LINKED DIGITAL FUTURE

A Linked Digital Future for the Performing Arts

Leveraging Synergies along the Value Chain

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Related resources and contents, including sample linked open data visualization, the conceptual model and controlled vocabularies, are available on the Linked Digital Future website:

http://linkeddigitalfuture.ca

CAPACOA acknowledges that rich artistic expressions have been part of our land long before European settlers set foot on the territory known today as Canada. As we embark on a journey to establish a performing arts domain within the web of data, we express the hope to create digital territories that do not replicate colonial or proprietary structures, but that are rather meant to be shared and be open to all forms of artistic expressions and worldviews, including the past and contemporary expressions of the First Nations, Inuit and Métis peoples of Turtle Island.

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Executive Summary

Over the last five years, the topic of performing arts metadata has emerged as one of the most pressing issues for the performing arts sector in Canada.

To address the resulting challenges, the Canadian Arts Presenting Association (CAPACOA) and its partners are undertaking a flagship digital literacy and transformation initiative. Based on shared metadata strategies and prototypes, CAPACOA's **Linked Digital Future Initiative (LDF Initiative)** seeks to enhance the discoverability of the performing arts and to help the sector leverage the potential of new technologies by fostering collaboration along the performing arts value chain.

In the first half of 2019, the project began with an **action research component, which is documented in this report.** The research lays the foundations for the ensuing prototyping and development phase, providing direction for the digital literacy campaign that will roll out in the arts sector, and informing the deliberations of the Advisory Committee on potential governance structures.

Our research catalogues **various initiatives at the international level to establish a linked open data ecosystem for the performing arts.** Most of these initiatives emerged from the heritage or research sectors; very few directly address the primary value chain of the performing arts, involving performing arts professionals, production companies, presenting organizations, operators of arts facilities, dissemination platforms, and concert/theatre goers. By placing primary focus on performing arts stakeholders, the LDF Initiative is breaking new ground.

Comparative analysis of the usage scenarios of different stakeholder groups has shown that the respective requirements for data overlap considerably; the core elements of the data model are consistent across sectors. This means that **substantial synergies are to be expected not only with regard to data maintenance, but also in view of the development of other parts of the data infrastructure**, including platforms for data entry, services for data extraction, analysis and visualization, or the provision of data and/or media repositories.

Furthermore, exchanges with LDF Initiative project members and institutions in other countries have shown that many usage scenarios related to a linked open data

ecosystem for the performing arts have international relevance. There are also important usage overlaps regarding works as well as artists and artists' collectives. Given the many links between Canadian performing arts metadata and similar data from other countries, **international cooperation should be strengthened.**

To facilitate the implementation of the technical solutions to be developed as part of the LDF Initiative, an **initial conceptual model and formal ontology** (available on the [project website](#)) were developed based on existing data models. Data modelling was guided by a set of sample resources describing current performing arts productions and performance events in Canada. The **data from the sample resources has been published as linked open data** and serves as a basis for discussion as the model continues to develop.

Prototyping and implementation of two **Canadian use cases** will be pursued during the remainder of the LDF Initiative:

- **RIDEAU's Scène Pro** is a centralized information system for the performing arts production market. It is meant to integrate and facilitate a number of operations such as showcase application, event registration, and block-booking. Some of the primary goals of Scène Pro are to reduce manual data population within different systems and to enable use of the same core data across a number of business processes.

- **Culture Creates' Footlight technology** harvests event information on websites and translates it into machine-readable metadata. Upon validation of the data by the presenters of these events, the metadata is republished as html-embedded JSON-LD on organizations' websites and also populated as linked open data in the Artsdata.ca knowledge graph. Culture Creates' Footlight technology thus enables performing arts organizations to easily create and expose machine-readable metadata without developing expertise on semantic technologies.

Both applications contribute to and consume data from the **Artsdata.ca performing arts knowledge graph**. At present, the graph database is still in its infancy, but the shared effort is on eventually assembling all relevant data about current and future performing arts events in Canada and by Canadian artists or artists' collectives abroad. The creation of Artsdata.ca aspires to give the arts sector some control over its own data in a digital environment ruled by recommendation algorithms that help people plan their leisure time; an activity increasingly reliant on quality structured data in order to deliver pertinent results. Artsdata.ca is open to further data providers and may serve a variety of use cases beyond consumption.

To better equip itself for the digital world, **members of the performing arts sector are strongly advised to embrace the linked open data approach** proposed in this report. To support this process, the LDF Initiative is planning a digital literacy campaign for the Canadian arts sector.

Based on the key insights gained through the action research, the LDF Initiative's Advisory Committee has adopted **five recommendations** to be taken into account during this and similar initiatives:

- **Immediate focus should be placed on populating a Canadian performing arts knowledge graph.** To do so, data about current and future events should be ingested into a knowledge graph via current and future LDFI prototyping partners or made available through interoperable data systems. In addition to ingesting event data, existing databases that contain data about works, venues, persons, and organizations involved in performing arts productions should be ingested or linked.

- **Wikidata is complementary to Artsdata.ca;** efforts should therefore be undertaken to contribute to its population with performing arts related data that is of relevance in the context of the Canadian knowledge graph.

- A **data governance framework needs to be developed** in cooperation with representatives from across the arts sector to establish who is able to share what type of data with whom, and who will have authority over which data/information.

- Further research is needed to better understand **user requirements with regard to the adoption of linked open data practices in existing and emerging service offerings.** It is crucial to create incentives for stakeholders who are expected to make an additional effort to contribute or enhance performing arts related data.

- Further effort is required to develop and describe (novel) **business models that leverage and maintain a well-functioning linked open data ecosystem for the performing arts.** It is essential to evaluate the long-term economic sustainability for individual contributions to the common knowledge graph by key players in the performing arts value network.

1 Introduction

Over the last five years, performing arts metadata has emerged as one of the most pressing issues for the performing arts sector in Canada.

Public and sector-led consultations, research activities, and cultural policies have stressed the need to develop the sector's digital literacy and to reconsider current business models and organisational cultures in response to cultural and social changes produced by the digital revolution. Most notably, in 2017, two research reports – the first by CAPACOA and Strategic Moves, the second by Québec's Observatoire de la culture et des communications – delivered the same conclusion and call to action: the performing arts sector needs a shared vision and a coherent strategy for high quality interoperable metadata.

Public and arts sector stakeholders are acting. While the Government of Québec is pursuing a *Plan culturel numérique* with dedicated resources to design and implement an action plan for metadata *(mesure 111)*[1] , the Canadian Arts Presenting Association (CAPACOA) and its partners are undertaking a flagship digital literacy and transformation initiative for the performing arts sector. Based on shared metadata strategies and prototypes, these parties seek to enhance discoverability of the performing arts and evolve radically new collaboration mindsets. The prerequisite and long-term vision is for the sector to develop capacity to translate public performing arts information (i.e., non-confidential information) into open, machine-readable, and interoperable metadata.

1.1 Overview of CAPACOA's Linked Digital Future Initiative

CAPACOA's Linked Digital Future Initiative (LDF Initiative or LDFI) has several components, such as "action research," "governance", "prototyping and development", as well as "digital literacy" and "communications" activities.

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1   http://culturenumerique.mcc.gouv.qc.ca/111-mettre-en-place-un-plan-daction-concernant-les-donnees-sur-les-contenus-culturels-quebecois/

Linked Digital Future Initiative Components and Anticipated Outcomes
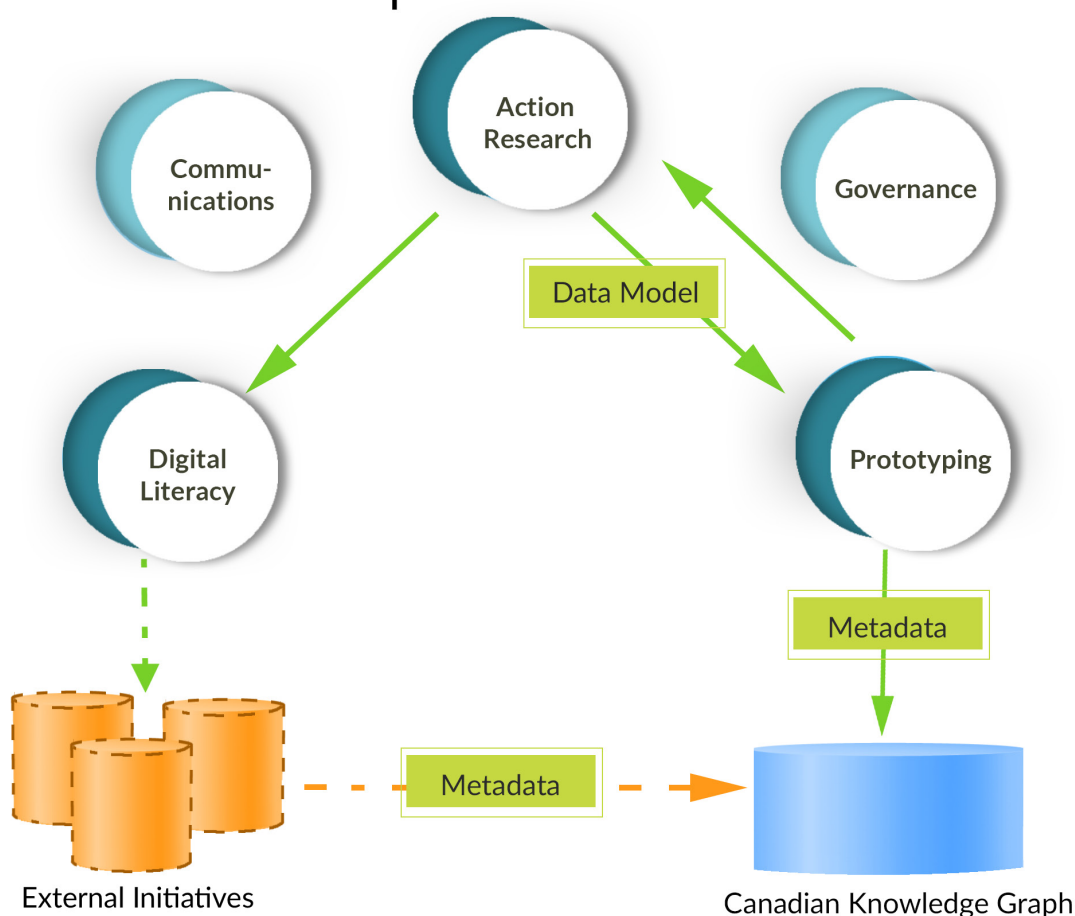
Figure 1: The Linked Digital Future Initiative and its anticipated outcomes.

Action Research (February 2019 – August 2019 and beyond)

This report lays the foundations for future LDFI components. During the initial action research phase, existing semantic technologies were examined and the potential for representing public performing arts information and knowledge as metadata was assessed.

The objective was to identify concrete recommendations for the implementation of shared semantic technologies across the performing arts value chain with the intent of improving data systems interoperability and enhancing the discoverability of the performing arts by consumers.

Prototyping and Development (Spring 2019 – March 2021)
Two prototyping partners – Culture Creates and RIDEAU – are actively contributing to design and roll out the action research roadmap. This involves participation in the development of the conceptual model and controlled vocabularies; validation of the conceptual model with real data and the development of a proof of concept; and implementation of the action research recommendations and conceptual model in their data hubs: the Artsdata.ca knowledge graph and the Scène Pro information system. Upon completing the prototyping phase, both systems will be fully mapped with the same conceptual model, providing solid proof of concept for semantic interoperability.

In addition, Culture Creates and CAPACOA will develop digital discoverability services for performing arts organizations. With natural language processing technology, Culture Creates will automate the translation of event information into machine-readable linked open data. Further prototyping and development activities will involve the attribution of unique identifiers and the automated inference of metadata.

Digital Literacy (August 2019 – March 2021)
The Digital Navigation Program will provide direct, timely assistance to arts organizations as they seek to identify and address business problems requiring digital solutions. Coaching to organizations will be provided in the early design phase of new digital initiatives to help foster collaboration and interoperability. This program will be delivered in a decentralized fashion via regional partners. Training sessions and materials will also be developed and delivered online and at conferences.

Governance (December 2018 - March 2021 and beyond)
The LDFI Advisory Committee was assembled at the very beginning of the Linked Digital Future initiative to provide guidance to the project team and to help address governance issues as they arise. The LDFI Advisory Committee provides oversight for all action research activities and in some cases contributed actively to the action research report. They have provided valuable input regarding data modelling issues, usage scenarios, and validation of the report's recommendations.

Following the report's publication, the LDFI Advisory Committee will reflect and deliberate upon the governance questions identified during the LDF initiative. Their final deliverable will be a set of recommendations for governance structures which address technical, ethical and business aspects.

Communications (March 2019 - March 2021 and beyond)
Communications activities are being implemented to support all LDFI components. The main communications deliverable is a website hosting this report and digital literacy contents.

1.2 Methodological Approach

To initialize the implementation of the technical solutions in development for the LDF Initiative and to provide guidance on the project's deployment, the following activities have been carried out:

- Existing elements and potential stakeholders of a linked open data ecosystem for the performing arts were identified based on desk research. The information gathered was complemented by interviews with some of the key players and inputs from various interlocutors from Canada and abroad.

- Based on this initial overview, the salient specifics of the Canadian context were carved out. The key components and the implementation context of the LDF Initiative were described in close cooperation with the members of the project team.

- An initial data model and formal ontology were developed based on existing data models. A set of sample resources describing current performing arts productions and performance events in Canada served as a guide for the initial focus of the model. Data from the sample resources has been published as linked open data by Culture Creates, and is serving as a basis for discussions on data modelling issues and further development.

- Insights from the preceding steps were gathered and a roadmap for the remainder of the project was laid out. This process was closely monitored by the Advisory Committee, who formulated a set of recommendations on the further deployment of the project and its long-term sustainability.

1.3 Structure of the Report

The remainder of the report is structured as follows:

- Section 2 provides an overview of current efforts to bootstrap a linked open data ecosystem for the performing arts. The focus is on various key stakeholders of the performing arts value network and their main usage scenarios. By juxtaposing different usage scenarios with required data, the areas where the greatest synergies are expected have been identified.

- Section 3 situates the LDF Initiative within the international context. To understand the specifications of the project, an analysis of the Canadian policy and implementation context is provided and the use cases envisioned by the Canadian implementation partners are presented. Usage scenarios promising to generate added short-term value are identified. These represent "low-hanging" fruit to pursue during the prototyping and development phase as we bootstrap the parts of the international linked open data ecosystem most relevant to the partners involved in the LDF Initiative.

- Section 4 provides an overview of the core aspects of the data model to be used and developed during the LDF Initiative. The full conceptual model, inspired by the Data Model for the Swiss Performing Arts, is available on the project website, where it has been documented and can be explored through Canadian sample data.

- Section 5 gives an account of the current state of the technical and organizational implementation of the LDF Initiative at the end of the Action Research Phase, and lays out the roadmap for ensuing Prototyping and Development Phases.

- Section 6 summarizes the key insights gained during the Action Research Component and contains a series of recommendations with regard to the further implementation of the LDF Initiative and in view of its long-term sustainability.

*Note: This report assumes that the reader has some preliminary knowledge of linked open data. For a short introduction to linked open data and pointers to further introductory material, see Estermann (2018a) or consult the project website.

2 Linked Open Data Ecosystem for the Performing Arts

In the past, we have seen various efforts and initiatives to create an international linked data ecosystem for the performing arts that rely both on Wikidata and the classical linked data approach.

In this section, we take stock of the various initiatives and provide an overview of key stakeholders and usage scenarios. We draw on first-hand experience in the context of linked open data projects in various segments of the performing arts value network, involving production and presenting companies, archival institutions, educational and research institutions, and the free online encyclopaedia Wikipedia. By juxtaposing different usage scenarios and required data, we pinpoint areas where the greatest synergies are expected and identify areas where further research is needed. Typical synergies related to linked open data involve the use of a shared data model; pursuit of overlapping use cases; use of shared identifiers; and the collaborative maintenance of base registers and authority files. Such synergies are the driving force behind any linked data initiative. Based on a currently available analysis of the data and the requirements implied by the various usage scenarios, we have singled out usage scenarios requiring the least effort to generate added value. Focusing on low-hanging fruit is crucial to early success as we bootstrap the linked open data ecosystem for the performing arts.

2.1 The Vision

The vision for a linked open data ecosystem consists of a distributed knowledge base for the performing arts based on linked data technology. Figure 2 gives an overview of the architecture of such a linked open data ecosystem. The different architectural layers are described below:

Presentation Layer

Search Engines

Encyclopaedias, Lexica

Cultural Agendas

... and a variety of other services

| Theatre Gateway with basic data views | Opera Gateway with basic data views | Data Visualizations |
| | | Analytical Tools / Data Extraction Tools |

International Performing Arts Platform

Application Layer

Cloud Services

Data Analysis Modules

Data Extraction Modules

Data Visualization Modules

Semantic Layer

Performing Arts Ontology

RDF-based

Data Layer

SPARQL

SPARQL

SPARQL/IIIF

SPARQL/IIIF

Base Registers & Authority Files

Wikidata

Wikimedia Commons

Fair Use Content Repository

(for research & education)

Semantically indexed multimedia/multimodal content

Decentralized Data Sources

National or regional data hubs, aggregating data from institutional databases & content repositories
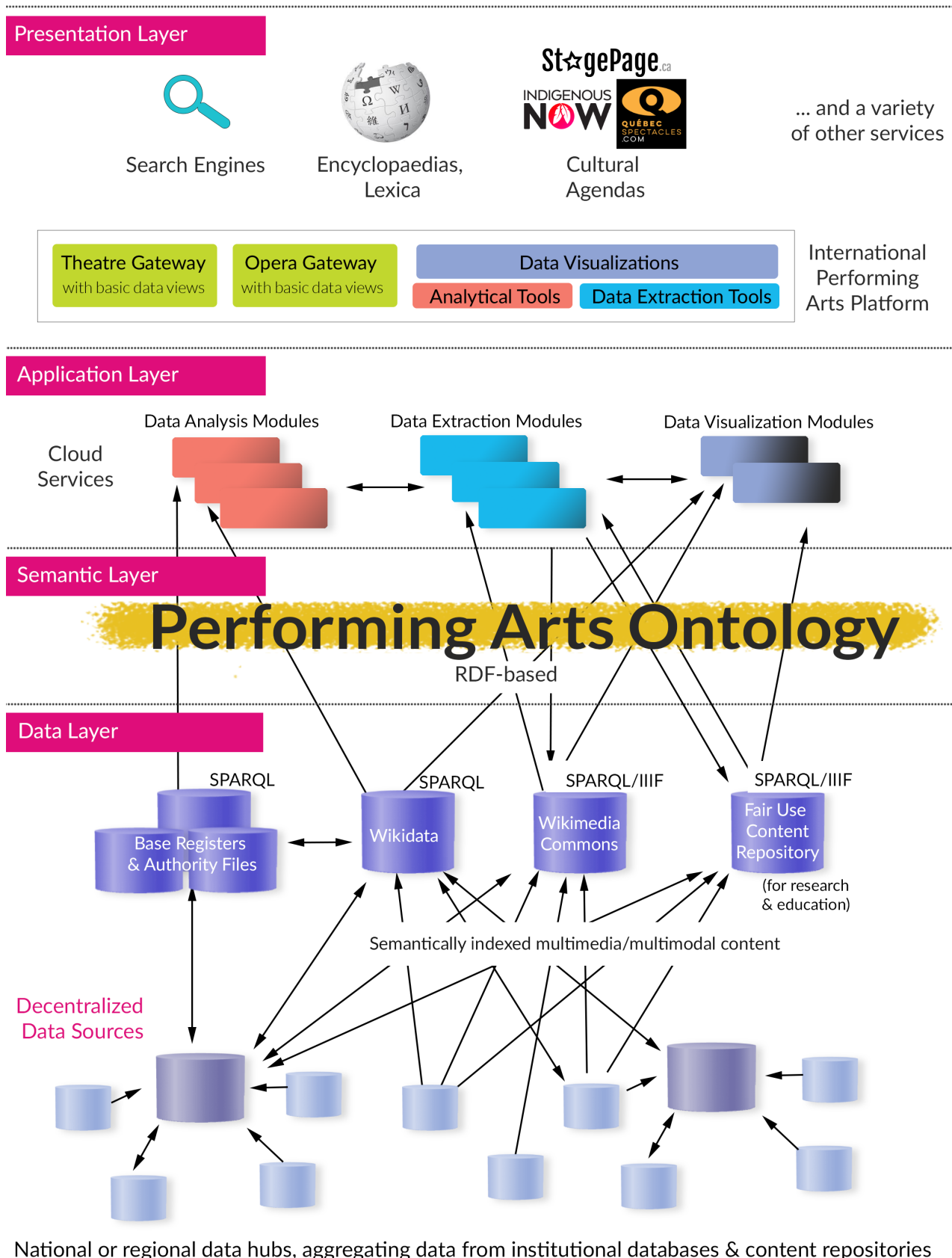
Figure 2: Architecture of the international linked open data ecosystem for the performing arts

Data layer:

Data layer: The data layer consists of a distributed database for the performing arts based on linked data technology, comprised of both data platforms through which structured data is made available, and content repositories through which media files (text, image, audio, video, 3D models) are provided. The data platforms include base registers (e.g. ISNI) and authority files (e.g. VIAF), which serve as common registers of named entities. The content repositories are expected to comply with the IIIF standard[2], while the structured data is provided through SPARQL endpoints.

Whether the distributed database will rely on a few centralized, highly integrated databases such as Wikidata[3] (which aggregate data from many different sources), or on many highly decentralized, interconnected databases remains an open question for the time being. In any case, the data layer is composed of data platforms which aggregate data from data providers who are either unable or unwilling to maintain a triple store themselves. While some of these platforms take the form of simple triple stores over which data is made available as linked open data, others take the form of community platforms which allow for collaborative data curation (such as Wikidata).

As with data platforms, media repositories may be more or less centralized, and may take the form of community platforms for the collaborative curation of digital content and its metadata, such as Wikimedia Commons[4]. While the structured data is by default made available as linked open data to facilitate the inter-linking of the various databases[5], a substantial amount of digital content related to the performing arts is covered by copyright. It is therefore up to the copyright holders to decide whether they want to make the content available under a free copyright license or in an open access regime. Copyright holder(s) may also decide to make content available only to certain user groups or for certain purposes, such as research and education.

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2   The International Image Interoperability Framework (IIIF) defines application programming interfaces that provide a standardized method for describing and delivering images over the web. Similar to the linked data approach, this standard supports a decentralized platform architecture where content is made available by various servers from where it can be dynamically integrated into various online services provided by clients. While IIIF programming interfaces for image content have existed for several years, the IIIF standard for audiovisual content is currently under development; for further information, see: https://iiif.io/community/groups/av/charter/#communication-channels.
3   Wikidata is a collaboratively edited knowledge base hosted by the Wikimedia Foundation and maintained by an online community which anybody is welcome to join. It runs on the MediaWiki software and uses the Wikibase extension to store structured data. The software provides the necessary online collaboration features, such as user management, version history, watchlists, discussion pages, etc. The data is provided free of copyright under the Creative Commons Zero Waiver and can be queried through a SPARQL endpoint. One of the main purposes of Wikidata is to serve as a repository for the structured data used in the context of the free online encyclopaedia Wikipedia.
4   Wikimedia Commons is a media repository hosted by the Wikimedia Foundation and maintained by an online community that anybody is welcome to join. All content is provided under free copyright licenses. One of the main purposes of Wikimedia Commons is to serve as a central repository for the media files used in the free online encyclopaedia Wikipedia.
5   Note that this may not apply to all countries, as some of them, including EU countries, grant sui generis intellectual property rights on databases. In this case, data publishers need to explicitly release their data under a CC Zero Waiver or under similar provisions.

In this case, the content repository would need to be equipped with adequate identity and access management as well as user role functionalities in order to manage access to the content in accordance with provisions made either by the rights holder(s) or embedded in statutory law[6].

Semantic layer: The semantic layer consists of ontologies, sometimes also referred to as data models, pertaining in some way or the other to the field of the performing arts[7]. Besides shared sets of named entities (authority files), commonly used ontologies provide the links between different datasets within the linked data cloud.

Ontologies may be provided as classical standalone RDF data models, such as FRBRoo, EBU Core, or schema.org, and/or they may be implemented and collaboratively maintained within Wikidata.

Application layer: The application layer consists of various cloud services tailored to the needs of some of the "power users" within the international linked open data ecosystem for the performing arts, such as data extraction tools for data publishers (e.g. helping them to semi-automatically extract metadata from media files), analytical tools for researchers, or data visualization tools for users interested in creating their own tailormade data visualizations. These services are typically provided according to the "software as a service" model and may be integrated into various offers targeted at end users (cf. presentation layer).

As outlined above, some of the data platforms and content repositories may take the form of online collaboration and/or crowdsourcing platforms; in this case they extend into the application layer, providing tools and services that go well beyond providing data and content.

Presentation layer: The presentation layer consists of a myriad of end user services that all draw, at least to some extent, on the elements of the three other layers (e.g., by exploiting or aggregating data from various data providers, by using shared ontologies, and/ or by making use of cloud services). Thanks to the clear separation of the data layer and the presentation layer, various gateways may provide a basic access to the shared data infrastructure. A gateway can be conceived as a single point of access to a subset of the platform ecosystem, tailored to the needs and expectations of a specific user segment. In some cases, users are consumers; in

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6   The copyright laws of some countries contain "fair use" or "fair dealing" provisions or some other limitations to copyright, which allow certain types of usages irrespective of copyright protection.
7   While the focus of the LDF Initiative is on live performances, the data model should eventually be extended or made interoperable with data models related to film, television, and radio productions as well as commercial sound recordings.

others, they take the role of "prosumers," engaging on crowdsourcing platforms and in collaboration spaces, which allow them to make their own contributions to the international linked open data ecosystem for the performing arts.

2.2 Key Stakeholders of the Performing Arts Value Network

The key stakeholders of the linked open data ecosystem for the performing arts are largely identical to those identified by various authors attempting to map the **"performing arts value chain"** (Preece, 2005), the **"creative value cycle"** (Statistics Canada, 2011), or the **"performing arts value network"** (Bonet & Schargorodsky, 2018). As Madudovà (2017) notes, the different types of models used to represent the arts sector have all their pros and cons, but more importantly, they influence how the sector and the interactions of its various members are perceived. In the following diagram, examples of the three types of models are presented, offering an overview of the key performing arts stakeholders and their activities. This overview is complemented by a reference to relevant categories in industry classification systems.

2.2.1 Performing Arts Value Chain

The Performing Arts Management Value Chain (PAVC) was introduced by Preece (2005) as a decision-making tool for managing collaborative ventures among organizations in the performing arts sector. The focus is on generic activities of performing arts organizations (PAO) (see figure 3), divided into a sequence of "primary activities" (such as "programming", "personnel", "promotion", and "production"), and a set of "support activities" (such as "governance", "administration", "fundraising", and "outreach"):
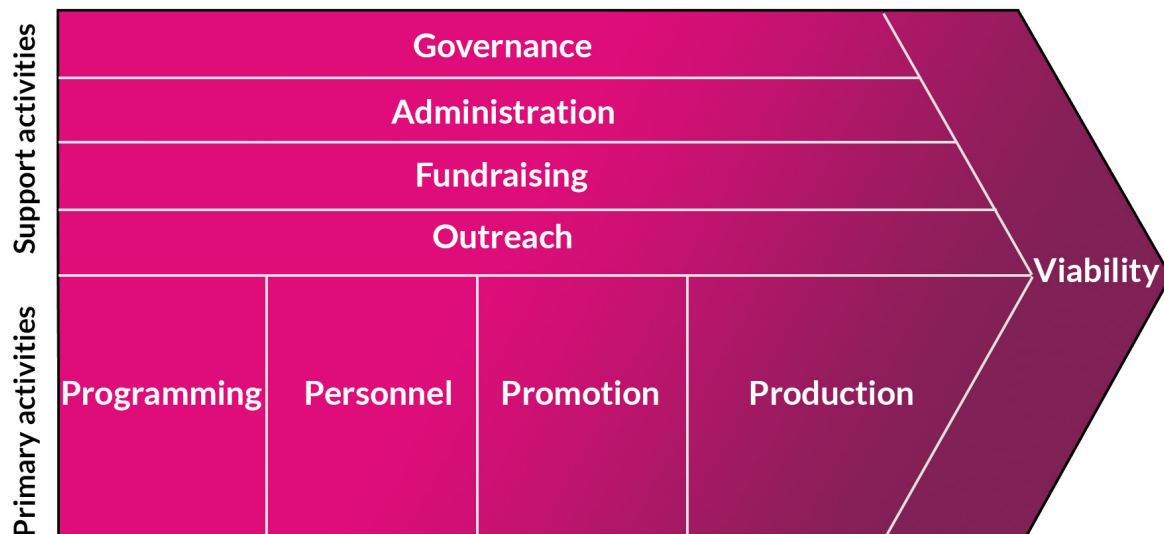
Figure 3: Performing Arts Value Chain (Preece, 2005, p. 22)

Primary activities must occur in some form for any performing arts event to take place. Support activities either sustain or hold together primary activities. Finally, all activities (both primary and support) contribute to the overall viability of the PAO. The interconnectedness of the activities suggests a "chain" relationship, while the individual and combined effects of the primary and secondary activities ultimately contribute "value" to the overall organizational viability. […]

The primary activities of any PAO include programming, personnel, promotion and production. Whether it is the work of an artistic director, conductor or choreographer, **programming** includes the selection and overall interpretation of artistic work. Due to the live nature of the performing arts, the core personnel - dancers, musicians, actors, singers - are the essential participants in the performance. Communicating a performing arts event to a potential audience and admitting the audience to the presentation space is defined as **promotion**. Finally, the physical requirements for rehearsal and performance are labelled **production**. These are the four building blocks of any performing arts event. […]

Support activities sustain and/or hold together primary activities. Governance includes the oversight of the organization, typically in the form of a board of directors. Administration represents th e management of functions within the organization (i.e., human resources, accounting, finance, technology).**Fundraising** refers to all efforts to garner resources (other than box-office receipts) - government, foundation, corporate or individual - grants, donations, subsidies, payments-in-kind and so on. Finally, **outreach** includes efforts to build bridges with the communities where arts organizations perform or reside.

(Preece, 2005, pp. 22-23, the highlighting is our own.)

2.2.2 Performing Arts Value Cycle

While Statistics Canada (2011) also relies on a linear model, they recognize the importance of arts consumption (the demand side) as well as the cyclical nature of the creative chain, acknowledging that yesterday's productions and their "use" serve as inputs for today's creation processes (see figure 4).
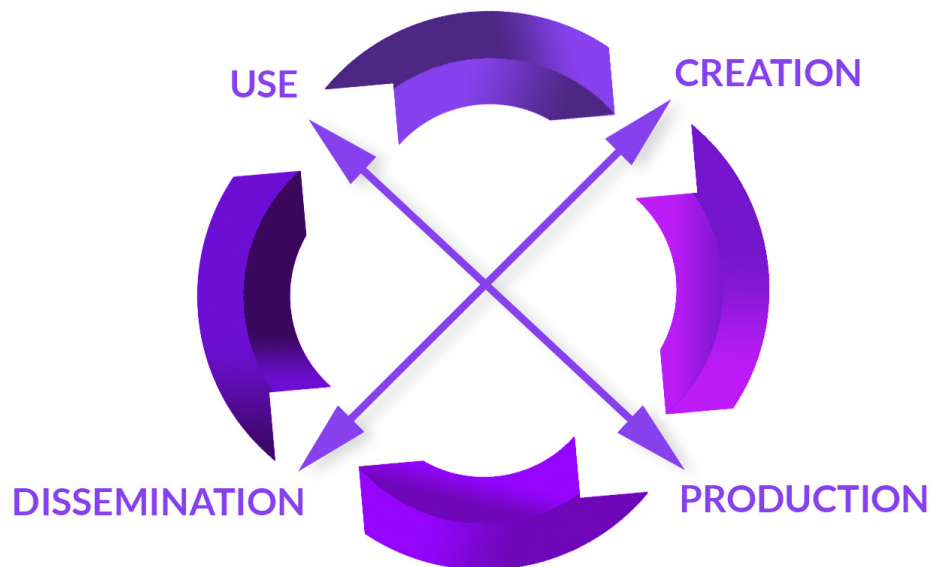
Figure 4: Feedback process in the creative chain (Statistics Canada, 2011, p. 27)

> The process between the creation of an original product and its use can be simple or complex depending upon the number of stages it goes through and the influence of transversal domains [...] Some products may not flow through all steps in the creative chain. The simplest form of creative chain is the creation of an original work, such as a painting, which the artist may sell directly to the consumer. (Statistics Canada, 2011, p. 27)

See figure 5 for a more complex form of the creative value chain in the case of the production and consumption of music.

Elements of the creative value chain in the case of the production and consumption of music:

- **Creation** – composition of the initial product, i.e. a music score/song (including music, lyrics)
- **Creation** – orchestration
- **Production** – sheet music
- **Production** – performance by musician(s)
- **Production** – recording of music performance
- **Production** – design of CD packaging and information materials
- **Production** – manufacture of CD (or related good) and packaging
- **Dissemination** – wholesale or retail distribution of CD
- **Dissemination** – marketing and promotion to increase the value of the product
- **Dissemination** – licensing rights to other platforms, e.g. television programs, video games, feature films, radio program, website, concert DVD, music compilation, etc.
- **Dissemination** – broadcast – radio, television, Internet
- **Use** – Internet download by consumer (free or paid)
- **Use** – consumer purchase or rental of music as CD, DVD, download
- **Use** – consumer listens to music by CD, DVD, download, streaming, etc.

Figure 5: Example of a complex form of the creative chain – production and consumption of music (Statistics Canada, 2011, p. 26)

Statistics Canada (2011) also highlights the transformative nature of the Internet with regard to the creative value chain, pointing to various trends, such as the individualization of offers; the re-purposing of cultural products; and increased ability of consumers to become creators of cultural products:

> The enormous role of the Internet and wireless technology in the dissemination and use of products, the introduction of e-commerce, and the ability of individuals to become creators, have all had a profound effect on culture. Digital technology has affected the traditional creative chain, encouraging distributors to tailor their products to meet individual consumer needs. In particular, the availability of new products on multiple platforms from a whole host of new sources geared to users of mediating products, such as portable digital tools, in turn encourages further the market for new culture products. These 'repurposed' products, and the new means of dissemination, feed the growing demands of Canadian consumers, who continue to be among the world's heaviest Internet users. The emergence of technology has also allowed individuals to self-publish/ produce, market, distribute and sell their creations, diminishing their reliance on traditional means of production, distribution, and marketing. (Statistics Canada, 2011, p. 15)

2.2.3 Performing Arts Value Network

Bonet & Schargorodsky (2018) made a departure from the standard performing arts value chain and further expanded it to include related activities, such as education, research, and heritage conservation in its sociocultural cycle. The resulting model, which they termed "Performing Arts System" (see figure 6), is a value network, comprised of several value chains and cycles.

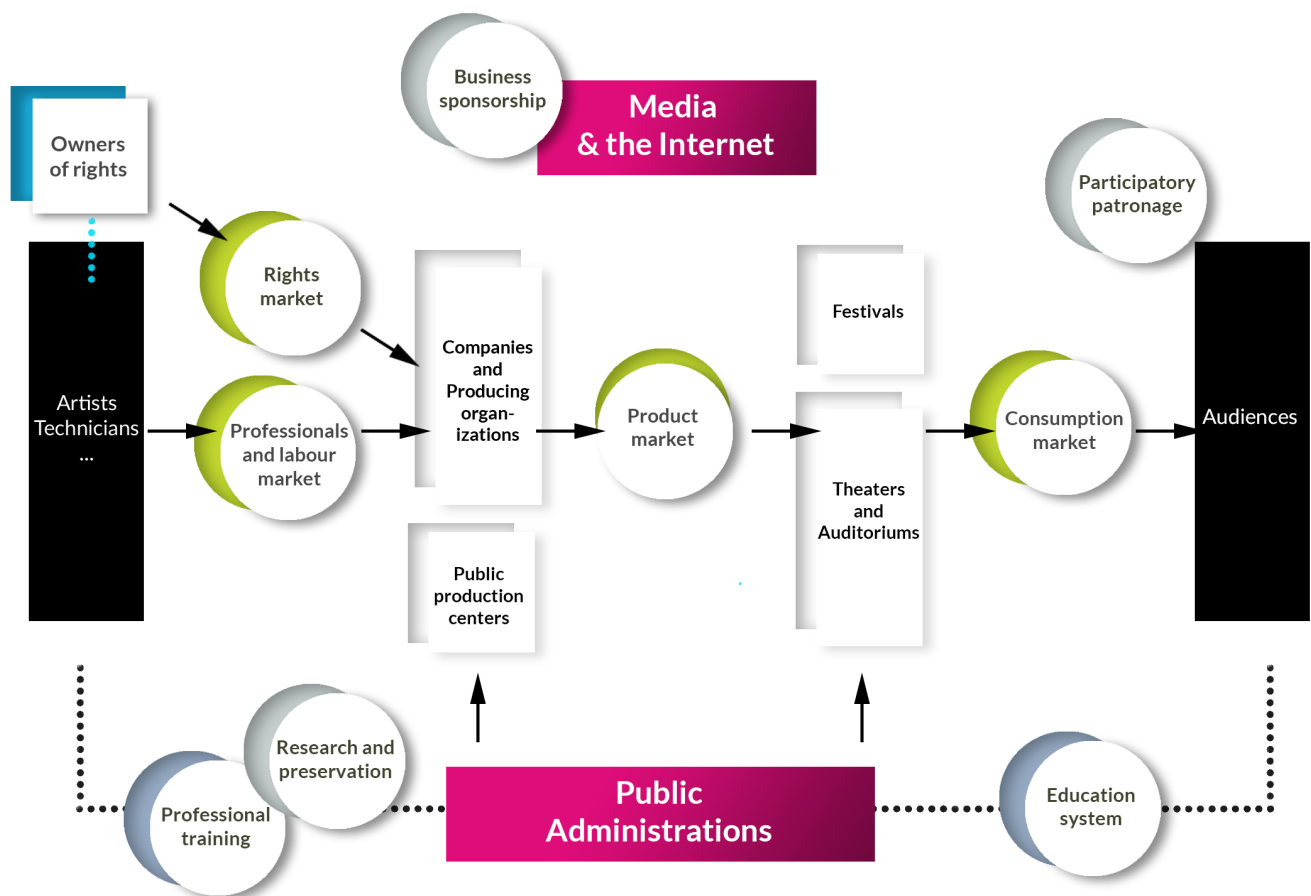Figure 6: The Performing Arts System (based on Bonet & Schargorodsky, 2018, p. 45)

In contrast to the preceding models, Bonet and Schargorodsky's model identifies the markets where the different agents of the performing arts value chain meet to carry out their transactions, distinguishing between a "consumption market"; "production market"; "rights market"; and "professionals and labour market":

The performing arts system is fundamentally structured into two major markets: the production market and the presentation market, which is complemented with the rights market (which remunerates authors and other holders of rights), plus the labour market formed by artists, administrative and technical staff. The production market has as its suppliers different production centres, from independent companies to private enterprises, cooperatives or theatre micro-companies, and including independent musical groups and public production centres. Theatres and festivals make up the demand that acquire in the aforementioned market, or co-produce with its agents, products adequate for their line of programming. For its part, the presentation market's different suppliers are the theatres and festivals that negotiated their shows in the production market; and its consumers are the audience that attends. When one same theatre produces and presents at the same time, this double market is not made explicit. (Bonet & Schargorodsky, 2018, pp. 46-47)

Bonet and Schargorodsky also recognize the mediating role of the media on several of these markets:

[The media's] influence reaches both creation and production alike - fundamentally through criticism or content and space granted in reviews and interviews - as well as consumption, by conditioning the audience's decision to attend. Investment in advertising by companies and theatres is complemented by the cultural news sections of newspapers, radio and television. For its part, the Internet opens up a dual communication channel by allowing both artists and theatres as well as the interested public to inform and to be informed (for example, investigating tendencies or other offers) and to share opinions. (Bonet & Schargorodsky, 2018, p. 48)

Further, they acknowledge the important role played by research and training as well as by the creative spaces provided by universities in developing the profession and in shaping new trends:

In many countries, universities play an important role in the configuration of the performing arts system. Their task features cultural outreach activities and the presentation of shows or the organisation of workshops or conferences, as well as academic research and training. This task is fundamental for creating spaces for the production and presentation of new performing arts tendencies (Bonet & Schargorodsky, 2018, p. 50)

And finally, their model incorporates cultural policy instruments and other public intervention mechanisms (including the legal framework) that influence activities of various stakeholders.

In addition to the four "markets" identified by Bonet & Schargorodsky, there is a further arena where individuals exchange among each other about their performing arts experiences, thereby building social and cultural capital. Cha et al. (2014) point to the important role of social media interaction as a complementary activity to on-site performing arts consumption, which plays an important role in shaping cultural meaning and in facilitating social interactions around cultural experiences. As they influence people's cultural tastes and choices in performing arts consumption, social media play an important role in electronic word-of-mouth. Like in other markets for experience goods (Litvin et al. 2008; Zhang et al., 2010; Ye et al. 2011), consumer-generated reviews can have a significant impact on business performance in the performing arts consumption market (cf. Hausmann & Poellmann, 2013).

2.2.4 Relevant Categories in Industry Classification Systems

Industry classification systems provide the framework for collecting and presenting statistical data according to economic activity in various statistical domains. Like the various models of the performing arts sector, these classification systems can be used to identify key stakeholder groups and activities within the performing arts sector.

The North American Industry Classification System (NAICS) distinguishes four basic processes: "producing events; organizing and promoting events; managing and representing entertainers; and providing the artistic, creative and technical skills necessary for the production of artistic products and live performances" (Statistics Canada, 2017, p. 457). The Canadian version of this classification system distinguishes between the following economic actors (ibid. pp. 457ff):

- **Theatre companies:** Establishments primarily engaged in producing live presentations that involve the performances of actors and actresses (including companies that operate their own facilities, primarily for the staging of their own productions).

- **Musical theatre and opera companies:** Establishments primarily engaged in producing live presentations that involve the performances of actors and actresses, opera singers, and other vocalists (including companies that operate their own facilities, primarily for the staging of their own productions).

- **Dance companies:** Establishments primarily engaged in producing live presentations that involve the performances of dancers (including companies that operate their own facilities, primarily for the staging of their own productions).

- **Musical groups and artists:** Establishments primarily engaged in producing live presentations (except musical theatre and opera productions) that involve the performances of musicians and/or vocalists.

- **Other performing arts companies:** Establishments, not classified to any other industry, primarily engaged in producing live performing arts presentations (e.g. carnivals, travelling shows, circuses, ice skating shows, magic shows).

- **Live theatres and other performing arts presenters with facilities:** Establishments primarily engaged in operating live theatres and other arts facilities and organizing and promoting performing arts productions held in these facilities (including theatre festivals with facilities).

- **Performing arts promoters (presenters) without facilities:** Establishments primarily engaged in organizing and promoting performing arts productions in facilities operated by others.

- **Festivals without facilities:** Establishments primarily engaged in organizing and promoting festivals in facilities operated by others.

- **Agents and managers for artists, entertainers and other public figures:** Establishments primarily engaged in representing or managing creative and performing artists, entertainers, and other public figures (representing their clients in contract negotiations, managing or organizing their client's financial affairs, and generally promoting the careers of their clients).

- **Independent actors, comedians and performers:** Independent individuals (freelance) primarily engaged in performing in artistic and cultural productions or providing technical expertise necessary for these works.

- **Independent writers and authors:** independent individuals (freelance) primarily engaged in creating artistic and cultural literary works, technical writing or copywriting.

The International Standard Industry Classification (ISIC) (United Nations 2008) and the Statistical Classification of Economic Activities in the European Community (NACE) (Eurostat 2008) feature similar categories, which are differently organized. In addition to the above-mentioned activities, they identify the following roles pertaining to the performing arts sector:

- **Casting agencies:** Activities of casting agencies and bureaus, such as theatrical casting agencies (United Nations, 2008, p. 235; Eurostat, 2008, p. 278).

- **Support activities to performing arts:** Support activities for the production of live theatrical presentations, concerts and opera or dance productions and other stage productions (activities of directors, producers, stage-set designers and builders, scene shifters, lighting engineers etc.) (Eurostat 2008, p. 300).

  In contrast to the Canadian classification system, there is an analytical distinction between (i) the actual production of live theatrical presentations, (ii) so-called "support activities", and (iii) the operation of arts facilities. In the logic of the Canadian system, the "support activities" would be carried out either by the production company, by the establishment managing the facilities, or by both of them.

- **Operation of arts facilities:** Operation of concert and theatre halls and other arts facilities (Eurostat 2008, p. 301).

Industry classification systems also include descriptions of further activities of the performing arts value network, such as the activities of heritage institutions, research, the media, etc. (which have been omitted for the sake of brevity). Likewise, this report does not systematically cover the activities related to the production and diffusion of literary, musical, and choreographic works, which may serve as a basis for performing arts productions, nor activities related to the production and diffusion of recordings of performing arts productions. Border cases are live broadcasts (and their online provision over an extended period) as well as simulcasts to other venues.

2.3 Usage Scenarios

In the course of several projects in cooperation with various types of partners (a theatre and dance archive, a research institution, a platform for audiovisual cultural heritage, and, in the current project, an association of performing arts presenters and its partners), the authors of this report have gathered a variety of information about key stakeholders of the linked open data ecosystem for the performing arts.

In the following section, we provide an overview of possible usage and contribution scenarios for different stakeholders, along with indications as to what kind of data they require (and may potentially contribute). These high-level usage scenarios will need validation as the linked open data ecosystem for the performing arts is deployed, and can serve as a basis for further research into user requirements in view of the development of concrete service offerings.

2.3.1 Performing Arts Professionals

Performing arts professionals offer their services vis-à-vis producing organizations – either as freelancers or as employees (professional and labor market). Many of today's artists rely on web documentation for reference on who they have performed with, etc.

Furthermore, stage directors, set designers, dramaturges, choreographers, conductors, and performers are interested in consulting documentation about earlier productions as a source of inspiration. Pointers to material held by regional institutions is helpful; immediate online access is a plus.

> In a linked digital future, it may be possible for performing arts professionals to curate information about themselves on dedicated platforms and/or on Wikidata / Wikimedia Commons, from which point it can be included in further offerings along the performing arts value chain by production companies and by presenters / promoters.

Accordingly, various claims can be backed up with data from reliable sources made permanently available online. Conversely, performing arts professionals can gain an immediate overview of the complete performance history of various artists, production companies, venues, composers, playwrights, etc. Thanks to finding aids of performing arts archives and documentation centres containing references to the wider linked open data ecosystem for the performing arts, it is easy to locate artefacts documenting specific performances and to retrieve information about their whereabouts, their conditions of access, and their digitization status.

2.3.2 Personal Theatrical or Artistic Agents or Agencies

Personal theatrical or artistic agents represent performing arts professionals vis-à-vis producing organizations **(professional and labor market)** and manage their public profile (social media, etc.).

In a linked digital future, it is possible for personal agents to curate information about their artists on dedicated platforms and/or on Wikidata and Wikimedia Commons, from which point it can be included in further offerings along the performing arts value chain, e.g. by producing organizations or presenters.

2.3.3 Casting Agencies

Casting agencies act as intermediaries between producing organizations and performers **(professional and labor market)**. Their requirements regarding the professional and labor market are similar to the ones of producing organizations (see below).

2.3.4 Performing Arts Production Companies (Producing Organizations) and Touring Agents

Producing organizations need an overview of performing arts professionals available for hire **(professional and labor market)** in the context of their productions. Representatives of producing organizations or of individual artists who produce their own concerts/shows list them on various **online platforms** where presenters can access information about them. They also submit applications for showcase or contact events where presenters seek to find tour-ready performances for their festivals or series/seasons **(production market).** One of their goals is selling shows to presenters and providing necessary information intended for the public. Some performing arts production companies play the role of presenters themselves and self-present their productions to the public **(consumption market)**, in which case their data use is very similar to that of performing arts presenters (see below).

In a linked digital future, online platforms catering to the production market are largely interoperable thanks to the use of a common data model and publication of most of the data about artists and their concerts/shows as linked open data (with the exception of sensitive personal data and commercially sensitive information).

Similarly, public information about producing and presenting organizations is shared as linked open data and made available in the context of the international linked open data ecosystem for the performing arts. In this way, common data needs to be entered only once, can be managed in one place, and can be propagated to other platforms, including platforms targeted at the general public. Further, interlinking with other publicly available information is facilitated (e.g. Wikipedia articles about artists, data about the classical repertoire, etc.). By ensuring that every artist, concert/show, venue, etc. is attributed its own unique identifier, these resources become "addressable" by anyone in the world, which greatly eases the aggregation of information about them.

2.3.5 Performing Arts Presenters (and Promoters)

Performing arts presenters put together a seasonal or festival program consisting of concerts/shows which they buy from producing organizations **(production market)** to present in one or several venues. They use various **diffusion platforms**, including social media platforms, to reach the media and the general public **(consumption market)**. On these platforms they make available information about the seasonal program as well as about individual concerts/shows and solicit feedback and comments from the audience. They may use dedicated **ticketing platforms** for ticket sales.

> In a linked digital future, the tools and platforms used by performing arts presenters to interact with the producing organizations on the production market are interoperable with the various tools and diffusion platforms used to promote the concerts/shows on the consumption market. Thanks to the use of the same data model and the publication of most data as linked open data, the same data needs to be entered only once and can be managed in one place.

For presenters, this offers possible efficiency gains, as the individual artists (or their representatives) and producing organizations can directly manage their own information, which can then be made directly available on diffusion platforms, ensuring the best possible quality, relevance, completeness and timeliness of the information made available to the public, orchestrated by the presenter. Similarly, it facilitates the cross-platform propagation of current sales information (availability of tickets, pricing, etc.). By exposing this information through HTML-embedded RDF data via online platforms, interpretation of the data by search engines and computer-based

personal assistants helps get relevant information to customers and a variety of intermediaries (journalists, persons providing tourist information, etc.). Thanks to the linked data approach, relevant data can also easily be exchanged with filmmakers and producers of radio and television programmes as well as producers of commercial music recordings.

2.3.6 Providers of Diffusion Platforms (e.g. Ticketing Platforms)

Ticketing platforms are interested in having real-time access to the most authoritative and up-to-date metadata for the events they are selling. They want to provide audiences with relevant, accurate, interesting information about the concerts/shows they have on offer.

> In a linked digital future, ticketing platforms can serve their audiences and the artists better by directly providing relevant, complete, and up-to-date information about the concerts/shows they have on offer[8]. They are able to draw on the knowledge graph in order to aggregate descriptive information (textual descriptions of productions, names of individual performers and contributors), photos, videos, and reviews that have been made available by artists, production companies, presenters, or reviewers.

2.3.7 Operators of Arts Facilities

Operators of arts facilities who do not act as producing or presenting organizations host events produced and presented by third parties. Such facilities may be primarily intended for performing arts productions or they may just occasionally host performing arts productions (e.g. sports stadiums). They need to provide potential users of the facilities with information about the price and availability of the facilities and with technical information (size of the stage, equipment, etc.).

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[8]   The concert discovery platform Songkick has been using Wikidata since 2017 and is interlinking its content with Wikipedia. See: Combining Forces with the Wikipedia Universe, Songkick Blog, 27 April 2017.

In a linked digital future, arts facilities operators provide additional layers of metadata to their rental clients: geographic metadata (address, coordinate location, and names of territories on which they are located), historic, architecture or heritage information about the facility, photos, the names of the individual halls or theatres under their roof, and the technical rider for each one.

This reduces data population and increases data quality for their rental clients. It also provides valuable information for users in the consumer market. Geographic metadata can be used by media professionals and tourism stakeholders to quickly find and remix event information within their area.

2.3.8 Writers, Composers (Rights Owners, Partly Represented by Collecting Societies)

Writers, composers and other rights owners are interested in obtaining due compensation for their work. They are often represented by collecting societies.

In a linked digital future, easily available and high-quality metadata on writers' or composers' works enhances opportunities for (re)use by others. Creators benefit from increased visibility across different platforms. Their business model and the way they license works determines the cases where financial compensation is due (exclusive representation by collecting societies is not the only possible model).

2.3.9 Theatre/Concert Goers

Theatre/concert goers are interested in receiving location-sensitive, up-to-date and complete information about performing arts experiences in areas and for time periods of their choice whenever they require them (whether several months ahead or a couple of hours beforehand). Such users typically appreciate photos and video previews of the performances and are interested

in content mediation (by journalists, by domain experts), in the form of reviews or ratings by other theatre/concert goers, and require easy access to transaction services for the (online) purchase of tickets. During or after the show, some theatre/concert goers like to share their photos and impressions on social media and to interact with others who have attended the same or similar concerts/shows. There is a continuum between live spectatorship and consuming additional material about the show online.

> In a linked digital future, theatre/concert goers have ubiquitous, up-to-date access to information about performing arts experiences in their area.

Thanks to the publication of relevant data as linked open data by producing organizations and presenters/promoters, search engines and computer-based personal assistants have immediate access to geo-located, timely, and up-to-date information about performing arts experiences. Thanks to appropriate interlinking of reviews and online discussions with the information about the actual production, it is easy for theatre/concert goers to navigate between reviews, online discussions, information about upcoming performances, and the corresponding online ticket stores. Furthermore, when sharing photos and impressions of their performing arts experience, theatre/concert goers can tag them with the unique identifier of their concert/show. This makes it easier for others to retrieve further information about the concert/show in question and possibly purchase a ticket themselves. Also, it enables online exchange among spectators of the same show/concert and fosters electronic word-of-mouth.

2.3.10 Online Consumers of Performing Arts

Online consumers of performing arts are interested in having easy online access to video (or audio) recordings of full productions. They also require easy online access to the description of theatre plots, to the description of the creation, staging, and reception history of a given concert/show. They are interested in content mediation (by journalists and/or domain experts). They may furthermore require access to sheet music or literary texts on which the concert/show was based, and they may want to share their impressions on social media and to interact with other people who have watched and/or listened to the same performances/productions.

In a linked digital future, online consumers of performing arts can gain an immediate overview of the complete performance history of various artists, production companies, venues, composers, playwrights, etc., with filtering capability on the availability of audio or video recordings.

Thanks to the interlinking with Wikidata, the linked open data ecosystem for the performing arts allows them to easily access and to collaboratively curate a variety of contextual information about artists, performing arts organizations, venues, works, etc. In the same vein, they will be able to easily locate sheet music or literary texts on which performing arts productions are based.

2.3.11 Media professionals, bloggers, podcasters

Media professionals can be journalists, bloggers or podcasters who create online content specifically for the arts and culture market. Most offer previews/reviews of shows and conduct interviews with performers and presenters, which often enriches their digital presence and are a key component for e-word-of-mouth. Further typical occasions for journalistic coverage of the performing arts are birthdays, anniversaries, or deaths of famous artists. Media professionals require access to reliable information about shows and performances. They are also interested in re-using photographs and audio-visual material. To find relevant material, they require powerful finding aids and immediate access to a preview version of the material in order to determine relevance. In addition, they need immediate access to the conditions of use. It is important to them to be able to procure usage rights to the material at very short notice.

In a linked digital future, online articles, blogs and podcasts dedicated to the performing arts can link to specific artists or performances in their content, assisting patrons in locating reviews, interviews and other related content quickly and easily. Digital platforms featuring artists or productions will be able to easily aggregate content thanks to the use of unique identifiers.

Conversely, media producers will have at their fingertips reliable data about the performance history of people, organizations, and places as well as about creative works related to the performing arts that are provided by authoritative sources (artists, performing arts companies, presenters, editors, heritage institutions) as linked open data. The same parties also make digital content available under free licenses or offer them for online purchase, so that pictures, audio and video files can easily be integrated into media products.

2.3.12 Tourist Boards (Territorial Marketing)

Tourist boards and other entities involved in territorial marketing are interested in providing their target audiences with a complete, up-to-date overview of the cultural offerings in their area, along with easy access to transaction services for the (online) purchase of tickets. They may also be interested in providing an overview of artists who have a relationship with the area (place of birth, place of living, place of professional activity, place of death, monuments dedicated to them, etc.), along with a map.

> In a linked digital future, tourist boards and other entities involved in territorial marketing will be able to automatically retrieve complete and up-to-date information about the cultural offerings in their area. They will also be able to automatically generate lists and maps of artists or artist collectives with a relationship to their region.

2.3.13 People Providing Tourist Information (Hotel Receptionists, Porters, etc.)

People who regularly interact with tourists to provide information on cultural offerings in a specific area need the same access to up-to-date and complete information about performing arts offers as the theatre/concert goers themselves; ideally in the main languages of the tourists, along with information about the linguistic accessibility of the shows.

> In a linked digital future, people providing tourist information will have online access to complete and up-to-date information about the cultural offerings in their area, complete with labels and descriptions in the languages of their clients.

2.3.14 Search Engines and Computer-based Personal Assistants

Search engines and computer-based personal assistants are supposed to provide their users with access to accurate, complete information about past, current, and future offers in the performing arts.

> In a linked digital future, information about artists and their concerts/shows is provided as linked open data, which helps search engines and computer-based assistants to reliably establish links between the different performances of the same production (e.g. of a concert tour or a touring theatre performance) and to reliably aggregate information about artists, production companies, venues, productions and performances, works, etc, which is not the case today.

2.3.15 Educators and Learners (Art Schools and General Educational System)

For educators and learners, straightforward access to content (audio/video recordings, photographs, textual material) is primordial. Ideally, the content is curated for better findability of relevant content with regard to specific topics. Content does not need to be freely licensed; however, the conditions of use should be immediately apparent. There should be uncomplicated online access to copyrighted material (in a protected environment), which allows for sharing in the classroom. Some educators and learners may be "remixers" of cultural content; in this case, the content should be available in common file formats. Also, the sharing of educational resources is significantly facilitated if the content they incorporate has been freely licensed. In any case, it should be

easy to extend the usage license to the following year so that the same content can be used in subsequent years. Students usually refrain from using offline audio terminals; if there is no easy online access to the material, they will most likely make use of alternative platforms or databases (and of alternative content).

In a linked digital future, educators and learners can gain an immediate overview of the performance history of various artists, production companies, venues, composers, playwrights, etc. with a possibility to filter them for the availability of audio or video recordings. Thanks to the International Knowledge Base for the Performing Arts, it is easy for them to retrieve further contextual information about the performances they listen to.

2.3.16 Researchers (Musicologists, Theatrologists, Art Historians, etc.)

Researchers require easy (online) access to artefacts documenting the production process of performing arts productions, the actual performance, its reception, as well as any contextual information that might be useful in putting the concert/show in its social and historical context. Researchers employing digital tools for their analyses should have the possibility to download the documentation material and to use it on the research platform of their choice. Furthermore, to be able to exploit the material, they require access to analytical tools and related services. Researchers are also very much interested in information that allows them to establish the quality and completeness of the documentation at hand. For them, knowing which documents/artefacts exist (even those which have not been digitized) is more important than having immediate access to the documents. Similarly, knowing what concerts/shows have been staged is valuable even if documentation about them is not accessible immediately.

In a linked digital future, researchers can gain an immediate overview of the complete performance history of various artists, production companies, venues, composers, playwrights, etc.

Thanks to the fact that the finding aids of performing arts archives and documentation centres contain references to the international linked open data ecosystem for the performing arts, it is easy to locate artefacts documenting specific performances and to retrieve information about their whereabouts, their conditions of access, and their digitization status. Furthermore, thanks to the interlinking with Wikidata, the linked open data ecosystem for the performing arts allows them to easily access and to collaboratively curate a variety of contextual information about artists, performing arts organizations, venues, etc. In a linked digital future, it becomes ever more important to researchers to be able to access reliable information about the provenance of the various information due to the potential bias of certain players (given for example the continuum of communication/promotion and publication/mediation on behalf of production companies and presenting organizations).

2.3.17 Lexicographers

Like media professionals or researchers, lexicographers need access to reliable information. They are interested in high-quality and complete data about who performed which work in which place at what time. They are also interested in re-using photographs and audio-visual material. To find relevant material, they require powerful finding aids and immediate access to a preview version of the material in order to appreciate its relevance. Furthermore, they need immediate access to the conditions of use. Depending on the intended use, content needs to be freely licensed (e.g. Wikipedia), or a license fee can be paid. Lexicographers typically have more time at their disposal to procure usage rights to the material than media professionals.

> In a linked digital future, reliable and properly sourced data about the performance history of people, organizations, and places as well as about creative works are provided by authoritative sources (artists, performing arts companies, presenters, editors, heritage institutions) as linked open data – either directly on Wikidata or through third party triple stores from where they can easily be ingested into Wikidata for use in the free online encyclopaedia Wikipedia.

The same parties also make digital content available under free licenses, so that pictures, audio and video files can be integrated into Wikipedia to enhance performing arts related articles. Data and content that is provided in this manner can also easily be re-used in the context of specialized lexica. Wikipedians and Wikidataists actively contribute to the collection, management, and curation of performing arts related data on their collaborative online platforms.

2.3.18 Heritage Institutions (Including Historical Archives of Performing Arts Related Organizations)

Heritage institutions with performing arts related holdings are interested in managing some of their data in collaboration with other institutions to use synergies and to avoid duplication of effort. They may also want to use crowdsourcing approaches to complement their data. For digitization and preservation planning as well as for purposes of rights clearance, heritage institutions require access to information that allow them to contextualize their collection items and to establish their rarity or uniqueness as well as their rights situation. To offer an attractive service to their users, heritage institutions need to provide powerful and user-friendly finding aids as well as online-access to digitized/digital collections in their thematic area (both to their own and to thematically related collections). Among their main users are researchers, educators and learners, performing arts professionals, content re-users, such as media professionals or lexicographers, as well as members of the interested public.

> In a linked digital future, heritage institutions avoid duplication of effort by collaboratively curating data that concerns several of them (e.g. data about persons, artist collectives, organizations, venues, and maybe even performing arts productions that are referenced in their catalogues or finding aids) and use crowdsourcing approaches to complement their data.

By systematically sharing data with other institutions, they are able to focus their digitization activities on the most relevant holdings in terms of rarity and uniqueness. Thanks to the international linked open data ecosystem for the performing arts, heritage institutions are able to offer an attractive service to their users, providing them with a powerful finding aid to locate documents both from their own holdings and from third parties, with the possibility of filtering search results according to a variety of criteria.

2.3.19 Private Collectors

Private collectors gather official or bootleg recordings of performing arts performances, photographs, costumes and props, program booklets, books, reviews, or paraphernalia related to performing arts productions and/or artists.

They require access to information that allow them to contextualize their collection items and to establish their rarity or uniqueness. They also require access to market places where such collection items are traded and to online platforms where they can exchange with like-minded people. It is quite common that collections gathered through the activities of private collectors are offered to research or heritage institutions shortly before or after the death of the collector.

In a linked digital future, the international linked open data ecosystem for the performing arts allows private collectors to directly access complete and reliable data about the performance history of people, organizations, and places as well as about creative works related to the performing arts.

As both private collectors and heritage institutions share their catalogues and finding aids as linked open data, it is easy for them to appraise the rarity or uniqueness of the items in their collections and to get in touch with like-minded people or organizations for the purpose of knowhow exchange or the exchange of collection items. The linked open data ecosystem for the performing arts also facilitates the planning of conservation and digitization activities as well as rights clearance. Like heritage institutions, private collectors benefit from the elimination of a series of media breaks when it comes to acquiring data about their collection items. At the same time they may be interested in sharing knowledge and information pertaining to their specific area of expertise.

2.3.20 Statistical Services

Statistical services are interested in having easy access to population data in their area (inventory of performing arts companies, inventory of performing arts venues, register of artists, etc.) as well as statistical data related to the performing arts. They want to increasingly access and integrate new data sources, including administrative data from sector stakeholders, in an effort to enhance industry surveys and to reduce survey response efforts by individual companies (cf. Statistics Canada 2018).

In a linked digital future, statistical services can map their statistical frameworks with an authoritative data model for the performing arts domain in order to more easily integrate external data from the sector. They can also track and measure performing arts related activities available as linked open data in their area.

2.3.21 Service Innovations for the Sector

Other forms of services that are currently not viable due to the lack of linked open data in the performing arts can only emerge with the support of such a linked open data initiative at an international level. In a linked digital future, there will be emergences of new kinds of services to support the sector's current and future needs, and offer the digital infrastructure necessary to attract and engage technologists and designers who are interested in contributing their expertise to the performing arts.

2.4 Integrated View of Stakeholder Requirements Regarding Data Coverage

By putting the usage scenarios of the various stakeholders in relation to each other, we can identify areas where various stakeholder requirements in terms of data coverage overlap. These are the areas where the linked data approach is likely to provide the most important synergies in terms of efficiency gains. Based on the usage scenarios described in the preceding section and the Data Model for the Swiss Performing Arts Platform (Estermann & Schneeberger, 2017), we provide a tentative overview where stakeholder requirements regarding data coverage overlap (table 1). For the purpose of simplification, we have grouped different usage scenarios together:

Production: Usage scenarios related to production comprise the activities required to create a new performing arts production, such as: selection and adaptation of the (literary, choreographic, musical) work; getting inspiration from earlier performances (e.g. by consulting an archive); acquisition of the performing rights (rights market); selection and hiring of artistic and technical personnel (professionals and labour market); finding a presenter (production

market); providing the presenter with the relevant information about the artists, the work, and the performing arts production to be provided to the public at large; as well as acquiring relevant information about the venue(s).

Presentation & Promotion: Usage scenarios related to presentation & promotion comprise the activities required to present a performing arts production to an audience, such as: programming; acquisition of performing arts productions (production market); finding and renting adequate venues; as well as marketing & sales, including the provision of short previews and trailers.

Coverage & Re-use: Usage scenarios related to (media) coverage & reuse comprise the activities required to cover performing arts in a variety of media, such as: writing previews, reviews, or other news articles related to the performing arts; assembling cultural agendas; writing encyclopedic articles; contributing content on social media; or providing search and retrieval services for such content.

Live Audiences: Usage scenarios of audiences comprise the exploration of performing arts offerings; the purchase of tickets and/or subscriptions; the search for information about the venue and its surroundings (indications on how to get there, transportation and parking options, complementary services, such as restaurants and bars, etc.); and the sharing of their impressions and opinions with other interested people in offline and online settings.

Online Consumption: Usage scenarios in the area of online consumption comprise the activities related to the consumption of music, of digital recordings of live performances and of information related to the performing arts. Online consumption of recordings is an important means to discover artists and collectives whose shows or concerts people may eventually want to attend.

Heritage: Heritage usage scenarios comprise the activities related to taking stock, preserving, digitizing, organizing, describing, providing access to, and mediating information and cultural artefacts related to the performing arts.

Research & Education: Usage scenarios related to research & education comprise a variety of activities related to the generation, description, and diffusion of knowledge and skills related to the performing arts.

Note that some of the usage scenarios in the areas of production, presentation, promotion, (media) coverage, re-use, and live audiences require access to (quasi-)real time data, while the timeliness criterion is of little relevance for the other usage scenarios.

By putting the different requirements in relation to each other, we can identify the types of data that are required by most stakeholder groups alike (on blue background), which can be considered as the common core of the linked open data ecosystem for the performing arts.

Table 1: Stakeholder requirements regarding data coverage

Type of Data (Classes and Attributes)	Production	Presentation & Promotion	Coverage & Re-use	Live Audiences	Online Consumption	Heritage	Research & Education
Performing Arts Production							
- **title**	x	x	x	x	x	x	x
- **genre**	x	x	x	x	x	x	x
- **work(s) performed, set list**	x	x	x	x	x	x	x
- **production company**	x	x	x	x	x	x	x
- **venue(s)**	x	x	x	x	x	x	x
- **first performance location**	x	x	x	x	x	x	x
- **first performance date**	x	x	x	x	x	x	x
- **premiere type**	x	x	x	x	x	x	x
- number of representations	x	x					
- **people in key roles of the production process (stage director, conductor, choreographer, set designer, costume designer, dramaturge, translator, adaptor)**	x	x	x	x	x	x	x
- **people in key roles of the performance (cast, musicians)**	x	x	x	x	x	x	x
- technical staff	x	x					
- presenting organization	x	x					
- representative image(s), promotional teasers/trailers	x	x	x	x	x		
- technical rider	x	x					
- textual description (for promotional purposes)	*x*	*x*		*x*			
- pointers to artefacts documenting the production process (including information about the documents' rights status)			x			x	x

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Type of Data (Classes and Attributes)	Production	Presentation & Promotion	Coverage & Re-use	Live Audiences	Online Consumption	Heritage	Research & Education
- pointers to artefacts documenting the performance(s) (recordings, stage photographs) (including information about the artefacts' rights status)	x		x		x	x	x
- **pointers to artefacts documenting the reception of the performance(s) (reviews, audience statistics, etc.)**	x	x	x	x	x	x	x
- pointers to previews and reviews of the performance(s) in the media (including blogs and social media)		x		x			

Individual Performance

Type of Data (Classes and Attributes)	Production	Presentation & Promotion	Coverage & Re-use	Live Audiences	Online Consumption	Heritage	Research & Education
- **people in key roles of the performance if they vary along the production (substitutes, guest appearances, guest conductor)**	x	x	x	x	x	x	x
- **venue if it varies along the production (e.g. concert tours, touring theatre productions)**	x	x	x	x	x	x	x
- **date and time**	x	x	x	x	x	x	x
- **pointer to super-event (e.g. festival)**	x	x	x	x	x	x	x
- available tickets (including pricing information)		x		x			
- presenting organization	x	x					

Festival (or other type of super-event)

Type of Data (Classes and Attributes)	Production	Presentation & Promotion	Coverage & Re-use	Live Audiences	Online Consumption	Heritage	Research & Education
- **date and time**	x	x	x	x	x	x	x
- **place**	x	x	x	x	x	x	x
- **pointers to individual performances**	x	x	x	x	x	x	x
- artistic director	x	x	x			x	x
- available tickets (including pricing information)		x		x			
- venues	x	x		x			

Type of Data (Classes and Attributes)	Production	Presenta-tion & Promotion	Coverage & Re-use	Live Audiences	Online Consumption	Heritage	Research & Education
Literary, musical, choreographic work (serving as a basis for a performing arts production)							
- **title**	x	x	x	x	x	x	x
- **genre**	x	x	x	x	x	x	x
- **creator(s) (or information about the origin of a work where no individual creator(s) are known)**	x	x	x	x	x	x	x
- **other key contributors (translator, adaptor)**	x	x	x	x	x	x	x
- **date of creation / publication**	x	x	x	x	x	x	x
- **place of creation / publication**	x	x	x	x	x	x	x
- **language of content (if applicable)**	x	x	x	x	x	x	x
- publisher	x	x	x		x	x	x
- rightsholders	x		x			(x)	(x)
- licensing information	x		x			x	x
- purchase information regarding performing rights	x						
- purchase information regarding publication rights			x			(x)	(x)
- digitization status						(x)	x
- pointer to analogue copy	x				x	x	x
- pointer to digital copy	x			x	x	x	x
- representative image(s)		x	x	x			
Recording of a live performance							
- conditions of access	x	x			x	x	x
- licensing information			x			x	x
Performing Arts Professional (performing artists, stage directors, choreographers, etc.)							
- **name** (given name(s), family name, patronymic where applicable)	x	x	x	x	x	x	x
- **aliases or stage names** (where applicable)	x	x	x	x	x	x	x
- **occupation** (including voice type for singers, instruments for instrumentalists, performing languages of actors)	x	x	x	x	x	x	x

Type of Data (Classes and Attributes)	Production	Presentation & Promotion	Coverage & Re-use	Live Audiences	Online Consumption	Heritage	Research & Education
– birth date	x	x		x		x	x
– place of birth		x	x				
– place of education	x	x	x			x	x
– place of residence	x	x	x				
– date of death	x				x	x	x
– place of death			x				
– professional contact details (manager, agent)	x						
– availability (including repertoire)	x						
– hiring conditions	x						
– representative photograph (including information about the rights status of the photograph)	x	x	x			x	
– **short biography**	**x**	**x**	**x**	**x**	**x**	**x**	**x**

Performing Artists' Collective

– **name**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
– registered office	(x)	x				x	
– date of creation						x	x
– members (founding members, currently active members, past members)	(x)	(x)				(x)	(x)
– contact details (manager, agent)	x						
– availability (including repertoire)	x						
– hiring conditions	x						
– representative photograph (including information about the rights status of the photograph)		x	x	x		x	

Type of Data (Classes and Attributes)	Production	Presenta-tion & Promotion	Coverage & Re-use	Live Audiences	Online Consumption	Heritage	Research & Education
Production Company							
- **name**	x	x	x	x	x	x	x
- registered office	x					x	
- date of creation						x	
- president of the board	x						
- artistic director	x	x				x	x
- key artistic staff members	x					x	
- artists' collectives that are part of the production company (e.g. theatre troupe, symphonic orchestra, choir, etc.)	x					x	
- administrative director	x						
- contact details, agent/representative information	x	x					
- job openings, conditions	x						
Presenting Organization, Promoter							
- name		x					
- contact details		x					
- conditions		x					
Professional Association							
- name	?	?				x	
- registered office	?	?				x	
- date of creation						x	
- president						x	
- members	?	?				x	

Type of Data (Classes and Attributes)	Production	Presenta-tion & Promotion	Coverage & Re-use	Live Audiences	Online Consumption	Heritage	Research & Education
Venue							
- **name**	x	x	x	x	x	x	x
- location	x	x	x	x		x	x
- date of creation						x	x
- owner/manager		x				x	
- transformations (history)						x	x
- equipment (e.g. sound system, etc.)	x	x					x
- seating / space capacities	x	x					x
- availability		x					
- rental conditions		x					
- accessibility		x		x			
- transportation options		x		x			
- information about restaurants, bars, cafés near the venue				x			
Heritage Institution							
- name	x		x			x	x
- physical location	x		x			x	x
- date of creation							
- contact details	x		x			x	x
- fonds / collections	x		x			x	x
Fonds / Collection							
- name	x		x			x	x
- period of creation						x	x
- originator						x	x

Type of Data (Classes and Attributes)	Production	Presenta-tion & Promotion	Coverage & Re-use	Live Audiences	Online Consumption	Heritage	Research & Education
- curator(s)						x	x
- coverage (thematic, tempo-ral, geographic)	x		x			x	x
- conditions of access	x		x			x	x
- internal structure (fonds, series, files)						x	
- pointers to digital documents	x		x			x	x

Individual Artifact (documenting the creation, representation, or reception of a pro-duction/performance, the life or work of an artist, etc.; recordings of live performances see above)

Type of Data (Classes and Attributes)	Production	Presenta-tion & Promotion	Coverage & Re-use	Live Audiences	Online Consumption	Heritage	Research & Education
- designation	x		x			x	x
- date and context of creation			(x)			(x)	(x)
- date and context of use	x		x			x	x
- preservation information						x	x
- conditions of access	x					x	x
- rightsholder			x			x	x
- licensing information			x			x	x
- digitization status			x			x	x
- pointer to a digital copy	x		x			x	x

2.5 Current State of Implementation

Now that we have an overview of the stakeholder requirements in terms of data coverage, we can ask which parts of the data infrastructure (semantic layer and data layer) already exist, and identify the implementation gaps that remain to be addressed:

2.5.1 Data Model and Ontologies

Data models or ontologies are part of the semantic infrastructure of a linked open data ecosystem. Ontologies exist in various forms, which differ in their complexity. Ontologies of lower degrees of complexity are sometimes named catalogs, glossaries, thesauri or taxonomies and are generally referred to as "controlled vocabularies". If different data sets are described using the same ontologies, they are interoperable at the semantic level.

The Data Model for the Swiss Performing Arts Platform (Estermann & Schneeberger 2017) covers all the aspects of the common core of the international linked open data ecosystem for the performing arts as well as most of the needs of the use scenarios related to heritage, research & education, online consumption, as well as coverage and re-use. Large parts of this conceptual model have already been implemented on Wikidata and are available as a formal ontology within Wikidata[9]. Its documentation requires improvement, and there is a series of open data modelling issues that need to be resolved in order to harmonize practices. Implementation of the conceptual model in classical RDF, mostly based on existing RDF ontologies, is currently underway at the Swiss Archives for the Performing Arts[10].

The existing conceptual model does not cover some of the transactional needs along the performing arts value chain (e.g. related to the acquisition of performance rights, the hiring of artists, the engagement of production companies, the rental of venues, or the sales of tickets). The conceptual model will need to be extended accordingly. As the transactional aspects do not lend themselves to implementation on Wikidata, they will need to be implemented in the context of specialized platforms supporting online transactions between stakeholders.

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9   See: https://www.wikidata.org/wiki/Wikidata:WikiProject_Performing_arts/Data_structure
10   For an overview of RDF data models and ontologies relevant to the performing arts, see the listing on the "Data structure" page of the Wikidata project: https://www.wikidata.org/wiki/Wikidata:WikiProject_Performing_arts/Data_structure. For the work in progress at SAPA, see: https://sapa.github.io/spa-specifications/

2.5.2 Typologies / Vocabularies

Typologies and vocabularies are agreed-upon sets of specific manifestations of a given characteristic. In the course of first data ingests on Wikidata, different typologies and vocabularies related to the performing arts have been implemented, e.g. regarding performing arts genres, types of music theater performances, performance types, or voice types[11]. A whole set of typologies and vocabularies have also been identified in the context of the DOREMUS project[12].

2.5.3 Base Registers / Authority Files

So-called "named entities" are used to uniquely identify the different instances of a class. By providing persistent identifiers for the various entities, shared registers with named entities allow to make statements about the same person, the same organization, the same administrative unit, etc. within the scope of different data sets. In the context of statistical offices and other public authorities, such registers are commonly referred to as "base registers". These registers are typically expected to list all existing instances of a class within a given administrative-territorial unit and are typically maintained by a public authority that has the legal mandate to do so. Their equivalent in the library world are called "authority files" and serve, for example, to unambiguously identify persons or works in the context of a library catalog. Since linked data is meant to link data across organizational and domain boundaries, base registers and authority files are nowadays often used beyond their original domain. Insofar as different base registers or authority files describe the same instances, concordance databases are used to map equivalent entities between them – a prominent example is the Virtual International Authority File (VIAF), which links the authority files of the national libraries of various countries. Another prominent example of such a central data hub for "entities" of different classes is Wikidata (Allison-Cassin & Scott, 2018).

So far, several base registers and authority files relevant for the performing arts have been made available as linked open data, such as the Virtual Authority File (VIAF) or the International Standard Name Identifier (ISNI).

The objective of VIAF consists in providing a reference source for libraries, archives, and museums worldwide and to reduce cataloguing costs through the pooling of data. For this purpose, VIAF clusters authority files of national libraries and countrywide union catalogues as well as specialized databases and makes them available for anyone to use. It initially started out with persons and corporate bodies but has since expanded its scope to include works, expressions, meetings, and geographic names. Its development is primarily driven by libraries (Angjeli et al., 2014).

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11   See: https://www.wikidata.org/wiki/Wikidata:WikiProject_Performing_arts/Typology
12   http://data.doremus.org/vocabularies/

The objective of ISNI, on the other hand, is to facilitate research and discovery of resources and to streamline business transactions across domains. The focus is on providing unique, global, cross-domain, standard, persistent identifiers for persons and organizations involved in the production and exploitation of creative content. The development of ISNI is mainly driven by libraries, rights management societies, stakeholders of the book supply chain, aggregators and service suppliers (Angjeli et al., 2014).

Both VIAF and ISNI aggregate existing identifiers without superseding them. As VIAF is among ISNI's sources for the aggregation of person and organization data, there is an important overlap between the two. However, while VIAF primarily serves as an automatized hub for decentrally managed authority files, ISNI takes a more centralizing role in standardizing the data by correcting the clustering of data and by excluding clusters that appear as sparse or undifferentiated. While ISNI is edited by its own quality team, it is accepting feedback from the public through a "monitored crowdsourcing" mechanism. The ISNI database is expected to evolve into a reliable, shared authority file at a global level (Angjeli et al., 2014).

As Vrandecic and Krötzsch (2014) note, Wikidata is developing into yet another global aggregator of authority files by providing links to a variety of such resources. In contrast to VIAF and ISNI, Wikidata is much wider in scope, covering the variety of concepts that can be found in an encyclopaedia (see table 2 for an overview of the number of entities for various classes contained in Wikidata). Furthermore, it relies on crowdsourcing and is free for anyone to edit. It is heavily interlinked with VIAF and ISNI[13]. A further reference source for music albums, musical works and performers is MusicBrainz, another community project relying on crowdsourcing. Further reference sources that might be of interest in the context of the performing arts are: the Internet Movie Database (IMDb) for actors, Songkick for concerts, and Discogs as an alternative to MusicBrainz for performers[14]. Table 2 gives an overview of the number of entities for each class contained in Wikidata.

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13   1.38M Wikidata entries are currently linked to one of the over 30 mio. VIAF clusters, while 1.06M Wikidata entries are linked to one of over 10M ISNI identities; Wikidata itself currently has 4.96M entries for people and 1.6M entries for organizations.
14   In a specific regional or national context, further reference sources might be of interest, such as the Canadian Encyclopedia, the Dictionnaire du théâtre en Suisse, etc.

Table 2: Number of entities in Wikidata (as of spring 2019)

Entities of the Class	Wikidata[15]
Musical work	420'000
Edition of a musical work	570
Choreographic work	880
Edition of a choreographic work	4
Play (incl. opera)	21'000
Edition/translation of a play (incl. opera)	650
Character role (in play or opera)	11'000
Performing arts building	20'000
- Theatre venue	17'000
- Music venue	3'500
Human	5.0M
Musician	260'000
Actor/actress	250'000
Stage director	7'600
Scenographer	3'500
Costume designer	2'700
Conductor	18'000
Choreographer	6'100
Organization	1.5M
Musical ensemble	87'000
Theatrical troupe	5'000
Dance troupe	340

2.5.4 Digital Content

There is already a host of performing arts related content available on the Internet. Some prominent platforms to go to are Youtube, Wikimedia Commons, or Europeana. They are all in the process of improving the metadata about their content. Youtube, for example, is nowadays using ISNI identifiers to refer to artists and is increasingly providing structured data about the works to be found on the platform. Wikimedia Commons is in the process of being transferred to a new platform infrastructure that uses the same software extension as Wikidata to store structured data. In the future, metadata on Wikimedia Commons will be available as linked open data through a SPARQL endpoint, and the IIIF standard will be supported to facilitate cross-platform exchange and manipulation of digital content. Similarly, metadata from Europeana is provided as linked open data, while the access to the actual content depends on the various decentralized data providers.

While some of the digital content is out of copyright or is made available under a free copyright license (as is regularly the case for content published on Wikimedia Commons), other content has been published under a proprietary license or without a proper rights statement (as is most often the case for

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15   See also: https://www.wikidata.org/wiki/Wikidata:WikiProject_Performing_arts/Statistics

content published on Youtube). User requirements regarding the licensing situation vary depending on the usage scenario.

2.5.5 Data Available as Linked Open Data

Linked data publication in the area of the performing arts is still in a pilot phase. So far, only a small share of performing arts related data is available as linked open data. Examples of datasets that contain data about performing arts productions or performance events include:

- AusStage Australian Live Performance Database (more than 100,000 performance events);

- Carnegie Hall Performance History[16] (approx. 50,000 performance events);

- Database of the Flanders Arts Institute (1993-2018), published on Wikidata (approx. 12,000 performing arts productions);

- Repertoire of Schauspielhaus Zürich (1938-1968), published on Wikidata (approx. 700 performing arts productions);

- Database of the DOREMUS project[17]

- Database of the Swiss Archive for the Performing Arts (in the process of being published)[18].

Further services, such as the Austrian performance data platform Theadok[19] and the Frankfurt-based Specialized Information Service Performing Arts[20] are planning to publish their data as linked data in the near future.

Based on these first pilot datasets, data modelling issues should be addressed systematically in order to harmonize data modelling practices. As could be demonstrated in the case of Wikidata, many critical data modelling issues await resolution[21]. Similar issues are to be expected whenever several databases are integrated and/or exploited in combination with each other.

There are important databases in adjacent areas that have a high potential for interlinking with performance histories, such as a variety of library databases (literary and musical works) or MusicBrainz (musical works, expressions of musical works, performers).

Further databases are available online, free from copyright restrictions, but have not yet been published as linked open data.

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16   https://github.com/CarnegieHall/linked-data#carnegie-hall-performance-history-as-linked-open-data
17   http://data.doremus.org/
18   https://sapa.github.io/spa-specifications/
19   https://theadok.at
20   https://www.performing-arts.eu/
21   https://www.wikidata.org/wiki/Wikidata:WikiProject_Performing_arts/Data_structure/Data_modelling_issues

2.6 Bootstrapping the Linked Open Data Ecosystem for the Performing Arts

Today, the linked open data ecosystem for the performing arts is in its infancy; especially information about individual productions and performances is still largely missing. When it comes to bootstrapping such a database, there are two promising avenues that are complementary to each other:

On one hand, a common knowledge base can be built up by piecing together information about the past, based on the data held by heritage institutions or the performance history of individual organizations. This approach has been pursued in the cases of linked open data publication mentioned above.

On the other hand, the knowledge base can be built up by tapping into the performing arts value chain, aggregating data about current and future performing events. This approach has been pursued by Operabase[22] since 1996, resulting in an international performance history database for opera covering the past 20 years. Unfortunately, large parts of this database are proprietary and therefore cannot readily be integrated into an international knowledge base founded on the principles of linked open data. Tapping into the performing arts value chain to provide linked open data is the approach that is being pursued in the context of the LDF Initiative (see section 3 below); this is also the most promising approach when it comes to ensuring the ongoing updating of the database in the future.

In both cases it makes sense to start out from larger, well-maintained existing databases that contain data about works, venues, persons, and organizations involved in performing arts productions. Furthermore, collective efforts to aggregate data should be driven by flexible usage scenarios that yield incremental benefits, with a focus on low-hanging fruit.

Regarding archival usage scenarios, the low-hanging fruit that could be aimed[23] for include improving the users' search experience by providing a high-level overview of what material can be found in various archives, creating something like a "Worldcat" for theatre by interlinking existing databases, and complementing the existing data by systematically publishing additional data in specific thematic areas that are of particular interest to researchers.

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22   https://www.operabase.com/home/en
23   As identified during a workshop with representatives of theatre archives in Düsseldorf in fall 2018.

Low-hanging fruit in the area of Wikipedia comprise the use of Wikidata-driven infoboxes for a variety of articles (on musical and dramatic works, artists, venues, etc.), whereas low-hanging fruit in the area of presentation and promotion could consist of exposing data about current and future performances in a format that allows search engines to aggregate them more easily.

Whatever usage scenario is pursued first, the chicken-and-egg problem of linked open data publication and consumption needs to be overcome (Estermann 2018b): A flourishing linked open data ecosystem requires attractive applications running on high-quality data. However, without complete, high-quality data, even the best application is sub-optimal, while incentives to populate such data are lacking in the absence of a widely used application. During the prototyping and validation phase, the LDF Initiative should therefore aim for the creation of a concrete application, linked to a viable business model, which allows to incrementally build up a knowledge graph by tapping into the performing arts value chain. It is thereby crucial to create added value for those stakeholders who are expected to make an additional effort to contribute or enhance performing arts related data.

3 The Canadian Context

This section offers an analysis of the Canadian policy and implementation context for the LDF Initiative. The use cases envisioned by the Canadian implementation partners are presented, and usage scenarios promising to generate short-term added value are identified.

These are among the "low-hanging" fruit that will be pursued during the prototyping and development phase to bootstrap the parts of the international linked open data ecosystem that are most relevant to the partners involved in the LDF Initiative.

3.1 Research and Policy Context

Since 2014, many cultural policies, digital literacy reports, and sector-led initiatives have prioritized the digital transformation of the Canadian performing arts sector.

On the policy front, the province of Québec took a leadership role in launching the Plan culturel numérique du Québec[24] in 2014. Three years later, the Canada Council for the Arts created the Digital Strategy Fund[25] to help the arts sector understand, engage with, and respond to the cultural and social change the digital world demands.

Meanwhile, various research and development initiatives revealed gaps and opportunities for the performing arts sector.

As part of its Digital Innovation Council, CAPACOA led consultation and research activities that resulted in the publication of *Digitizing the Performing Arts: An Assessment of Opportunities, Issues and Challenges* in April 2017. This report observed that the performing arts sector was at a foetal stage in the knowledge and use of metadata: every stakeholder is operating in a silo, using individual ad hoc data and metadata structures. The report concluded that discoverability, traceability and measurement of the arts requires a) a global vision, a coherent strategy, and a governance structure for metadata; and b) good-quality, interoperable metadata (Observatoire de la culture, 2017. p. 61).

In October 2017, Québec's Observatoire de la culture et des communications published État des lieux des métadonnées relatives aux contenus culturels. This report observed that the performing arts sector was at a foetal stage in the knowledge and use of metadata: every stakeholder is operating in a silo, using individual ad hoc data and metadata structures. The report concluded that discoverability, traceability and measurement of the arts requires a) a global vision, a coherent strategy, and a governance structure for metadata; and b) good-quality, interoperable metadata (Observatoire de la culture, 2017. p. 61).

In response to this report, Québec's Ministère de la Culture et des Communications undertook the task of bringing stakeholders into a linked open data ecosystem (mesure 111 – *Mettre en place un plan d'action concernant les données sur les contenus culturels québécois*[26] – in the *Plan culturel numérique du Québec*). The same "mesure" also intends to ensure cohesion between digital initiatives and to develop a brand new metadata culture within the sector.

CAPACOA's Linked Digital Future initiative shares similar goals with *mesure 111.* The present report and the accompanying conceptual model are meant to provide a pan-Canadian contribution to *mesure 111* and to the international linked open data ecosystem for the performing arts.

Mesure 111 is currently addressing data integration issues in five sectoral committees, which all deal with at least some data relevant in the context of the Linked Digital Future Initiative:

- **Heritage:** Of particular interest are data about historic buildings that also serve as performing arts venues; in the medium term, it would also be interested to provide links to any heritage object related to the performing arts (exemplars of creative works, documentary photographs, stage designs, stage models, reviews, etc.).

- **Music:** Of interest are data about musical works (including information about the individual parts of complex works, about the instrumentation or the distribution of voices); furthermore, it would be helpful to be able to provide links to music industry database entries about songwriters, performers and their releases.

- **Performing Arts:** see table 1 for an overview of the data that is of relevance.

- **Cinema:** Given the fact that many film actors and actresses are also active on stage, it would be important to be able to establish links to the respective film databases.

- **Books:** Of particular interest are data about literary works (both at the level of frbr:Work and frbr:Expression) which have served as a basis for performing arts productions.

Ideally, these data would be provided as linked open data by key players of the various sectors. Of primary importance are datasets that take the role of base registers or authority files (e.g. inventories of creative works, authors, musicians, actors, venues, etc.), along with unique, persistent identifiers. From the point of view of the LDF initiative, it would be helpful to be able to access an overview of existing databases in the near future, along with a timeplan regarding their release as open data and their publication as linked open data.

3.2 Available Data

As concerns the data of the Canadian stakeholders of the primary value chain, data related to the performing arts domain is contained in a large number of relatively small and narrowly-focused proprietary information systems. For the purpose of the Linked Digital Future initiative, we inventoried existing or in-development information systems in the production and consumption markets as well as in support functions such as funding.

This non-exhaustive inventory identified more than 40 different information systems related to eleven use cases. These include directories of all sorts, as well as systems supporting various transactions and business functions[27].

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27   Frédéric Julien, An Overview of Performing Arts Presenting Information Systems in Canada (and their Use Cases), unpublished.

This inventory confirms that the situation has not changed much since a similar exercise was conducted in 2017:

> Several proprietary online applications have been developed by presenting networks to assist with various aspects of the creation and presentation chain including showcasing, block-booking, and reporting. While some of these applications have been adopted by several presenting networks, there is no standard tool for all of Canada, and current tools used can't share data with one another. In addition, there is no tool currently that can handle both showcase applications and block-booking even though those two processes are closely related. (Petri & Julien 2017, pp. 37-38)

In matters of box office alone, there are at least 16 different third-party ticketing service providers in the Canadian market (Hill Strategies Research & CAPACOA, 2019, p. 14), each using its own proprietary, non-interoperable information system. Ticketing information is therefore particularly dispersed and siloed. This negatively impacts the sector's capacity to aggregate event information, as well as the capacity to link up-to-date information on ticket availability and price to event metadata.

Collective management organizations (also called collecting societies) have extensive databases of works and right holders. These databases are likely to include valuable metadata with respect to live performance use cases. In the music industry, metadata about performers (International Performer Number and ISNI) could help identify performers in a live performance. Metadata about music albums and EPs (UPC and ISRC) could make it possible to denote the relationship between a live performance and the sound recording product it is based upon.

In Canada, SOCAN manages copyright and Re:Sound manages neighbouring rights on behalf of union organizations and individual right holders. In the absence of open authority databases, SOCAN has its own database and identifiers mapped to the International Standard Work Code and the International Standard Recording Code. SOCAN recently launched Dataclef, an "authoritative music database from more than 200 world territories" accessible as a commercial service. Re:Sound also maintains its own database and identifiers, but uses the International Performer Number when provided. Extended uses of the International Performer Number are currently limited (Observatoire de la culture et des communications, 2017).

There are no collecting societies for performers, actors, or dancers. In the literary sector, there are five collecting societies: Access Copyright and Copibec manage rights for the copy of print works. Société des auteurs et compositeurs dramatiques, Playwrights Guild of Canada and Société québécoise des auteurs dramatiques manage rights for the performance of dramatic works.

Further research must be conducted to assess the feasibility of enriching performing arts metadata with data held by collective management organizations. Besides, the ISNI bridge identifier and the MusicBrainz linked open database may also be useful authority databases for live performance use cases.

3.3 Use Cases of the Canadian Implementation Partners

RIDEAU and Culture Creates are the primary implementation partners in the initial phase of the LDF Initiative. Each one is uniquely positioned to contribute to the linked open data ecosystem for the performing arts.

RIDEAU's Scène Pro is a centralized information system for the performing arts production market. It is meant to integrate and facilitate a number of operations such as showcase application, event registration, and block-booking. Some of the primary goals of Scène Pro are to reduce manual data population into different systems and to enable the re-use of core data across a number of business processes. Scène Pro will thus gather a lot of reliable, validated, up-to-date information about performing arts companies, productions and presenters. Such information will then populate directories and applications intended for sector stakeholders. In addition, all non-sensitive information will be made available for other use cases via an open API.

Culture Creates has been developing tools and services to enhance the findability and discoverability of performing arts events in the consumption market. Using natural language processing, Culture Creates' Footlight technology harvests unstructured or semi-structured event information on websites and translates it into machine-readable structured metadata (Saumier-Finch, 2019).

Upon validation of the metadata by the presenters of these events, the metadata is republished as html-embedded JSON-LD on the organizations' websites and also populated as linked open data in the Artsdata.ca knowledge graph. Culture Creates' Footlight technology enables performing arts organizations to easily create and expose machine-readable metadata without having to acquire any knowledge about RDF, schema.org and other semantic technologies. The publication of the event metadata as linked open data also enables Artsdata.ca to serve many use cases beyond consumption.

> In addition to these primary implementation partners, a number of Canadian arts service organizations are currently leading or undertaking new digital initiatives that could become metadata contributors or metadata users in a linked open data ecosystem for the performing arts.

Certain initiatives, such as Artse, Diverse Theatre BC, OperaOp, SmartSplit, Bemused Network and Performance Wiki, have a focus on individual creators and their works. Such initiatives can fill a critical metadata gap at the very beginning of the performing arts value chain and serve richer metadata for initiative and applications focusing on the end of the value chain: the consumer market.

There are many consumer-oriented initiatives that are meant to build, curate and disseminate listings of live events. Of these, a significant proportion are integrating recommendation technologies – content-based, knowledge-based, collaborative, and context-aware filters and algorithms – to deliver personalized recommendations to their users. Such initiatives include: Arts2U, Québec Spectacles, Spotev, StagePage, and Indigenous Now. The success of each of these applications will be partly dependent on the availability of detailed event metadata supported by controlled vocabularies. These applications could therefore become both contributors and users of the linked open data ecosystem for the performing arts.

3.4 Artsdata.ca: Creating a Knowledge Graph for the Sector

Artsdata.ca[28] is a Canadian performing arts knowledge graph initiated in 2018 by Culture Creates with the support of the Canada Council for the Arts and several arts organizations.

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28   https://artsdata.ca

While at the time of writing this report, the graph database is still in its infancy, it is eventually meant to assemble all relevant data about current and future performing arts events in Canada and by Canadian artists or artists' collectives abroad. The creation of Artsdata.ca is an attempt to give the arts sector some agency over its own data in an environment characterized by novel discovery tools such as AI-driven search engines and virtual assistants that help people plan their leisure time. In order to participate in this AI shift, events and artistic productions need descriptive metadata. Without the data, even the best algorithms will fail, and the "long tail" of the Internet will disappear.

Today, most arts organizations are poorly equipped to benefit from the surge in AI discoverability. While some large arts organizations have the technical skills to generate descriptive metadata on their websites, they are only a handful. For the 14,900 producing and presenting performing arts organizations in Canada[29], it is not economically viable for each organization to hire a web developer with the skills needed to publish descriptive metadata.

This leaves a majority of arts organizations both unaware (not realizing their event data is missing) and vulnerable (mis-represented by third parties who do generate descriptive metadata). The AI boom has shifted control away from arts organizations and into the hands of third parties who maintain control over the descriptive metadata appearing in search engines and virtual assistants. A quick Google search for "events near me" will show event metadata sourced from meetup sites (meetup.ca), event aggregators (theatrelandltd.com, eventful.com), restaurant aggregators (restomontreal.ca), tourism sites (rove. me), and ticketing platforms (ticketmaster.ca, StubHub.com). Notably, there is almost a complete absence of authoritative metadata sourced from arts organizations that produce or present events. This is a problem insofar as the parties currently serving performing arts related data to the wider public may have their own vested interest in promoting certain offers and eclipsing others.

Furthermore, when looking at the entertainment industry as a whole, the gap is widening between those sectors that have descriptive metadata, such as the commercial film industry, and those that don't (Observatoire de la culture, 2017). Arts organizations are carefully curating cluttered web pages with semi-structured data, while fewer and fewer people use websites to learn what is happening near them.

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29   Statistics Canada, Table 33-10-0105-01 Canadian Business Counts, with employees, December 2018,   and Table 33-10-0106-01 Canadian Business Counts, without employees, December 2018. This count includes the following NAICS categories: 711111, 711112, 711120, 711130, 711190, 711311, 711321, 711322.

It is crucial for the arts sector to have a concerted strategy to provide information about events as linked open data for easier consumption by search engines and virtual assistants.

Artsdata.ca was started in parallel with Footlight, which both feeds data to the knowledge graph and uses its data extensively. Artsdata.ca will eventually have multiple sources of data including existing structured data; manually entered data; and data made available through trusted, interoperable data systems. Specific data population activities will be undertaken as part of the LDFI (see section 5.5).

While the governance structure of Artsdata.ca is yet to be decided, Culture Creates proposes putting the valuable mass of metadata generated by the sector into an innovative model of collective ownership involving arts organizations across Canada in the form of a platform cooperative. Culture Creates thereby seeks to shift the existing power of closed exclusive data access presently held by multinational tech companies to one that is open and accessible for the arts sector in Canada.

3.5 Addressing Diversity

Ensuring that search and recommendation technologies can find and recommend performing arts events and content is one thing. Ensuring that they can find and recommend diverse performing arts content is quite another.

On February 7-8, 2019, the Department of Canadian Heritage and the Canadian Commission for UNESCO hosted an international meeting on diversity of content in the digital age. As contributing authors and participants in this event noted, discoverability of diverse content is dependent on the existence of data about such content (the algorithmic input) and on this data being absent of systemic biases or inequities (McKelvey and Hunt, 2019). Consequently, the final report noted that an "avenue of intervention could be a form of support for the development and implementation of metadata associated with diverse cultural content".

Descriptive metadata denoting concepts of diversity can present challenges for a collective endeavour such as the linked open data ecosystem for the performing arts. First of all, concepts such as an individual artist's gender designations or belonging to distinct cultural groups or pluralistic identities relate to knowledge domains external to the performing arts and are beyond the scope of this initiative. Qualifiers related to identity are extremely personal. The authority for attributing such qualifiers rests with the individuals themselves. Besides, an individual may resist being assigned a label or category. Nuances of diversity can easily be lost in the process of

representing an aspect of diversity within a controlled vocabulary. Mitigating the loss of nuance could be essential to mitigating resistance to the adoption of standardized metadata to denote concepts of diversity.

In the Canadian context, the representation of Indigenous knowledge and concepts as metadata will present unique challenges and opportunities. There are a number Indigenous concepts and relations that would deserve to be adequately represented (or, at the very least, not excluded) in the linked open data ecosystem for the performing arts, including:

- Indigenous knowledge relative to artistic expressions and living traditions;

- Indigenous Peoples or Nations;

- Indigenous identities (e.g., the relationship between a given person and the People(s) or Nation(s) to whom they belong to or identify with).

> While Indigenous knowledge related to artistic expression is complex, the representation of Indigenous Peoples and identities as linked open data appears to be achievable, and it could yield significant benefits in terms of discoverability of Indigenous artists and their works.

A discussion paper on Indigenous Worldviews in the Web of Data was written and circulated as part of the Linked Digital Future initiative to test this hypothesis. Early feedback suggested that there are a number of issues with how Indigenous concepts are represented in Wikidata, in the terminology and in the accuracy of classes describing Nations, languages and territories.

Infusing ontological diversity to the web of data will require integrated thinking and respectful multidisciplinary collaboration (Bourgeois-Doyle, 2019). For example, accommodating diverse identities and different ways of naming and representing aspects of diversity may require an integrated perspective with two types of data: (1) standardized data / controlled vocabularies; (2) the preferred terms in which people refer to themselves, their geographies, and what they do. In the context of concrete applications, when to present which type of data will require further reflection and discussion.

3.6 Ensuring Interoperability with Existing Geographic and Tourism Data

Considering the rise of context-aware recommendations (based on time of day and location of the user) (McKelvey & Hunt, 2019, p. 6) and the fact that the performing arts is an intangible object that only exists at a given place and time, geographic metadata about live performances is of prime importance for all use cases related to consumers. It is a prerequisite to the recommendation of a specific live performance to a particular consumer, be it directly from a search and recommendation technology or through a human intermediary such as a tourism office employee or a hotel concierge.

Geographic metadata can also be attributed to people (i.e., the place of birth or of residence of an artist) or to places identified in a creative work (i.e., a play whose action unfolds in a specific city). Geographic metadata can also serve many use cases beyond consumer-oriented recommendations, including traceability of works or creators for statistical or cultural policies (i.e. identifying local resources for a cultural mapping process or else determining if a given work meets particular criteria to be deemed "Canadian content").

Geographic metadata can be of many types and formats. In addition to address and geo coordinates, geographic properties such as administrative territorial entities (districts, cities, administrative regions) can serve a lot of use cases related to traceability. Places and events with proper geographic metadata can also be expressed as points of interest for geographic information systems (i.e. GPS software, Google Maps) and tourism platforms. There are many proprietary and open file formats for publishing points of interest.

Geographic metadata and synergies with the tourism sector were only briefly explored in parallel to this action research. Further research and prototyping would be needed to explore possibilities for automatically inferring geographic metadata, for linking to geographic metadata in open knowledge bases such as Wikidata and Open Street Maps, and for building interoperability between performing arts metadata and point of interest file formats.

4 Conceptual Model for the LDF Initiative

The conceptual model for the LDF Initiative is used as a starting point to establish the formal RDF ontologies needed to represent the data published in RDF format in the context of the LDF Initiative.

In the course of the first action research component, an initial conceptual model has been developed based on the Data Model for the Swiss Performing Arts Platform (SPA Data Model, Estermann & Schneeberger, 2017), which is currently the most complete data model in the area of the performing arts, and a series of sample productions and performances from Canada, including one festival. To ensure that the development of the conceptual model is driven by the needs of the sector, actual data found on websites concerning the various productions and performances was used as a basis for the development of the model and has been made available for exploration in a pilot implementation[30].

Although performances of various genres (concerts, spoken theatre, musical theatre, dance, circus, staged readings, social dance events, social events with live music) were included in the data sample, the initial conceptual model is far from complete and will need further development through dialogue with key stakeholders and according to data published during the prototyping and development phase.

A two-pronged approach has been pursued in order to ensure maximal interoperability with the existing linked data cloud, including Wikidata: the conceptual model provides both pointers to equivalent classes and properties from existing RDF ontologies and from Wikidata. Of particular interest in view of the Canadian pilot implementation cases are equivalences with schema.org[31], the main ontology used by search engines.

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30 http://linkeddigitalfuture.ca
31 http://schema.org

At the same time, conceptual alignment with the FRBR and CIDOC data models[32] have been targeted. These models are well established in the heritage community and with EBUCore[33], a data model widely used among broadcasters. Table 3 gives an overview of the ontologies that are currently used in the context of the conceptual model.

Table 3: Overview of ontologies, data models, and vocabularies referenced by the LDFI Conceptual Model

Prefix	Name	URL
CIDOC-CRM	Definition of the CIDOC Conceptual Reference Model, Version 6.2.1	http://www.cidoc-crm.org/sites/default/files/cidoc_crm_version_6.2.1.pdf
ebucore	EBU Core Ontology	https://www.ebu.ch/metadata/ontologies/ebucore/
edm	Europeana Data Model	http://www.europeana.eu/schemas/edm/
fabio	FaBiO, the FRBR-aligned Bibliographic Ontology	http://purl.org/spar/fabio/
foaf	FOAF Vocabulary Specification 0.99	http://xmlns.com/foaf/spec/
frbr	Expression of Core FRBR Concepts in RDF	http://purl.org/vocab/frbr/core#
FRBRoo	FRBRoo Model	http://iflastandards.info/ns/fr/frbr/frbroo/
geo	WGS84 Geo Positioning: an RDF vocabulary	http://www.w3.org/2003/01/geo/wgs84_pos#
mo	Music Ontology	http://musicontology.com/specification/
ore	Open Archives Initiative, Object Exchange and Reuse	http://www.openarchives.org/ore/terms/
premis	Preservation Metadata: Implementation Strategies (PREMIS) Ontology	http://id.loc.gov/ontologies/premis.html
po	Programmes Ontology, Version 0.2	https://www.bbc.co.uk/ontologies/po/0.2
pq	Wikidata Qualifier	http://www.wikidata.org/prop/qualifier/
rdf	Resource Description Framework	http://www.w3.org/1999/02/22-rdf-syntax-ns#
rdfs	Resource Description Framework Schema	http://www.w3.org/2000/01/rdf-schema#
RiC	Records in Context, A Conceptual Model for Archival Description, Consultation Draft v0.1	Records in Context, A Conceptual Model for Archival Description, Consultation Draft v0.1
rdac	RDA, Classes	http://www.rdaregistry.info/Elements/c/
rdae	RDA, Expression Properties	http://www.rdaregistry.info/Elements/e/
rdam	RDA, Manifestation Properties	http://www.rdaregistry.info/Elements/m/
rdau	RDA, Unconstrained Properties	http://www.rdaregistry.info/Elements/u/
schema	Schema.org	http://schema.org/
skos	Simple Knowledge Organization System, SKOS	http://www.w3.org/2004/02/skos/core#
wd	Wikidata Entity	http://www.wikidata.org/entity/
wdt	Wikidata Property	http://www.wikidata.org/prop/direct/

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32   See for example FRBRoo and RDA. "FRBR object oriented" (FRBRoo) is a formal ontology intended to capture and represent the underlying semantics of bibliographic information and to facilitate the integration, mediation, and interchange of bibliographic and museum information. FRBRoo contains one of the early modelling examples of performances works and performing events. "Resource Description and Access" (RDA) is a standard for descriptive cataloguing in the area of bibliographic data. The underlying conceptual models for RDA are the Functional Requirements for Bibliographic Records (FRBR), Functional Requirements for Authority Data (FRAD), and Functional Requirements for Subject Authority Data (FRSAD) maintained by the International Federation of Library Associations and Institutions (IFLA). RDA thus facilitates linking performing arts related data to the data managed by libraries (e.g. creative works, their editions, creators, and contributors); furthermore, it contains a series of properties that are specific to the performing arts and/or film.
33   https://www.ebu.ch/metadata/ontologies/ebucore/

In the following section, the core classes of the conceptual model and how they relate to each other are presented. The current version of the model is available on the [project website](#), where it is not only documented, but can also be explored based on sample data from Canada.

4.1 Classes of the LDFI Conceptual Model

"A class is a category of items that share one or more common traits serving as criteria to identify the items belonging to the class." (CIDOC CRM, 2015, pp. vii). Classes can be specialized by defining several subclasses for a given class (e.g. "Play" is a subclass of "Literary Work", which in turn is a subclass of "Work"). Similarly to the SPA Data Model, the organization of most classes of the LDFI Conceptual Model is inspired by the categorization of the FRBR Data Model, thus:

- Group 1 Classes comprise the "products of intellectual or artistic endeavor that are named or described in bibliographic records" (FRBR, 2009, p. 13) as well as their equivalents in the domain of performance works.

- Group 2 Classes comprise "those entities responsible for the intellectual or artistic content, the physical production and dissemination, or the custodianship" (FRBR, 2009, p. 13) of entities belonging to the first group.

- Group 3 Classes in turn comprise "an additional set of entities that serve as the subjects of intellectual or artistic endeavor" (FRBR, 2009, p. 13).

- Further Classes: Several further classes have been defined to describe media objects, character roles, people's occupations, contact points, postal addresses, target audiences, ticket offers, and various other aspects covered by the sample data.

4.1.1 Group 1 Classes

Group 1 Classes comprise the "products of intellectual or artistic endeavor that are named or described in bibliographic records" (FRBR, 2009, p. 13) as well as their equivalents in the domain of performance works.
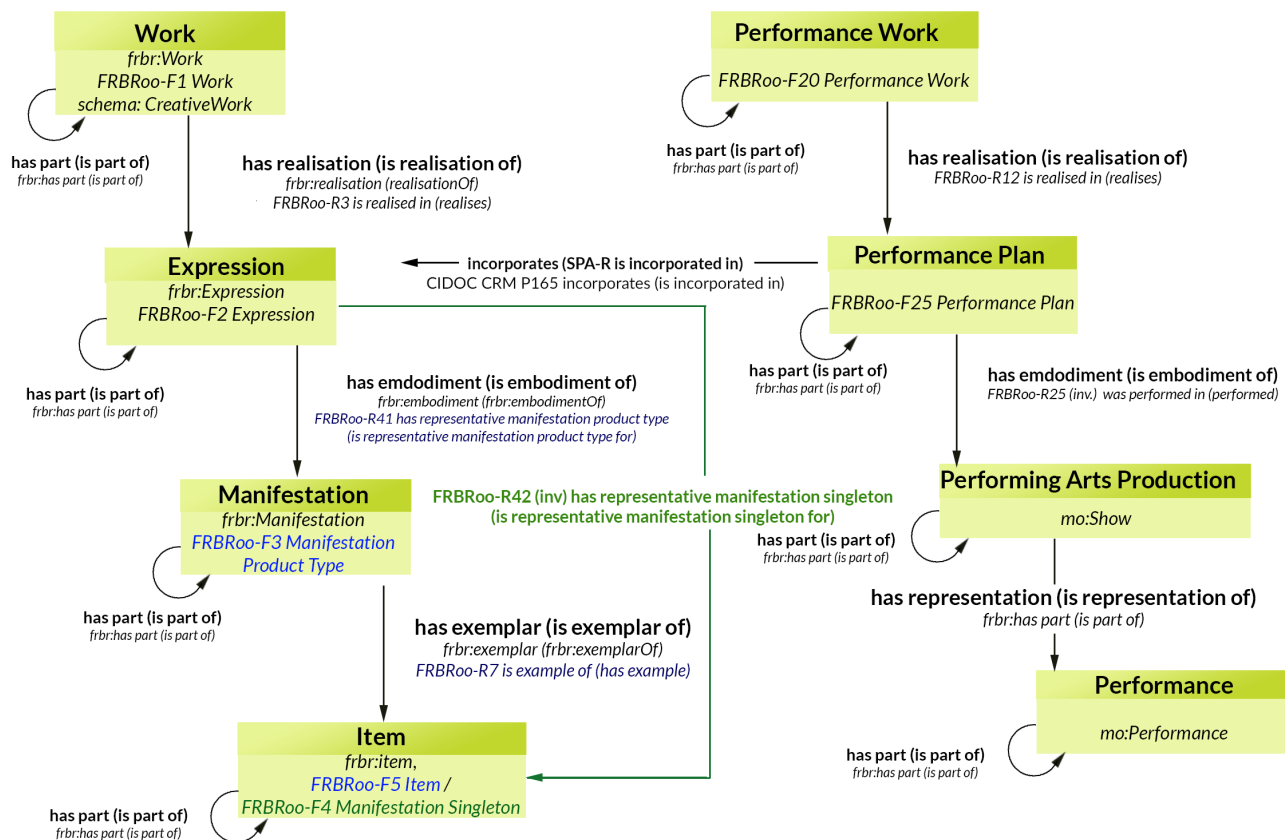
Figure 7: Group 1 classes based on FRBR and FRBRoo

The group 1 classes integrate both the **perspective of the literary, musical, or choreographic work** having its tangible manifestation in a physical artefact and which may serve as a basis for a performing arts production and the **perspective of the performance work** having its intangible manifestation in an ephemeral performing arts production.

As demonstrated by the SPA Data Model, which has been developed specifically for the heritage sector, it is easy to extend the conceptual model to cover also the **perspective of archival structures**, and it would be possible to also include the **perspective of the detailed description of museum objects** as well as the **perspective of the recording work** (FRBRoo-F21 Recording Work), which applies to audiovisual works that are meant as standalone works, such as the Hamlet movie by Kenneth Branagh (1996) (Estermann & Schneeberger 2017). As all three perspectives play a minor role in the context of the LDF Initiative, these perspectives are not specifically taken into account by the conceptual model; it is however possible to extend the data model accordingly if such a need arises.

Figure 7 gives an overview of some of the group 1 classes included in the SPA Data Model: "While the classes Work, Expression, Manifestation, and Item correspond to the same classes of the FRBR model, the classes Performance Work, Performance Plan, Performing Arts Production, and Performance build

an analogous strand for works of the performing arts. They are mainly inspired by the FRBRoo data model. Note however that at the difference to the FRBRoo model, the SPA Data Model distinguishes between the classes Performing Arts Production and Performance. While the former describes a set of similar (theoretically identical) performances, the latter describes an individual performance. In order to facilitate the description of series of similar Performances as part of a given Performing Arts Production, a class Series of Performances has been defined." The figure also shows the main relationships between the group 1 classes, mainly following the logic of the FRBR and FRBRoo data models.

It also becomes apparent from the figure how the different elements of the LDFI Conceptual Model can be mapped to various other ontologies. Note that equivalent classes in Wikidata have been identified for most classes, but are omitted here for reasons of simplicity.

For the purpose of the LDF Initiative, the SPA Data Model has been simplified as follows (see figure 8):

- The "Expression" and "Manifestation" classes have been conflated into one class; this means the various properties are just attached to the same entity; if the need arises, the entity can always be transformed into a more complex structure and the properties attached accordingly.

- The classes "Performance Work", "Performance Plan", and "Performing Arts Production" have been conflated into the class "Performing Arts Production". In practice, this also means that the properties that would otherwise be attached to the "Performance Work" entity or the "Performance Plan" entity are attached to the "Performing Arts Production" entity.

- The properties "based on" and "has subject" are used to create links between different works. The property "based on" is for example used to express the fact that a particular performance of Hamlet is "based on" Shakespeare's play or a specific version thereof. Note that the same property can be used to create links between different classes – Work, Expression/Manifestation on one hand, and Performing Arts Production or Performance on the other hand. The property "has subject", in contrast, is used to express the fact that one work has the other work as a subject, think for example of a photograph depicting a scene from a particular performance or of a video trailer of a particular production.

- Media resources (class "Media Resource"), such as the image files, video, or audio recordings, are directly linked to the "Work" or "Expression / Manifestation" class. If the need arises, a more complex structure could be applied to differentiate between various copies of the same media resource (see Estermann & Schneeberger 2017).
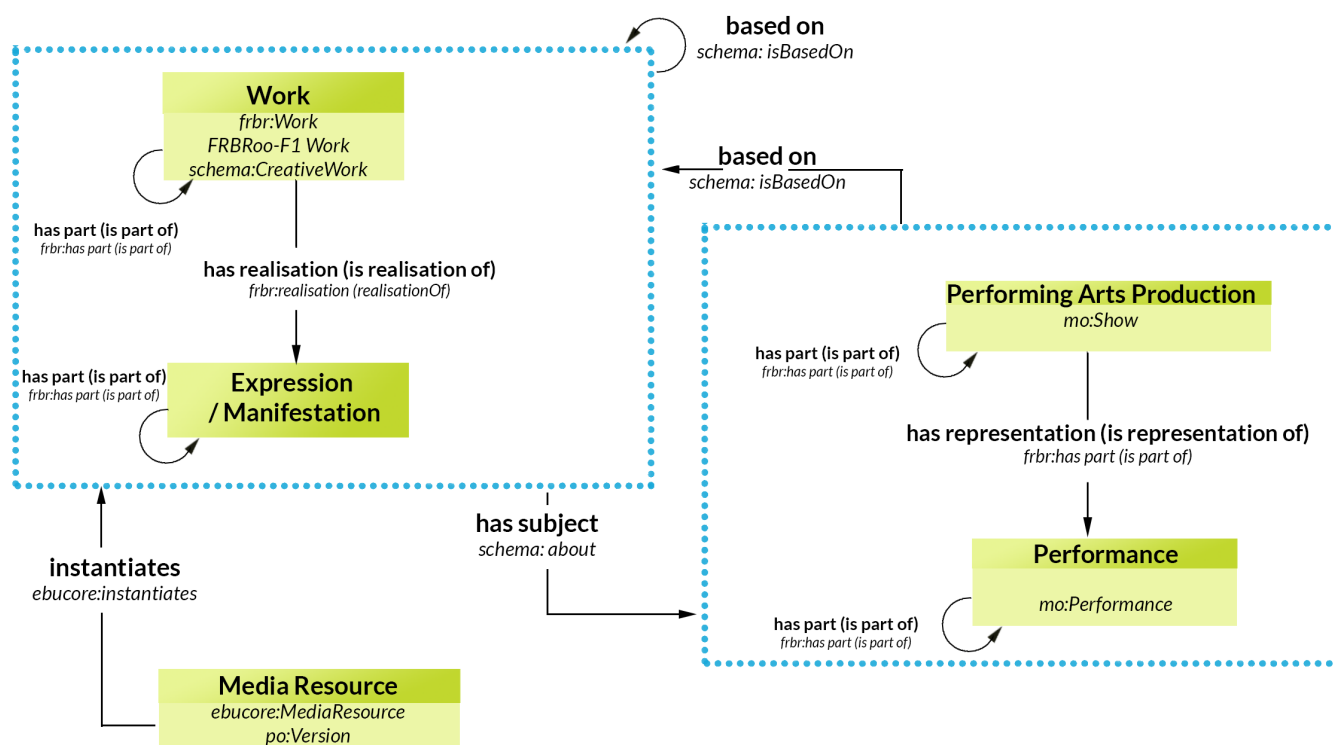
Figure 8: Group 1 classes – simplified model

4.1.2 Group 2 Classes

Group 2 classes pertain to agents, i.e. "those entities responsible for the intellectual or artistic content, the physical production and dissemination, or the custodianship" (FRBR, 2009, p. 13) of the entities belonging to the first group. Like RDA or FRBRoo, the SPA Data Model distinguishes between three sub-classes of Agent, namely Person, Family, and Corporate Body. Note that other data models, such as CIDOC CRM, only distinguish between Person and Group, while FRBR only distinguishes between Person and Corporate Body. Figure 9 gives an overview of all the group 2 classes and their ontological relationships.
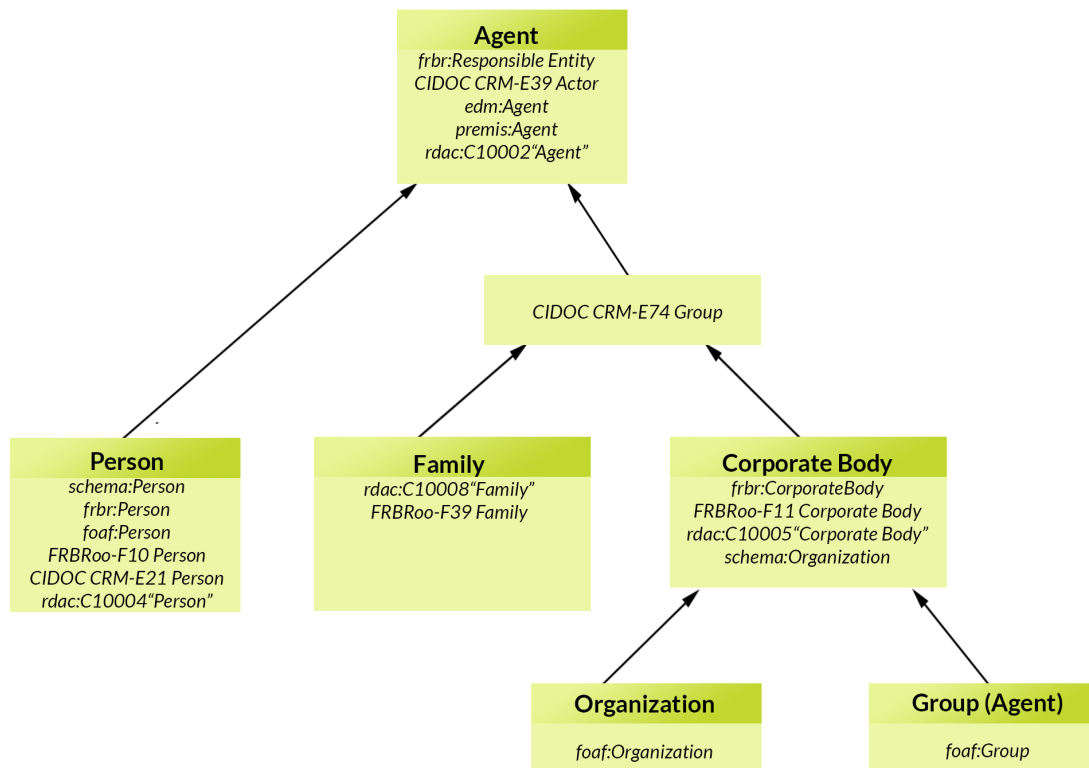
Figure 9: Group 2 classes

4.1.3 Group 3 Classes

Group 3 classes represent an additional set of entities that may serve as the subjects of works or records, or have any relevance with regard to their conception, creation, performance, reception, curation or management. The group includes Place (a location), Object (a material thing), Concept (an abstract notion or idea), and Event (an action or occurrence) (cf. FRBR, 2009, p. 17).

Note that both group1 and group 2 classes may also be the subjects of works or records. Figure 10 gives an overview of group 1 and group 3 classes and their ontological relationships; group 2 classes are not represented in the figure.
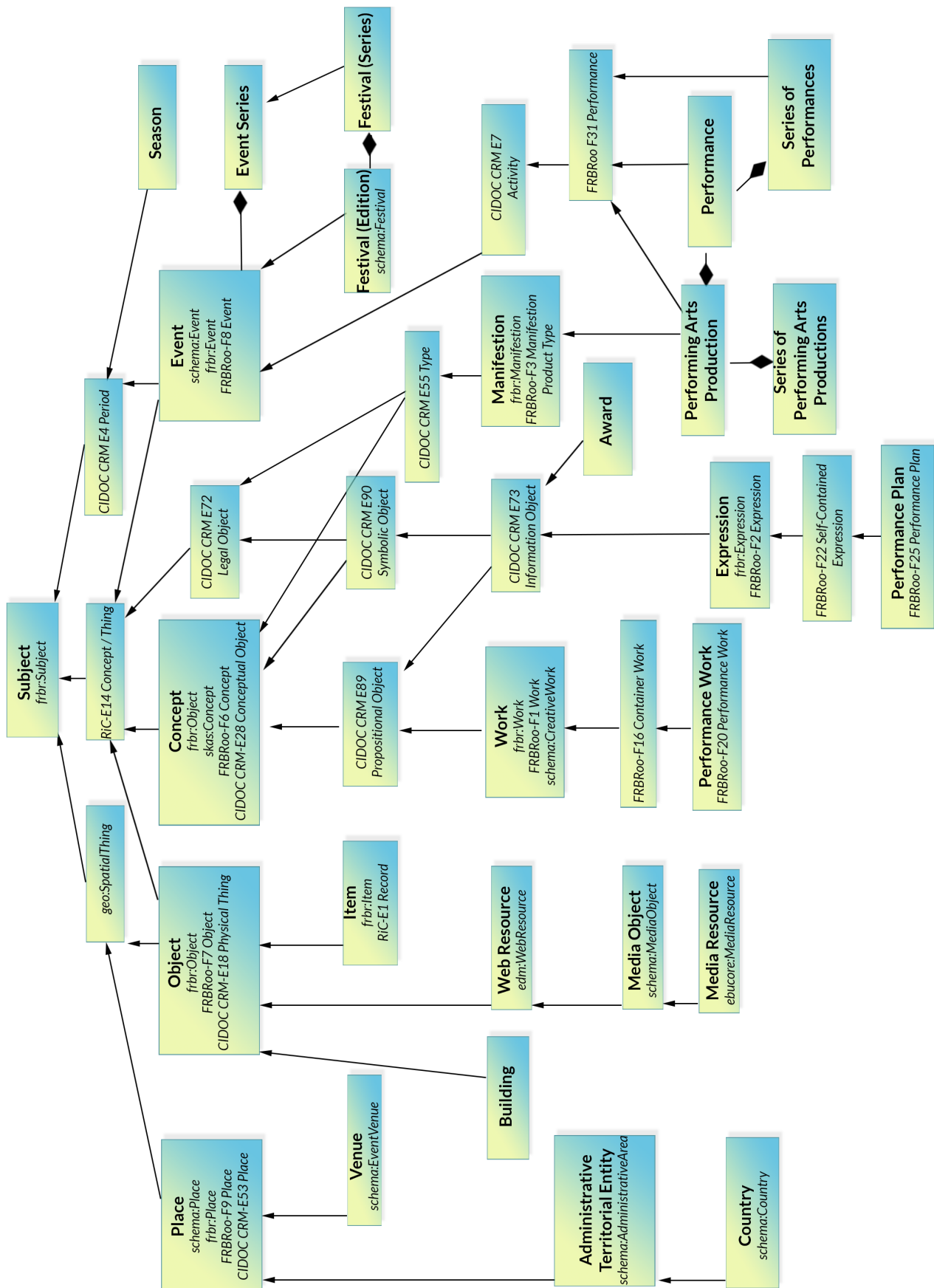
Figure 10: Group 3 classes

4.2 Properties of the LDFI Conceptual Model

A property serves to provide further information about an item (taking the form of an attribute), to express the relationship between two items (taking the form of a relation), or to provide further information about a property of the type attribute or relation (taking the form of a qualifier). Properties can also be specialized in the same manner as classes, resulting in relationships between subproperties and their superproperties.

Some of the properties defined in the context of the LDFI Conceptual Model are apparent from the figures in this chapter. Again, although they have been identified, equivalent properties in Wikidata are not shown in the graphics for reasons of simplicity. Please refer to the online reference for a complete documentation of the model at its current state.

4.3 Open Modelling Issues

For various properties, a controlled set of accepted values, a so-called "controlled vocabulary" will need to be agreed upon in order to allow for the coherent rendering of the data in applications. In some cases, the selection of these controlled vocabularies is rather straightforward and has already been made at the stage of the pilot implementation (e.g. for currency codes, country codes, or language codes). In other cases, these controlled vocabularies will need to be agreed upon by the different stakeholders involved in the project: For example, is a set of three values ("male", "female", "other") sufficient to indicate the "gender" of a person, or does the model need to be more specific? Or: Which are accepted values for the "genre" of a performing arts production? In some cases, such controlled vocabularies already exist, but in any case, discussion will be required among the community of data holders and data users in order to agree on specific sets of accepted values.

There are also still some open issues with regard to the modelling of various aspects, such as character roles, postal addresses, or awards. In view of the integration of data from RIDEAU, the modelling of performing arts productions during their initialization phase (before the actual production has fully taken shape and a premiere has been scheduled) will need to be discussed. While some open issues are already known today, others may be identified in the further course of the project. Among the cases that are the hardest to resolve are those where several conflicting modelling approaches already exist. As a consequence, some further reflection and discussion – also in light of concrete use cases where interoperability with other systems is an issue – will be required, before definitively settling for a specific modelling approach.

4.4 Modelling Examples

In the following some modelling examples are provided for illustration purposes. They show an extract of the data that is available for each production. Further examples are available on the project website where the sample data can be explored in an interactive manner.

4.4.1 "J'aime Hydro" by Porte Parole and Champ gauche

"J'aime Hydro" is a touring theatre production by Porte Parole and Champ gauche. Figure 11 shows the information about different contributors, the production companies with their addresses and contact information, various stops of the tour, and a pointer to the ticketing website for the series of performances at Usine C in Montreal.

Figure 11: A touring theatre production with contact points of the production company and link to ticketing website

4.4.2 "Émotions fortes" by the Molinari Quartet

"Émotions fortes" is a concert by the Molinari Quartet offered on the production market during the season 2019-2020. Figure 12 shows the information about the production: the ensemble, the musical works performed, the genre, the target audience, the season during which the production is on offer, as well as the contact information for bookings.
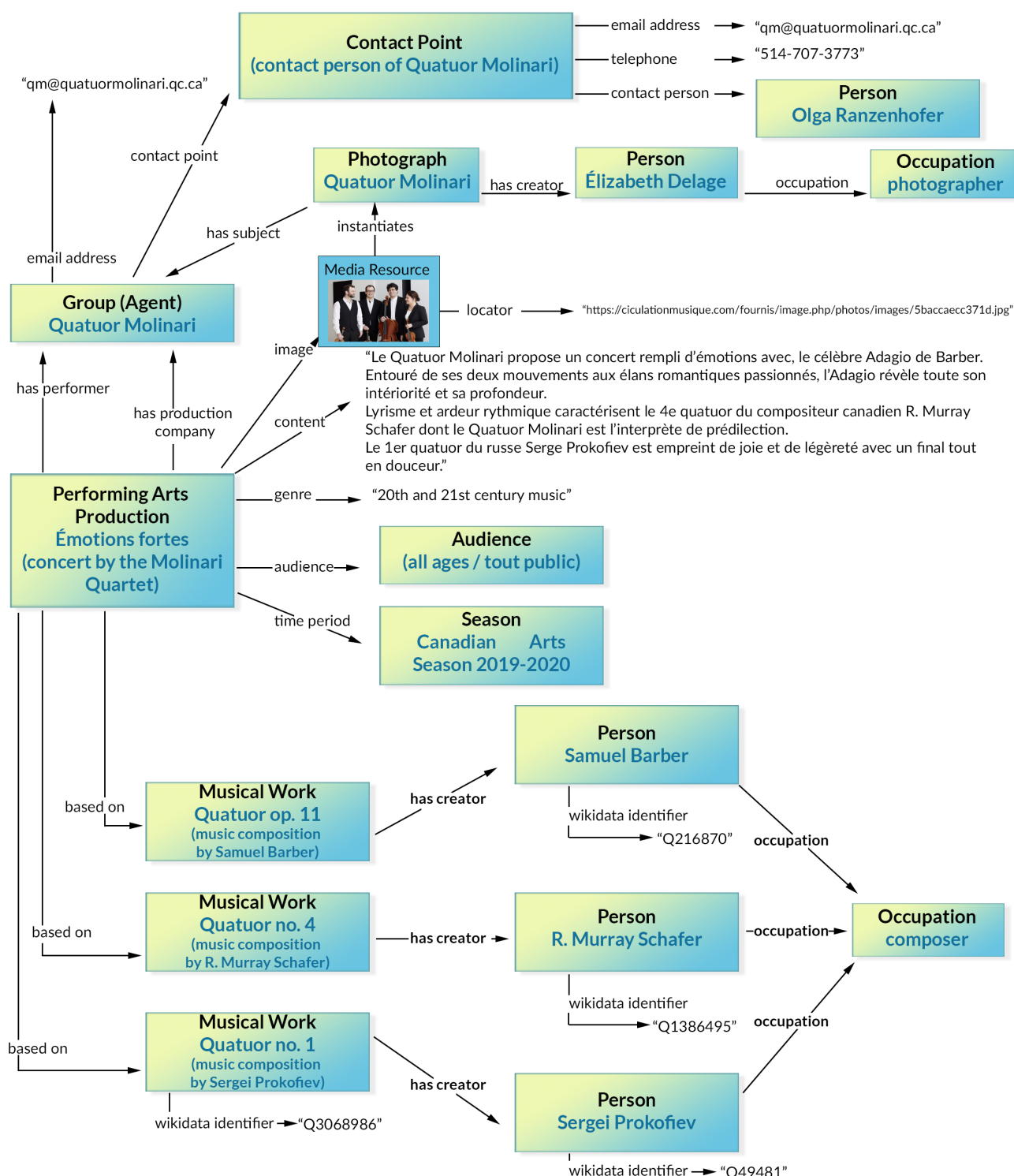
Figure 12: A concert offered on the production market with a picture of the performers and pointers to Wikidata entries where available

4.4.3 18th Annual Talking Stick Festival

The Talking Stick Festival is a multi-day festival in Vancouver which features storytelling, dance, music, theatre and other performing arts and cultural works by a wide range of Indigenous artists. Figure 13 shows an extract of the programme of its 2019 edition, featuring various types of productions, performances, and events, partly held in different parts of the same venue.
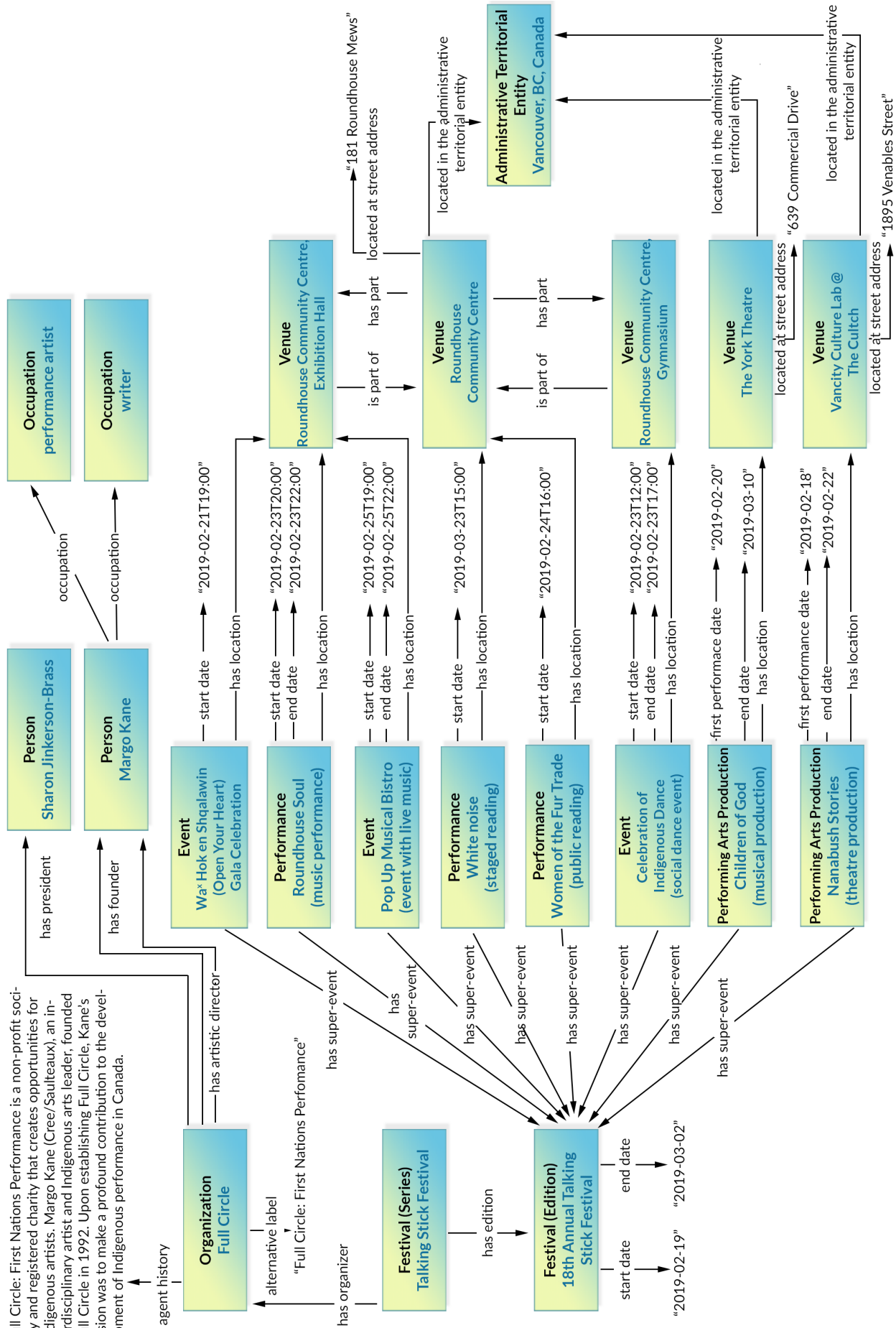
Figure 13: A festival with various types of productions, performances, and events (extract)

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4.4.4 "The Glass Menagerie" at the Shawfest 2019

The last example features a theatre classic by Tennessee Williams, performed during the 2019 season of the Shawfest, an annual theatre festival in Niagara-on-the-Lake. In addition to the information about various contributors of the production and a pointer to the play it is based on, the performance roles played by the different actors are also indicated (figure 14).
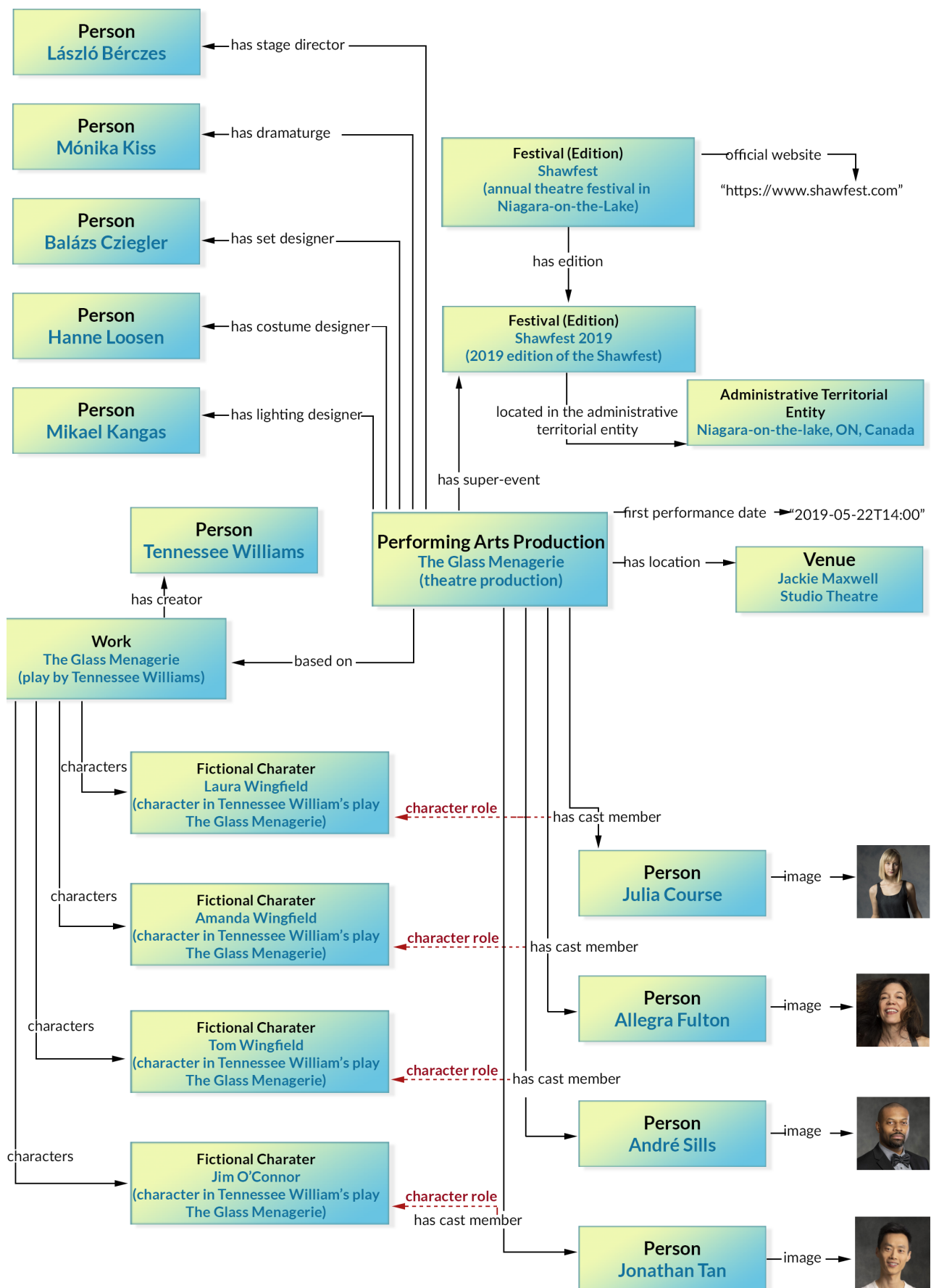
Figure 14: A theatre production with reference to the play it is based on and indication of performance roles (the dashed red lines are qualifiers which further specify the property "has cast member").

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5. Current State of Implementation

This section gives an account of the current state of the technical and organizational implementation of the LDF Initiative at the end of the Action Research Phase 1 (end of June 2019) and offers an outlook on the ensuing Prototyping and Development Phase.

While the Action Research Phase was mainly concerned with providing proofs of concept in view of the Prototyping and Development Phase, which would see the actual implementation of said concepts, the two go hand in hand and have been approached in this vein by Culture Creates who acted as the main implementation partner during this first phase of the project.

5.1 Conceptual Model / Ontology

As described in section 4, a series of sample productions and performance events, including a festival, have served as a basis for the development of an initial data model. To the extent possible, mappings to classical RDF ontologies (schema.org, RDA, etc.) and to Wikidata have been provided for the classes and properties contained in the model. The data about the sample productions and events have been published as linked open data and can be inspected with the aid of the Ontodia tool[34]. An initial set of controlled vocabularies as well as a list of known data modelling issues have been provided.

The issue of reification (required to further qualify individual statements) still needs to be tackled: while character roles and organization roles so far have been implemented using the schema:Role class, solutions for the historicization of statements[36] or for the tracking of their provenance[35] still need to be implemented. Similarly, the version history, which will allow tracking the modifications made to the graph database, has not yet been implemented.

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34   http://linkeddigitalfuture.ca
35   Used for example to express that John Doe was the director of a particular theatre company from 2011 to 2018.
36   When aggregating data from various sources, it is necessary to be able to indicate the source of each statement to facilitate the management of data quality.

The management of the LDFI Conceptual Model has been handed over to Culture Creates, and the process for documenting and expanding the data model and adding new ontological structures has been set up. During further phases of the project, the process will need to be expanded to involve further stakeholders. The process for collaboratively developing and documenting controlled vocabularies has yet to be implemented. In general, the further development of the LDFI Conceptual Model should be driven by actual data that is ingested into the Artsdata.ca knowledge graph.

5.2 Population of the Database

The current version of the LDFI Conceptual Model has been implemented in the Artsdata.ca knowledge graph, and a semantic pathway to express Scène Pro data as RDF triples has been described. Also, Culture Creates' Footlight prototype has been set up to harvest data from arts organizations' websites and to feed them into the Artsdata.ca knowledge graph. Both the data harvested by the Footlight prototype and the sample data have been published to a triple store and can be queried through a SPARQL endpoint and be displayed and explored online. So far, data about 4670 performance events have been ingested. Work on the further development of the Footlight prototype to extend its support to additional elements of the Conceptual Model has been initiated.

As the Artsdata.ca knowledge graph still contains quite little data, interlinking with relevant international authority databases (ISNI, VIAF, Wikidata, etc.) has been done only on an experimental basis. In order to identify the databases the Artsdata.ca knowledge graph shall systematically point to, a systematic evaluation of the various authority databases will need to be carried out after further populating the knowledge graph with actual data from Canada. Apart from the quality and completeness of the data already contained in the various authority databases, the ease of querying the databases, their credibility when it comes to providing persistent identifiers, as well as the processes through which the authority databases can be complemented if entries are missing will need to be considered in the evaluation as well.

5.3 Use Cases & Business Models

While the use cases of the Canadian implementation partners RIDEAU and Culture Creates have been described (section 3.3) and ideas for sustainable business models have been explored, these business models still need to be put to a test. Furthermore, the value propositions of the two partners will need to be further refined based on requirements that will be collected from pilot clients. In addition, the interplay between the use cases of the two implementation partners will need to be demonstrated, and the long-term role of CAPACOA needs to be determined with regard to the linked open data ecosystem for the performing arts.

5.4 Internationalization

The action research has led to the insight that the international dimension plays an important role not only in view of the coordination of the data model in order to ensure interoperability between the various national initiatives, but also regarding the provision of data that is relevant to several countries (e.g. data regarding the repertoire or regarding artists and artists' collectives with an international career).

For this reason, a process should be set up to ensure the international coordination of the data model and its further development. In the longer run, the necessary structures will need to be put in place to facilitate international standardization in this area (designation or creation of a standardization body).

Important synergies are to be expected between various use cases and infrastructure elements at the international level. While some possible areas for international cooperation have been identified during Action Research Phase 1, limited time resources have not allowed for a systematic analysis. Similarly, while some probes were made into extending the Footlight business model to also include other countries, the on-boarding of pilot clients from abroad is currently on hold due to resource constraints.

> The international dimension definitely merits further exploration, and given the fact that several international partners would be ready to start interacting with the partners of the LDF Initiative in view of the common development of the linked open data ecosystem for the performing arts, further efforts should be undertaken in this area.

Possible funding schemes to support international cooperation are Eurostars[37] and COST[38].

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[37]   https://www.eurostars-eureka.eu/ – Eurostars is targeted at SMEs and their (international) partners willing to engage in innovative product development.
[38]   European Cooperation in Science and Technology (COST) is Europe's longest-running intergovernmental framework for cooperation in science and technology. It offers researchers, engineers and scholars from both private and public sectors the opportunity to embark on bottom-up, multidisciplinary cooperation across all science and technology domains by setting up thematic networks.

5.5 Next Steps

Next prototyping steps will focus on populating the Artsdata.ca knowledge graph with more data. This will make it possible to test the conceptual model and to progressively tackle the technical issues that still need to be resolved, such as interlinking with authority databases and defining controlled vocabularies. It will also provide essential benchmarking information for the exploration of sustainable business models.

As of September 2019, a first cohort of presenting organizations will be enrolled into a discoverability program with Culture Creates and CAPACOA. A user console connected to the Artsdata.ca knowledge graph will allow these organizations to populate minimal information and subsequently initiate the automated harvesting of event information on their respective websites with the Footlight technology. The cohort approach will be a test bed both for the service delivery model and the Footlight technology. As errors resulting from the natural language processing are identified and corrected, the Footlight technology will become more accurate and efficient. This, in turn, will reduce the time resources required on the part of participating organizations to validate their information, and on the part of CAPACOA and Culture Creates to provide technical assistance. These efficiencies will make it more affordable and sustainable to onboard the remainder of the performing arts presenting sector.

Meanwhile, RIDEAU will be rolling out the first cycle of data population into Scène Pro. Once data related to the supply of performing arts productions for the purpose of the RIDEAU conference is fully populated in Scène Pro, it will be possible to test the semantic pathway between the Scène Pro core API and the Artsdata.ca knowledge graph. Non-sensitive, public information will be ingested in Artsdata.ca, and the combined database will be linked to existing authority databases.

Digital literacy and communication activities will unfold in parallel to the prototyping and development activities. The digital literacy component is both a full-fledged initiative in and of itself, as well as a critical condition for the success of the first two components. It will raise awareness of the action research and prototyping activities, and it will build readiness for acting on the roadmap proposed in this report. In addition, digital literacy events may also provide opportunities to explore critical questions raised in the present report with regard to the sustainability of a linked open data ecosystem, such as governance and business models.

All of the above activities will be rolled out in an agile manner. Lessons learnt will be shared back with the performing arts sector via the project website. They will also drive decisions related to further action research activities in 2020-2021.

6 Key Insights and Recommendations

This section summarizes the key insights gained during the Action Research Component and contains a series of recommendations with regard to the further implementation of the LDF Initiative and in view of its long-term sustainability.

6.1 Key Insights Gathered During the Action Research Component

During this initial phase of the project, a series of insights were gathered that will inform its further deployment:

I-1.

There are various initiatives at the international level to establish a linked open data ecosystem for the performing arts. Most of these initiatives have emerged from the heritage or research sectors. Only few initiatives so far have directly addressed the primary value chain of the performing arts, involving performing arts professionals, production companies, presenting organizations, operators of arts facilities, dissemination platforms, and concert/theatre goers. By putting its main focus on the stakeholders of the primary value chain, the LDF Initiative breaks new ground.

I-2.

Exchanges with the project members of the LDF Initiative as well as with representatives of the Flanders Arts Institute, the Swiss Archives for the Performing Arts, and the Specialised Information Services Performing Arts in Frankfurt, have shown that the usage scenarios not only of the heritage and research sectors, but also of some of the stakeholders of the primary value chain have an international character (e.g. a strong interest in promoting domestic artists' collectives and productions abroad, or the promotion of live performances among tourists). Furthermore, there are important overlaps regarding the repertoire, and many renowned artists and artists' collectives have an international career, which means that the same people and groups show up in the databases of various countries.

I-3.

Furthermore, the comparative analysis of the usage scenarios of different stakeholder groups related to the performing arts has shown that their needs in terms of data overlap to a considerable extent, and that the core elements of the data model are the same across sectors. This means that substantial synergies are to be expected not only with regard to data maintenance, but also in view of the development of other parts of the data infrastructure, including platforms for data entry, services for data extraction, analysis, and visualization, or the provision of data and/or media repositories. Canadian partners should clarify their role with regard to the linked open data ecosystem for the performing arts at an international level and specify which parts of the infrastructure they will provide themselves and where they will build on the work done elsewhere. This includes addressing the question of the structure of Canadian databases connected to the linked open data ecosystem for the performing arts: How many data hubs? How much centralization / decentralization?

I-4.

As Langeveld et al. (2014) note, there are competing and converging interests among the stakeholders of the performing arts value network. In some cases, data sharing will be beneficial to all players, in others, some players will have an incentive to withhold data due to competitive dynamics. When tapping into the performing arts value chain to assemble data to be integrated into the linked open data ecosystem for the performing arts, it is therefore important to understand these dynamics and to gain insights into what types of cooperation would be facilitated by increased data sharing/pooling. Also, there should be a data governance framework detailing who is expected to share what type of data with whom. Some data may best be shared only between the parties to a specific transaction or on a particular market.

I-5.

In a similar vein, it should be clarified who is expected to have the authority over which data/information, including personal information. There is a need to balance personal, commercial, and public interests. To maintain a healthy data ecosystem, it will be necessary to source statements, to track data provenance and to critically assess sources of information. When it comes to balancing various interests, political, legal, and ethical issues will need to be considered (Estermann et al., 2018).

I-6.

It makes sense to manage some of the performing arts data in Wikidata – especially in areas where there are important overlaps to be expected with regard to other sectors and/or countries, where stakeholders are expected to maintain their own data directly on the platform, or where the reuse of the data within the online encyclopaedia Wikipedia would be beneficial from the point of view of the arts sector. In which case it would be best to use Wikidata as the master database, and in which case it is preferable to populate Wikidata from authoritative databases developed in the course of the LDF Initiative, needs to be analyzed / experimented over the remainder of the project. To populate Wikidata with relevant data from the performing arts, the methodology currently developed by the Wiki Movement Brasil in cooperation with OpenGLAM Switzerland (Fontenelle & Estermann 2019) could be adapted to the performing arts sector; it foresees the empowerment of stakeholders to curate their own entries on Wikidata.

I-7.

When allowing users to make improvements to data in a crowdsourcing environment, organizations will need to develop a policy as to whether and how to integrate data gathered through crowdsourcing back into their authoritative databases (see Zeinstra 2019). Processes will need to be established to keep partly overlapping databases in sync.

1-8.

So far, relatively little performance data has been gathered for Canada. One of the key foci of the LDF Initiative therefore lies on populating a sector-owned Canadian knowledge graph such as the Artsdata.ca knowledge graph. This is a prerequisite for tackling further issues related to data modelling, reconciliation of the data with existing base registers / authority files, and agreeing on controlled vocabularies for various parameters. The two primary Linked Digital Future implementation partners will progressively contribute both permanent data (on organizations and productions) and time-sensitive data (on live events). In addition, the knowledge graph could and should integrate data from many other open data sources, be it from Wikidata or from other data repositories.

I-9.

Culture Creates has developed tools and a sound methodology to make data ingestion into the Artsdata.ca knowledge graph scale over the coming years. Artsdata.ca could thus serve the function of a national data hub and become a central node of the international linked open data ecosystem for the performing arts. Yet the sustainability of Artsdata.ca and of Culture Creates' business model still needs to be validated over the remainder of the project. Uptake by the sector will be promoted through sensitization and digital literacy campaigns.

I-10.

Culture Creates' Footlight tool constitutes a promising application based on the Artsdata.ca knowledge graph and the LDFI Conceptual Model. Concrete applications that generate real value for users and to the arts sector as a whole are crucial to get the buy-in from further data providers. Moreover, it is only by putting the data to some real use, that qualified feedback regarding the fitness of the data in terms of quality, completeness, and structure can be obtained. The requirements regarding the ontology and the actual data contained in the knowledge graph should be further elaborated in view of specific use cases served by concrete applications. The knowledge graph could then be evaluated and further developed with concrete competency questions in mind (cf. Ren et al., 2014).

I-11.

In the course of the first action research phase, a conceptual model has been developed and validated based on a set of sample performances and productions from Canada. While it was ensured that performances of various genres were included in the data sample, the initial conceptual model is far from complete and needs further development in a dialogue with key stakeholders and according to the data published during the remainder of the project. The current conceptual model does not yet include shared taxonomies or controlled vocabularies to qualify the data at a more granular level. Controlled vocabularies will have to be developed for information such as organization type, activity type, venue/facility type, artistic discipline/genre/form, target audience, etc. Multilingual controlled vocabularies would be particularly beneficial in the Canadian context. They would contribute to a broader adoption of the conceptual model, and provide more elaborate and diverse algorithmic inputs to search and recommendation technologies.

I-12.

To better equip itself for a digital world where machines deliver recommendations rather than search results, the performing arts sector is strongly advised to embrace the linked open data approach proposed by this action research report. More implementation partners will be needed in the production and consumption market, and ideally also in the labour and rights markets. New digital initiatives supported by Canadian public arts funders ought to adopt linked open data standards proposed in this report so that new platforms, applications or information systems are interoperable with one another and collectively contribute to building an international linked open data ecosystem for the performing arts. While this action research is an important first step in building an awareness about this kind of digital collaboration, arts organizations and their digital service providers may need practical assistance in designing and rolling out digital initiatives powered by linked open data.

I-13.

How AI-powered recommendation technologies will evolve depends on the quality and the diversity of data used as input. The performing arts sector can assume its responsibility by adopting the conceptual model, publishing linked open data, and contributing to data to the Artsdata.ca knowledge graph. However, a real diversity of data in the performing arts will itself depend on a capacity to link performing arts data to other, cross-sectional knowledge domains such as Indigenous knowledge. This is beyond the scope of the current action research, but worth mentioning as a topic requiring further research and concrete action.

I-14.

A knowledge graph for the performing arts cannot be static. Not only must it scale vertically by constantly integrating and linking new data, but the conceptual model that supports it must also adapt and evolve to reflect changes in performing arts artistic or business practices or to interlink with other closely (or loosely) related knowledge domains. This will require ongoing input from information and development specialists via some form of development-focused governing body.

I-15.

In the future, opportunities to use machine-learning approaches in combination with a knowledge graph should be explored when it comes to datafying and indexing existing documents related to the performing arts (e.g. by semi-automatically extracting data from PDF documents; semi-automatically tagging persons or characters in photographs; automatically segmenting and indexing audio or video recordings; etc.).

I-16.

There is currently no solution for systematic long-term preservation of the data and the media files accumulated in the context of the LDF Initiative. So far, given that the initiative is mainly driven by stakeholders of the primary value chain, limited interaction has taken place with representatives of the heritage, research, and educational sectors on this topic. It remains unclear who is responsible for establishing the fair use media repository (long-term access to content for research and education).

6.2 Recommendations Regarding the Further Implementation of the LDF Initiative

Based on the insights gathered, the Advisory Committee has formulated five recommendations to be taken into account during the further deployment of the LDF Initiative and beyond, in order to secure the long-term sustainability of the linked open data ecosystem for the performing arts:

R.1

Immediate focus should be placed on populating a Canadian knowledge graph with performing arts data. To do so, data about current and future events should be ingested into a knowledge graph via current and future LDFI prototyping partners or made available through interoperable data systems which conform to the LDFI Conceptual Model. In addition to ingesting event data, existing databases that contain data about works, venues, persons, and organizations involved in performing arts productions should be ingested or linked to. This includes establishing links to existing base registers / authority files and convincing their maintainers to embrace linked open data.

R.2

Wikidata is to be seen as complementary to the Canadian knowledge graph; efforts should therefore be undertaken to contribute to its population with performing arts related data that is of relevance in the context of the Canadian knowledge graph. This includes implementing missing elements from the LDFI Conceptual Model on Wikidata, aligning definitions, interlinking or ingesting existing databases, engaging in regular data maintenance, and empowering stakeholders from the arts sector to curate their own data entries on Wikidata. Furthermore, cooperating with the Wikipedia community to promote more performing arts related data and information to Wikipedia would also enhance the visibility of the sector as a whole.

R.3

When tapping into the performing arts value chain to assemble data to be integrated into the linked open data ecosystem, it is important to understand the dynamics at play between the different stakeholders and to gain insights as to what types of cooperation would be facilitated by increased data sharing/pooling. A data governance framework should be developed in cooperation with representatives of the various sections of the arts sector to establish who is able to share what type of data with whom and who will have authority over which data/information. The governance framework needs to address technical, ethical and business aspects.

R.4

Further research is needed to better understand the user requirements with regard to the adoption of linked open data practices in existing and emerging service offerings. Collective efforts to aggregate data should be driven by flexible usage scenarios that yield incremental benefits to users, with a focus on low-hanging fruit. It is thereby crucial to create incentives for those stakeholders who are expected to make an additional effort to contribute or enhance performing arts related data.

R.5

Further efforts need to be put into developing and describing (novel) business models making use of and maintaining a well-functioning linked open data ecosystem for the performing arts. It needs to be established to what extent the key players of the performing arts value network will be able to economically sustain their contributions to the common knowledge graph in the long run. Resources provided through the LDF Initiative should be used to cover one-time investments benefitting the entire sector. Recurring costs should be shouldered by the implementation partners and the immediate beneficiaries of the services provided. Their funders and sponsors need to be made aware of the long-term benefits of maintaining a common knowledge graph, both in terms of efficiency gains along the performing arts value chain and in terms of improved visibility of the arts sector's offerings.

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