CONZEPTUALIZING A MOBILE APP FRAMEWORK FOR THE MUSEUM APPLICATION DOMAIN

Tobias Baumgärtner

University of Passau, tobi Baumgaertner@uni-passau.de

Follow this and additional works at: https://aisel.aisnet.org/ecis2019_rp

Recommended Citation

https://aisel.aisnet.org/ecis2019_rp/71
CONZEPTUALIZING A MOBILE APP FRAMEWORK FOR THE MUSEUM APPLICATION DOMAIN

Research paper

Baumgaertner, Tobias, University of Passau, Passau, Germany, tobias.baumgaertner@uni-passau.de

Abstract

The Museum Application Domain is the most visible part of cultural heritage institutions. It gives museum professionals the opportunity to deliver their insights towards a public audience. The demand for virtual accessibility and digital visibility is soaring because of both, the possibilities showcased by industry leaders and the appeal voiced by visitors. The unique preconditions, emphasized within small and medium sized museums, set an interdisciplinary and intriguing environment for practitioners and researchers alike. In particular, mobile apps already inspire research concerning a multitude of questions targeting the user’s perspective. However, the situation of creators, concerning the development process, content strategy, and general feasibility are often overlooked. This paper suggests a framework to serve as an entry point for curators and other museum professionals towards structured digital content. The question of how data visualization can aid the aforementioned issues has to be answered. This leads to the core concept of breaking down the complexity of structured data, sustainability, and collaboration by utilizing the resulting end-user application as an anchor.

Keywords: Museum, Application, Domain, Framework

1 Introduction

This chapter processes the general motivation, introduces the general idea of the mobile business ecosystem and produces the research question, which then is reflected upon the problem domain.

1.1 General Motivation

Since the introduction of smart mobile devices, the interconnection and the usage of data have been fundamentally changed. The increasing capabilities and number of smartphones as well as the continuous improvement of access points to the internet, i.e. LTE and Wi-Fi-Hotspots, to this day rapidly trigger the process of innovation. Thus, businesses become capable of supplying their customers with ubiquitous information offerings and services that are independent of time and location. This opened up new roles and business models in the mobile ecosystem (Decker, 2015; Hufenbach, 2014; Marty and Burton Jones, 2008).

Learning environments and historico-cultural institutions like museums are among the earliest application domains incorporating information systems and technology. The opportunities those structures have to offer were addressed almost 50 years ago during the IBM conference at the Metropolitan Museum of Art in 1968, where the term “museum automation” was initially coined (Stam, 1996).

The emerging trends of that time were enabled by the internet, relational databases, and services such as search. Museums were able to abolish paper-based systems and access information in completely new ways (Stam, 1996). Today new transformational drivers are about to change IT infrastructure as a whole, with heavy impact from both mobile devices and the cloud (Lehner and Meier, 2005; Niroshinie et al., 2013).
Smartphones are a daily companion for many people. In Germany the rate of smartphone users exceeded three quarters of the population in 2016 and still keeps on growing (Bitkom, 2017). The market of mobile cloud-based applications has reached around $10 billion in 2015 and is projected to surpass $35 billion by 2020 with around one trillion connected devices worldwide by then (Niroshinie et al., 2013; Research & Markets, 2016).

Those innovations and their adoption are a valuable appliance for companies across all domains to build customer touch points and create engagement opportunities that can be individually tailored and managed. Commercial companies already use these opportunities quite effectively as the market numbers indicate, but because of certain restrictions, other institutions struggle to keep up with the new mobile business opportunities (Atkinson, 2013; Hufenbach, 2014).

In particular, the initial position of museums is more restrained compared to operators of profit-oriented business models since they are forced to act under restricted budget and with a different focus. They often depend on public funding and volunteer work, notably when it comes to small and medium sized institutions (Skinner et al, 2009). This does not foster innovation very well, since the development and long-term success of applications depends on the input and continuous feedback of the target domain. Thus, the Museum Application Domain (MAD) can serve as a vivid example in this regard, despite the apparent complexity.

Compared to operational enterprise software that needs to reflect process chains, transfer data across multiple firms and entities, as well as being accessed in real time, the use cases within the MAD can be more easily illustrated, as the general impact is lower and thus the constraints which apply are well explainable and overall better comprehensible.

The central issue remains within the complexity of digital data records. Stakeholders need support to comprehend the necessity and importance of metadata entry. Therefore, it is mandatory to look beyond the ontology and ask the question:

How can a visual anchor embedded within a framework for mobile applications ensure quality, consistency, and increase accessibility of metadata within the museum application domain?

### 1.2 Domain Specific Issues

To further distinguish the needs of the MAD from generic business related issues the historically grown structures and unique characteristics need to be underlined. G. Wayne Clough (2013), secretary of the Smithsonian Institution puts it like this: “[The digital revolution] has left many institutions struggling to adapt and is forcing them to rethink how to maintain their unique qualities while at the same time adding value.” (Clough, 2013).

Big and well-funded institutions can offer high profile digital exhibitions, while smaller institutions often struggle to find any entry point at all. The Cleveland Museum of Art offers one prime example of digital leadership in the domain. Their portfolio contains an extraordinary digital exhibition, the Gallery One, and Art Lens, a mobile app, for their overall exhibition space (Alexander, 2014). Many institutions, however, are overwhelmed solely by the basics of digital transformation since the focus is heavily shifted towards technical aspects rather than highlighting the museum professionals’ point of view (Baumgaertner and Lehner, 2017).

Also, within the scientific community, apps are the central target of many researchers and studies tied to the cultural heritage demesne. Palumbo et al. (2013) describe the application design process based on the drivers of visitor satisfaction. Others are focused on a more technical approach by highlighting graphical user interfaces (Pallud & Straub, 2014), bleeding edge technologies like augmented and virtual reality (Wojciechowski et al., 2004), or standardization concerning the semantic web and knowledge management (Eide et al., 2008). Even human computer interaction in general (Garcia-Madariaga et al., 2017) and economic questions along with managerial implications (Moss and...
Walmsley, 2014) are considered, while data entry and maintenance as well as the creation and operating processes are often neglected.

Overall, the research questions are heavily focused on different selective aspects of the end user perspective, rather than to deliver a holistic view. This fragmentation is difficult to integrate since every aspect alongside the development process needs to be evaluated individually. If in addition know how and available resources to be devoted are limited and innovations regularly change the available possibilities it is even harder to start and to keep up.

This partly is because of improper lucidity and unclear usage of central terms revolving around mobile applications as well as their development process. Another factor is the heavy focus on the end-user rather than everybody involved in the delivery process. This makes it difficult to grasp the big picture. That is the reason why a more comprehensive approach is mandatory to counteract fragmentation and provide a common working basis.

This integrated view of how information can be structured in a way that it is accessible for both creators and consumers, while at the same time being machine-readable and transferable poses a question that can only be answered by an interdisciplinary approach, which makes it predestined for being addressed by the Information Systems discipline.

That is why this paper explores the possibility of introducing a conceptual framework, enabling small and medium sized museums to adapt and keep pace with innovative information technologies and to engage in forms of interactions, foremost mobile applications, despite the overwhelming complexity of the global context (Frank et al., 2014). Therefore, data visualization is put at the start of the collection process to enable museum professionals to grasp the necessity of comprehensive metadata entries by applying the more obvious needs of the end user as early as possible.

To accomplish that, this paper is structured the following way. First, the methods, which were utilized for conducting this research, are introduced and the most relevant terms are defined. The particular preconditions that are to be found in the context of the MAD are discussed and the technical outline is drawn to prepare the framework scope. Then, the framework, which is based upon these characteristics, is introduced. In the end the findings are summarized, limitations are pointed out, and the future research scope is outlined.

2 Research Foundation

This chapter is concerned with the basics of design science research as well as domain-driven design, which make up the foundation of the research conducted. Furthermore, the most relevant terms are to be introduced and distinguished.

2.1 Design Science Research

Hevner et al. (2004) describe the predominant paradigm for Design Science Research (DSR). The approach introduces three circles involved in design science research accompanied with seven guidelines for the appropriate implementation. These three proclaimed cycles represent the exchange between the three pillars: the environment, DSR, and the knowledge base.

The knowledge base contains scientific theories and methods that act as the theoretical foundation for an accurate DSR implementation. Additionally the state of the art and existing artifacts and processes within the application domain (meta-artifacts) are included to enable the grounding of DSR via the rigor cycle and to absorb the research findings (Hevner et al., 2004).

The environment contains the application domain itself, consisting of people, organizational and technical systems, that interact to work towards a common goal. Therefore, the relevance cycle initiates the research process by providing requirements as well as acceptance criteria for the result evaluation in the end (Hevner et al., 2004).
The goal of this paper – even with the holistic view in mind – still is to develop a technology-based solution for a relevant business problem (Guideline 2) in form of a viable framework model (Guideline 1) that benefits the institutions in question (Guideline 4). To do that rigorous methods are applied (Guideline 5) to explore a well-defined domain environment (Guideline 6). The findings are to be presented towards the appropriate audience (Guideline 7) to be able to discuss the outcome and evaluate the results (Guideline 3) as well as initiate future design iterations (Hevner et al., 2004).

2.2 Domain-Driven Design

To aid the DSR process, the insights of Eric Evans (2004) concerning Domain-Driven Design (DDD) are relevant, especially to avoid modeling work that in the end does not provide much real benefit. The approach tries to accommodate that by clearly defining the domain, described as the central sphere of knowledge, influence, or activity. The central approach of DDD rests on three core concepts.

The focus should be directly based within the core domain (1) while models, the problem abstractions, are to be explored in a creative collaboration process between domain and software experts (2). Within this process a ubiquitous language structured around the domain model must be maintained, based on the explicitly bounded context, the setting in which a statement appears that determines its meaning (3) (Evans, 2004).

Therefore, rigorous modelling conventions must be balanced with the ability of free exploration of models in collaboration with non-technical people, combining tactics and strategy to succeed. This can be enabled by isolating the model, eliminating the dependency on infrastructure, user interface or application logic and continuous integration of model iterations (Evans, 2004).

This conceptual reference model helps to combat issues with terminology and invokes a clear setup of defining the core terms, which simplifies the setup before entering the central design science cycles. Within the design process the philosophy of using domains specific knowledge during the implementation. This enables keeping the model ubiquitous, adaptable and independent as well as approachable by other domain experts.

2.3 Assessment of the Technical Terms

In this section, general concepts and terms are introduced to establish a ubiquitous language to be fitted into the bounded context of the Museum Application Domain and the engineering perspective as described in chapter 3. This is grave necessary to correctly frame the environmental conditions and to create common ground for understanding the preconditions. Otherwise, confusion occurs either in meaning or in usage.

Framework

To commence, it is necessary to establish some terms that are commonly confused with the conceptual idea of a framework. The clarifications are following the explanation of Shukla (2017) and cover the phrases platform, library, toolkit, and framework as summarized in table 1.

The most specific term in this regard is platform. The choice of platform, the target software for which the application software is built, may restrict the access to the application, as it happens to be with mobile operating systems.

A library usually acts as a shortcut in application development since it provides solutions to complex situations. Functions provided could be developed and self-engineered, but it is usually more convenient not to do that. Those functions provided are accessed via Application Programming Interfaces (APIs).
The term *toolkit* is not coined towards a specific situation but usually refers to any set of software tools that work well together or follow a consistent goal, commonly the term *Software Development Kit* (SDK) is used for toolkits revolving around the development for a certain platform.

Finally, the goal of a *framework* is to highlight common components and reusable patterns while not dictating the specific implementation, providing a general structure for solving similar sets of problems.

<table>
<thead>
<tr>
<th>Term</th>
<th>Explanation</th>
<th>Contextual Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platform</td>
<td>Target software for which the application software is built.</td>
<td>Mobile Operating System (iOS, Android) Web Browser (Chrome, Firefox, Safari)</td>
</tr>
<tr>
<td>Library</td>
<td>Code that provides functions, which can be called by the application code.</td>
<td>Mathematical functions (logarithm, mean) String operations (capitalize, splice)</td>
</tr>
<tr>
<td>Toolkit</td>
<td>A collection of “tools” that serve a common goal.</td>
<td>Android Development Kit</td>
</tr>
<tr>
<td>Framework</td>
<td>A generic structure or skeleton architecture that enables the implementation of specific software solutions.</td>
<td>AngularJS (JavaScript Framework for Single Page Applications)</td>
</tr>
</tbody>
</table>

*Table 1. Distinction of framework related terms.*

**User and Application**

As stated earlier, there is a heavy focus on the end-user perspective when it comes to mobile application design as highlighted by the dotted box in figure 1. However, this view is only a small snippet and for the most part is embedded within a greater structure that heavily influences the end users’ sensation. If the information flow is retraced to its origin, another user is responsible to interact with the information system. Therefore, to being able to cater to the content *consumer* needs, the people, that are responsible for producing content, the *creators*, need to be supported as well. Within the MAD, the user typically is referred to as *visitor*, while the creator is represented by a *curator* or the more generic term *museum professional*.

Similarly, an application is usually seen as a piece of software that users can interact with through a graphical user interface on a device-screen. The depth on the application view and which parts of the information system or the interaction layer are even included often times is just implied. To clarify that within the bounded context of this paper the term *application* describes the interface the consumer interacts with together with the necessary program logic that it is engaged with. The software provided for the creator is called *backend*, which also does include necessary program logic.

The actors on the operator level however are usually not interested in the information system, which consists of program logic and databases, per se, but rather how they can access and contact with it via an interaction layer. For the intents and purposes of this paper, an application is accessed by the consumer using a *mobile device*, while data entry and maintenance This form of data visualization is accomplished by the creator via a backend interface accessed via a *personal computer*.

The goal is to conceive a way that both distinct user groups can be satisfied while at the same time enabling developers to implement the information system and designers to create the interfaces necessary for the interaction layer. This is putting the focus on the actual data model to create common ground for the operating user groups and other parties involved in the design and development processes.
User Interface & E-Learning

While creative freedom offers nearly unlimited possibilities to display content on a device screen, certain constants can be identified and should be preserved. To be able to describe these, first some basic terms need to be thoroughly distinguished.

Again, that characterization strongly depends on the perspective. User Interfaces (UIs) are represented as nested components that are ordered on the screen. Regardless of platform or implementation, the basic structure for the interaction layer is described as the layout. If a certain layout is expressed either by absolute or by relative measures rather than rough arrangement the term template is used as it can act as a blueprint for a specific implementation. The way the user feels interacting with a piece of software usually is referred to as User Experience (UX) (Bruck et al., 2012; Gerald et al., 2005).

One of the central resources for insights regarding mobile UX can be derived from E-Learning literature. Especially the delivery of micro content (Bruck et al., 2012) is relevant within the bounded context of the MAD. Content of that nature should not use up more space than one screen can accommodate, comparable to flash cards in the analogue world, thus avoiding scrolling and information overload (Eppler and Mengis, 2004).

The attention span of a consumer is usually limited, even more so in an unknown impactful environment they are expected to interact with, a situation referred to as ambient learning (Gerald et al., 2005).

Therefore, the layout needs to fulfill two criteria. Since the consumer is inclined to use the application in an information heavy environment, it is important that the additionally offered information does not lead to an information overflow while still providing added value. Additionally, it should offer continuity, meaning similar information and controls should occupy comparable areas on the screen.

The implications for the underlying data structure are that, even if the layout should change at some point, the data should be structured in one defined way, such that the reference can be altered or replaced without rendering available data sets useless.

One of the most common page layouts for mobile applications is displayed in figure 2. The screen is divided into three sections. The top section (header) contains information that classifies the content like the relative position within the application or summarizing attributes concerning the content like a title. The bottom section (footer) usually is reserved for navigational elements and not concerned with the displayed content directly, while the center (body) is reserved for the content.

![Figure 1. Distinction of the term user and information flow.](image-url)
For each individual data entry, a new page should be prepared. Mapping information to a certain layout can aid non-tech people to more easily grasp data structures without diving into the details and technical implications.

This form of data visualization for the creator, by always mapping the entered information to the corresponding consumer layout, has impact upon their appreciation. As a result, data no longer just is archived into a system to maybe being accessed at a later point in time by someone, but being available immediately as an app page for consumers and creators.

The previously displayed composition demonstrates grounding within the rigor cycle of design science research and sets up a ubiquitous language as suggested by DDD. In the next section that is followed up by highlighting the requirements within the bounded context of the domain environment initializing the relevance cycle.

3 Practical Impact

This section is concerned with the museum application domain and the specific preconditions that went into the framework design from the engineering perspective.

The central challenge is to not only moderate between creators and consumers but also developers, designers, curators, and researchers that all take a part in the content creation and delivery process along the “Customer Experience Value Chain” (Baumgärtner and Lehner, 2017).

3.1 The Museum Application Domain

The responsibilities of museums are defined as “preserving, interpreting, and promoting the natural and cultural inheritance of humanity”, described in the Code of Ethics published by the International Council of Museums (ICOM).

Even though technology does play an increased role in all these regards museum professionals are not usually trained to be experts in information technology (IT) and the specific solutions within the domain. That is another reason, why they do not go out of their way to put information into a database for long-term benefits unless they can identify immediate results due to their aforementioned constraints regarding time, personal, and finances. The MAD presents similar symptoms as small and medium sized enterprises (SME), with the added constraints of being non-profit and volunteer dependent.

This complicates the development process on two levels. First, the non-profit aspect leads to the problem that financial aspects, either through their entry-level investment or through lack of long-term thinking, prevent innovations. Secondly, the technical resources and know how are limited, since they are rarely necessary for the core entourage. While basic web presences usually are available, for internal communication paper-based channels are still preferred because of the lack of infrastructure. On top of that, historically museums did not have to compete against other tourist destinations (van Aalst and Boogaarts, 2002) as they usually provide their own moat. The trend of cannibalism within cultural tourism however is amplified within the digital age as competition both increases and is more visible than ever before (Proctor, 2010) (Richards and Wilson, 2006).

Widespread solutions for public museums like information-panels or audio-guides are constrained mostly by the financial aspects. In addition to the effort of content creation, devices need to be constantly maintained and acquired in sufficient numbers. That also locks them in a certain subset of available technologies and prevents long-term innovation. However, in an environment where visitors carry their own devices, those can be utilized by the institutions in question. In a “bring-your-own-
device” strategy (BYOD) the customers’ devices play a vital part. Content may be prepared in a way that it can be accessed using personal devices of the visitor. That lifts the access restrictions by a wide margin, considering hardware (Ho and Chua, 2015).

This is the reason to discuss a way to establish a data driven structure for mobile applications for an audience that can be targeted by a BYOD approach. With that in mind, the possibilities for providing an entry point for an overall digital strategy and foster innovation is being explored. By not being restricted to a certain system but providing a modular approach to adapt to upcoming innovations transforming cultural heritage institutions, prior missteps should not be repeated and lock-ins avoided to further honour the relevance cycle of DSR.

### 3.2 Technical Perspective

For the description of objects, the JavaScript Object Notation (JSON) is most fitting. It was created to follow the ECMAScript Programming Language Standard (ECMA-262). Contrary to what the name suggests, it is universally applicable and not limited to just the JavaScript language (IETF, 2017a), since the two central building blocks are objects and arrays, appointed in a way as those are understood and implemented in most of today’s languages and systems.

The advantages towards the eXtensible Markup Language (XML) are the shorter notation for one, as JSON does not use end-tags. Between Asynchronous JavaScript and XML (AJAX) and Representational State Transfer (REST) APIs JSON is the de-facto standard in modern web based applications. Another positive attribute is that JSON is equally human and machine readable without using any sort of transformational process as it also can be persisted document based. That helps to structure information in a way so that single pages are packaged in a way that they can be read and understood as a single unit of content. JSON Schema should therefore act as the basis for any reference implementation and can aid the modelling process because of its independence and stand-alone capabilities.

Additionally, JSON Schema exists as an open internet draft maintained by the Internet Engineering Task Force (IETF), which provides a validation layer (IETF, 2017b). It serves to represent a desired data structure and is used later to illustrate the proposed framework.

As a structural example the most common domain data set, an exhibition object, was modelled. The basic characteristics of such an “E22: Man-Made Object” follow the language of the Conceptual Reference Model, an ontology provided by the ICOM, also referred to as CIDOC CRM. It provides definitions and a formal structure for “describing the implicit and explicit concepts and relationships used in cultural heritage documentation” (ICOM, 2018). This assures to comply with the specific knowledge base of the domain and honours the rigor of DSR as well as the demands of DDD regarding domain names.

Extra, framework specific properties, not found within the CRM ontology, are introduced in addition to the mandatory information needed to properly describe and display the data set to the visitor. Additional fields can bolster the value of the entry by the time of creation or can be added later.

This makes for a total of eight properties for the sample exhibit data set as displayed in the left half of figure 3. Four of which originate from the CIDOC CRM ontology and a marked with an E followed by the respective entity identifier. These metadata entries are necessary for establishing a structured way data can be saved, classified, and accessed. Beyond that, the fields “image”, “short description”, and “application text” are added to fit the bounded context of the consumer application and the visualisation purpose, as an example for the consumer-centric paradigm. Additionally a “related object” can be linked. The right half of figure 3 depicts a sample layout of how to arrange the mandatory entries within the UI of a mobile application.
4 Framework Concept

4.1 Requirement Summary

The goal of conceptualizing a framework utilizing a data model that caters to the needs of both creators and consumers while being easily understood by developers and designers independent of any target platform or technology is ambitious.

The data should be stored in a way that simple CRUD (create, read, update, delete) operations can be conducted. No platform or vendor lock-ins should restrict future development. It should act as a data store for metadata and delivery tool for the consumer application. The initial setup should be as effortless as possible and functional out of the box.

These key requirements differentiate the proposed artifact from existing solutions like content management systems (CMS). The focus on different operators within the museum application domain is unique and deserves further exploration. Restricting the possibilities for the creator can prevent information overload on the consumer end and eliminate lengthy forms for the creator. That again requires previous knowledge regarding learning strategies and UX design, which usually is not available. Furthermore, flexibility to adapt to specific needs and integrate it to existing solutions, if in place, should be provided. Third party components and development should not be prevented, but encouraged.

Equipping museum professionals (the creators) with a tool to describe museum objects, and in further iterations miscellaneous museum specific information like opening hours, news, and events in a structured and accessible way with the priority of app delivery towards museum visitors (the consumers) the underlying technical implications can be conveyed, despite their overwhelming complexity by showing the immediate use case.

The summarized goal is to design the framework in a way that it can be easily accessed, is resilient against change, modular and independent of its actual implementation and technology.

4.2 The Resulting Framework Structure

This section introduces the combined framework structure as displayed in listing 1 in the appendix at the ending of this paper. The JSON Schema representation of the museum exhibit is following the conditions described in section 3.2 and figure 3 and the combined reflections previously made.

The output of his representation as well as the schema itself do validate against the Schema Draft v6 specification of the IETF and must be seen as the stencil for every data set created.
That is achieved by disallowing properties that are not specified within the model ("additionalProperties" : false). The crucial information is marked mandatory by including the property name inside of the "required" array. Particular properties can be limited to a certain number of options ("type") by utilizing an "enum" array. Also properties can be restricted by setting discrete limits for numbers ("minimum", "maximum") or length restrictions for strings ("minLength", "maxLength"), which allows proper representation of the input value, but also prevents improper usage.

The "layout" property follows the preferred layout for mobile applications and contains arrays for each of the three sections ("header", "body", "footer") containing the information to be allocated on the screen for the corresponding data field.

In that manner the balance between an informational complete data set, a sensible consumer representation, and the creators effort during data entry can be supported. By initially limiting the overall options, similar to the application interface, the complexity of the input layout representation for the backend interface can be reduced, as visualized in figure 4. The entered information can be previewed to the creator using the layout shown in figure 3.

Thus, once created, the data model reflects the mandatory aspects to be compatible with the ontology, since it sticks to the vocabulary introduced by the ICOM. At the same time, the model can act as a blueprint for both the entry form for the backend interface as well as the layout for the application interface. Since the origin of the model is rooted within the idea of micro-content, the entries committed through the schema can be reused independently and specific UI implementations can be prepared independently as well.

This decouples the entry process from both the UI and logic components for different applications. Additionally, entries can be created without the need of studying the reference model and producing data sets ready for immediate use within applications. Once an implementation provides a template for the data input and output interfaces those can be used, shared and adapted as see fit.

The described model sufficiently describes the necessary information to enable the creation of an information entry form (figure 4), a mobile application page (figure 3) and can aid to persist the information in a standardized and accessible fashion (listing 1). Targeting the consumer’s device by following a BYOD strategy eliminates the financial burden acquiring and owning devices for the display of information, thus concentrating resources towards generating data sets. The data visualization for the creator by always mapping entered information to the corresponding consumer layout enhances the approachability of the data entries, while the standardized data format enforced by the schema enables accessibility and shareability.

Figure 4. Visual backend representation of the data input
5 Conclusion

5.1 Summary

The gap between those institutions, which can afford to keep investing into big reoccurring innovation, and those who do not even have the chance to enter that circle due to certain restrictions becomes increasingly prominent. To start out with digital mobile technologies a BYOD approach can aid to get involved.

Especially in the context of museums, it is necessary to simultaneously cater to different perspectives, to provide a coherent digital customer experience, and to implement a sustainable digital strategy.

Other than that, more benefits can be achieved by introducing mobile apps within the Museum Application Domain. The museum can establish a bidirectional relationship with their visitors. The interactive user experience can be extended to support visitors before and after their visit and decouple the physical exhibition space from the visitor’s location. Aside from that, other symbiotic upsides can be found. From the visitors’ perspective information can be provided more purposeful directed towards intention and interests. The museum on the other hand can learn from the feedback and user metrics and improve their portfolio (Pallud and Straub, 2014). Therefore, managerial implications for content evaluation and overall digital strategies can be derived.

These are the reasons, why this paper examines the Museum Application Domain by looking into the domain specific environment requirements and establishing a ubiquitous language as the basis of a holistic and interdisciplinary view. This resolves in a framework structure grounded on a solid theoretical foundation and practical implications. The suggested model satisfies creators and consumers by focusing on the central resource anchored towards the consumer interface for visualization purposes. To allocate a positive user experience for all operators the influence of E-Learning are considered for content preparation, building the data schema, as well as standards from both historico-cultural and information systems origins are considered.

The possibility to unite the upside of structured data, layout concerns, and the environmental conditions within a technical foundation is uniquely displayed by providing a sustainable and easy access utensil, utilizing the end-user perspective as a visual anchor.

In that manner, creators can visualize the purpose of data entry as they primarily are working towards application pages that are prepared for immediate and unaltered presentation towards the consumer while producing sharable, structured, and accessible data sets.

5.2 Limitations and Future Research

This paper describes the benefits of metadata visualization within the context of mobile apps for collecting and structuring data within a framework for the Museum Application Domain.

The most obvious limitation emerges from the resulting gap between the theoretical foundation and the practical applicability without providing a reference implementation. However, it is from crucial importance that the initial design iteration is properly set up by thoroughly looking at the environmental conditions and ground the resulting artifact within the knowledge bases of the involved fields to establish a solid foundation.

Consequently, the next step is to develop and provide said reference implementation to enable field testing and set up future iterations of the suggested framework as well as to test the proposed model for its viability, robustness, and overall practicality. In this regard first prototypical efforts have been conducted and foreshadow promising results from both scientific and practical perspectives.

Subsequently, it will be necessary to developing user stories that embed the framework outlined here by bolstering the capabilities enabling institutions to not only conceive data sets that are limited to cer-
tain exhibits but also allow the description of people, events, and locations for more elaborate representation of crucial data necessary within the realm of historico-cultural institutions. The domain language however should always be set as the baseline.

The focus of this paper is data describing museum objects (metadata). While in the context of mobile apps, the use of multimedia objects is appealing, problems arise during both content creation and delivery. In theory, from the technical perspective, it would not cast any issues to reference any multimedia file like the image in the chosen example within the framework using unique resource identifiers (URI).

However, in practice the complexity of producing such content may run into some of the same issues, which prevent the institutions from entering digital in the first place. While using sound recordings to enable additional features like audio guides within the consumer application, might be feasible by certain institutions, the possibility of producing quality 4K video or extensive virtual reality experiences and bringing that to the consumer’s device within the BYOD approach is questionable. Again, the goal should not be to compete with industry leaders but to develop a sense for digital content and engaging in methods and tools to not being left behind.

To conclude the insights gained while conceptualizing this mobile app framework for the Museum Application Domain should be discussed within the community and added to the knowledge base to be possibly transferred to other domains sharing a similar problem scope.
Appendix

Listing 1. JSON Schema representation of the sample exhibition object

```
{
  "title" : "sample exhibit",
  "type" : "object",
  "properties" : {
    "identifier" : {
      "type" : "number",
      "minimum" : 1000,
      "maximum" : 9999
    },
    "note" : {
      "type" : "string",
      "minLength" : 10,
      "maxLength" : 60
    },
    "type" : {
      "type" : "string",
      "enum" : ["plain object", "painting", "sculpture", "vessel"]
    },
    "title" : {
      "type" : "string",
      "minLength" : 5,
      "maxLength" : 20
    },
    "short_description" : {
      "type" : "string",
      "minLength" : 50,
      "maxLength" : 150
    },
    "application_text" : {
      "type" : "string",
      "minimum" : 151,
      "maximum" : 400
    },
    "related_object" : {
      "type" : "number",
      "description" : "<resource identifier of another object>"
    },
    "image" : {
      "type" : "string",
      "description" : "<resource identifier of an image file>"
    },
    "layout" : {
      "header" : ["title"],
      "body" : ["short_description", "image", "application_text"],
      "footer" : ["related_object"]
    }
  }
}
```

Listing 1. JSON Schema representation of the sample exhibition object
References


