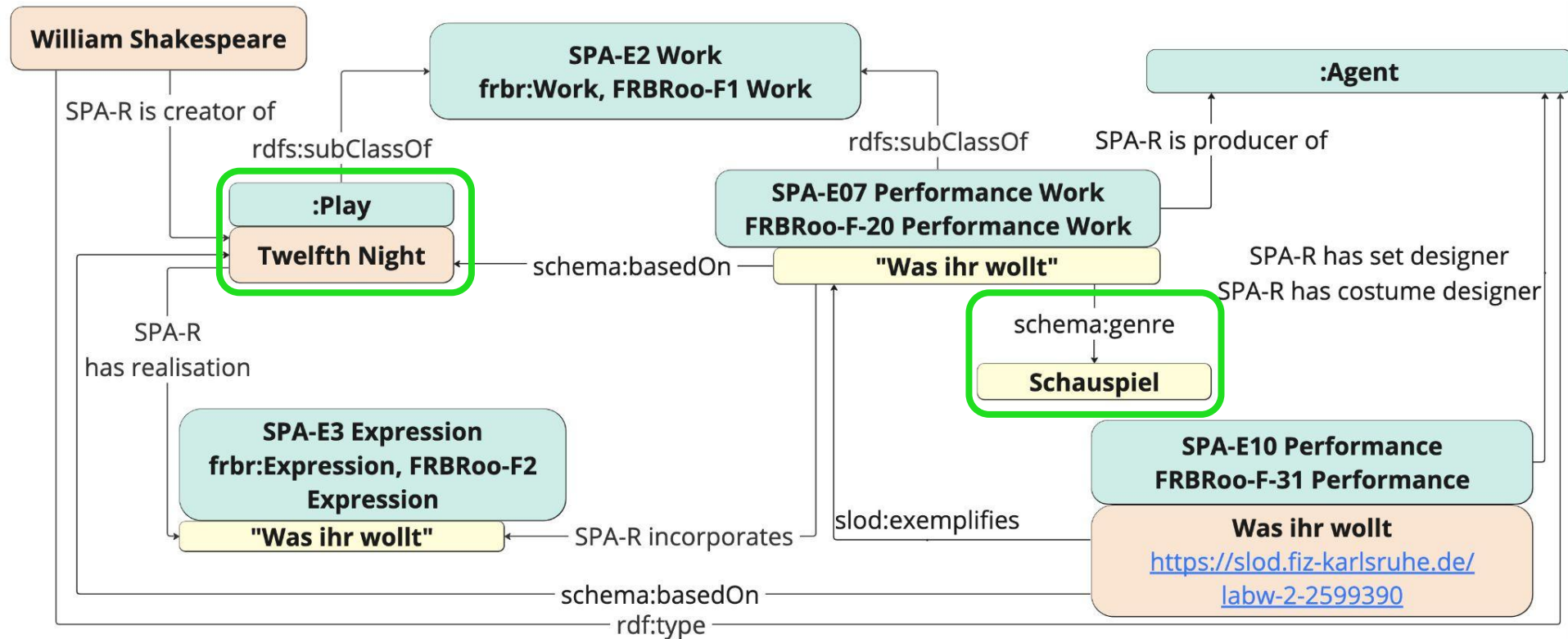
COMPETENCY QUESTIONS:

- List all performances in the genre "Schauspiel"
- List all performances which are based on a literary source in the genre of "Play"

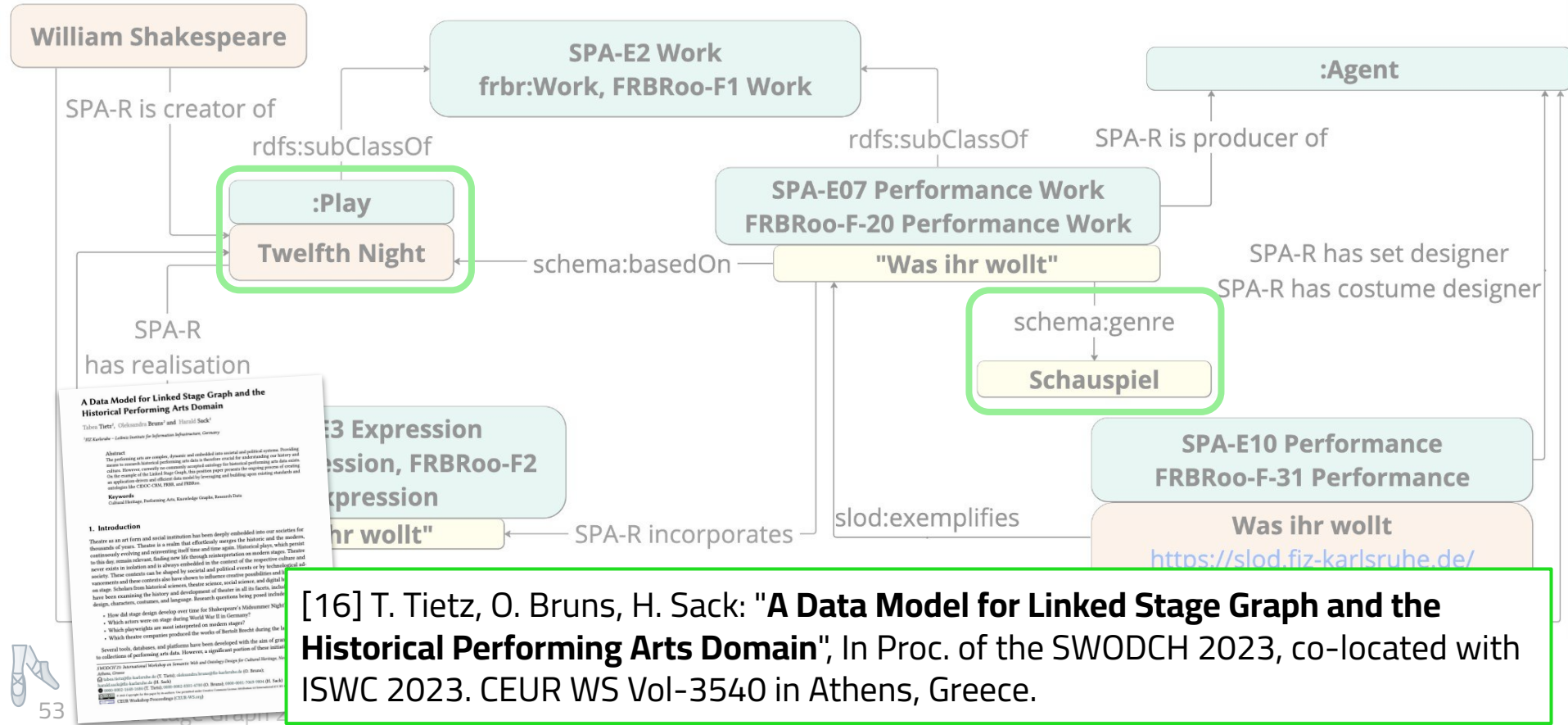
→ Literary Work and Performance Work can have different genres



LINKED STAGE GRAPH DATA MODEL



LINKED STAGE GRAPH DATA MODEL



LINKED STAGE GRAPH DATA MODEL

CONCLUSION

- Goal is to create a linked open research resource based on diverse data sources.
- Enabling both an efficient and scientifically accurate exploration of historical performing arts data.



LINKED STAGE GRAPH DATA MODEL

CONCLUSION

- Lightweight, interoperable, easy to further extend and specify data model
- Goal is to create an expressive and efficient data model for
 - Linked Stage Graph
 - the performing arts community
- Leveraging existing standards and ontologies like CIDOC-CRM, FRBR, and FRBRoo.



THANK YOU!

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RESOURCES

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