DOCUMENTING AND MINING MUSEUM BIG DATA:
CHALLENGES ADDRESSED BY A NEW RESEARCH PROJECT IN QATAR

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Abstract. This paper aims to contribute towards the development of Big Data and Data Mining methods and techniques on museum datasets by exploring and case-studying available museum datasets from Qatar, as well as to contribute towards new Big Data policy documents via relevant policy research. In Qatar, as elsewhere, Big Data and Data mining processes comprise relatively new fields in museum research and inquiry, which are expected to become core disciplines as museum data input increases and digital museum data collections from museums' everyday activities and operations become increasingly larger. Modern museums all over the world maintain and expand dynamic databases and Big datasets on museum objects and operations as well as generated data extending from visitors numbers, times and stops to tweets, likes and shares. There is an emerging need to detect new and discover hidden and useful information, patterns, clusters and relationships among large sums of museum data. To address this need we require ethical considerations and processes, a thorough understanding of contexts in the real and the digital world, and cross-disciplinary Big Data methods, techniques and testing, all of which fall within this new project's (and this paper's) objectives and discussion points.

Keywords: Museum Big Data, Museums in Qatar, Culture Counts, Sentiment Analysis, Culture Pass

1 Introduction

Museum Big Data is a relatively new field of research relating to Big Data in Humanities, Arts and Memory Institutions, such as libraries and archives. Mass digitisation processes, large object-related information datasets, visitor-related data (numbers, routes, time spent in galleries and objects) and data from social media come to mind when referring to Museum Big Data in the modern world of volume, velocity and variety, the three Vs characterising Big Data (De Mauro et al. 2015). There is a forth V for Museum Big Data referring to visitors (Papaioannou 2019). It is a growing field of research and enquiry which can help towards quantitative and qualitative assessments, facilitate data-driven decision making in audience management and development, affect operational ways and services within museums, modify policies, and offer career opportunities, taking into account ethical considerations and processes, issues of privacy, data protection, abuse of power and unfair competition (Papaioannou & Sarakinos 2018). Relevant publications have started appearing (Milosch et al. 2018; Gilmore et al. 2018; Schiuma and Carlucci 2018; Papaioannou 2019) based upon Big Data projects and practices in the museum world. An ongoing Museum Big Data project in and for museums in Qatar is presented here with a focus on challenges to be addressed via actions based upon existing practices and results.

1.1 The Museum Big Data in Qatar project

This is a new project on museum Big Data and data mining on data related to museums in Qatar. It has been acronymised as MBD Qatar, it started in December 2017, and it has secured funding for two years. In the museums of Qatar, as elsewhere in the world, there is an emerging need to detect new and discover hidden and useful information, patterns, clusters and relationships among large sums of museum-related data. Addressing this need, it requires ethical considerations and processes, a thorough understanding of contexts in the real and the digital world, and cross-disciplinary Big Data methods, techniques and testing.

The aims of MBD Qatar are (i) to contribute to the development of Big Data and Data Mining methods and techniques on museum datasets, (ii) to produce a policy document on Big Data and the museums in Qatar, (iii) to initiate at University College London in Qatar a working research team on Museum / Cultural Heritage Big Data, and (iv) to explore links and collaborations to information seeking research schemes related to Social Media cultural dataset-producing processes in Qatar.

The MDB Qatar project has addressed museums in Qatar briefly presented in chapter 2 and has adopted the approaches of Culture Counts (chapter 3), Sentiment Analysis (chapter 4) and membership reward (chapter 5).

2 Museums in Qatar and the *Qatar Museums*

During the last decade, Qatar has experienced fast development and radical changes. In 2008, the Qatar National Vision 2030 (QNV 2030) program was launched to bring the country to a more diversified economy and to secure income for the next (and probably post carbon-based) economy and generations. Culture and heritage play important parts in this project in terms of education, heritage and tradition preservation, as well as a voice to be heard internationally (General Secretariat For Development Planning 2008). To support this vision, an organisation currently called *Qatar Museums* has been established and a number of new museums were planned, all of them in Qatar's capital city of Doha. Some of them are complete and running, other are nearly complete and expected to fully operate by 2022. They are all briefly presented in the next lines in chronological order.

2.1 Qatar Museums (QM)

The organisation *Qatar Museums* (QM), previously *Qatar Museums Authority* (QMA), was born in 2005 by H.E. Sheikha Al Mayassa bint Hamad bin Khalifa Al Thani as Chairperson. In compliance to the Qatar National Vision 2030 (QNV 2030), their aim is to achieve a balance between preserving traditions and heritage, as well as to support new cultural creation (Exell 2016, 28–31; Qatar Museums 2016c). They actively participate in multi-cultural dialogue and diplomacy with the *Years of Culture* program (Qatar Museums 2016d). QM is in charge of all public founded museums and of most of the archaeological sites, activities and actions.

2.2 The Museum of Islamic Art (MIA)

The MIA and its adjacent park comprise a landmark of Doha's and Qatar's urban landscape. Designed by the famous architect I. M. Pei, MIA was inaugurated in September 2008 to host Islamic art from all over the Islamic world. The architect was inspired by the ablution fountain of the Ibn Tulun mosque in Cairo and adopted simple geometrical shapes frequently encountered in Islamic art, creating an interplay of lights and shades (Jodidio et al. 2008). In the interior, Pei included a double curled staircase, huge glass window facing Doha's skyline cross the bay and elements of secular and religious architectural features of the Islamic world: fountain, atrium, dome consisting of a combination of triangles, squares, octagons and circles, Islamic metallic lamps. The museum space is distributed in four floors (ground floor and three floors). On the ground floor, the atrium gives access to a café, a gift shop, an auditorium of 200 seats, a hall for temporary exhibitions. On the first floor, visitors can see a thematic presentation of objects. The second floor, offers a journey through chronology and geography, while the third floor is used for temporary exhibitions. Adjacent to the main building, a public library and an education centre fulfil the initial aim of the Museum of Islamic Art to be a place for knowledge and its diffusion (MIA 2016). Entrance is free.

2.3 The Mathaf, Arab Museum of Modern Art

The *Mathaf* (meaning museum) opened in December 2010 with a specific task: to let the world know about Arab artists and to re-evaluate their place in art history following the impulse of H.E. Sheikh Hassan bin Mohammed bin Ali al Thani (Al-Khudhairi 2014). In 2004, he donated his art collection to Qatar Foundation, Qatar's leading organisation for education, science, research and community engagement, and that explains why Mathaf is housed in Education City, quite far from Doha's city centre. Qatar Museums have the responsibility of the collection since 2008 (ibid.). The building is a former school transformed to a large exhibition space by Jean-François Bodininto (Scott 2014). The Mathaf has two exhibition floors. On the ground floor, a large atrium with sizable masterpieces welcomes the visitors allowing access to the café, the gift shop and the library, *Maktaba*, hosting a large collection of art and art history books. Admittance is free and open to public, like the Museum of Islamic Art. The galleries of the ground floor are usually dedicated to temporary exhibitions while on the upper floor the permanent collection is display. With more than 9,000 works of art, the galleries of permanent collections are frequently renewed (Mathaf: Arab Museum of Modern Art 2016).

2.4 The Fire Station

Launched in March 2015, the Fire Station is an artist's residence and an exhibition gallery. Artists already resident in Qatar may apply for one of the twenty studios available and for a period of nine months. Four other studios are saved for international artists (D'Mello 2015). The building was formerly used by the Civil Defence as a Fire Station. It was renovated by Ibrahim Al Jeidah to serve its new purposes. The program of residency take his roots in a previous program initiated by H.E. Sheikh Hassan bin Mohammed bin Ali al Thani (D'Mello 2015). In addition to display some of the residents' works, the Fire station hosted major international exhibitions, such as the Picasso-Giacometti in 2017 and the Laundromat by Ai WeiWei in 2018 (Qatar Museums 2017, 2018). A café, an art supplier shop and a cinema complete the building, proposing cultural events and transforming the site into a social space for the art community of Doha (Fire Station 2018).

2.5 The (new) National Museum of Qatar (NMoQ)

The new National Museum of Qatar should open its doors in late 2019. It has been designed to surround the previous national museum built in 1975 by Emir Khalifa bin Hamad al Thani, the grandfather of the current Emir (Mitchell 2016, 60). Jean Nouvel, NMoQ's architect, realized the building shaped as a huge desert rose. The museum is expected to display the life in Qatar and of Qatar's people, with galleries devoted to geology and ecology of the Qatari Peninsula, traces the ancient occupation with archaeological artefacts, narratives of Qatari traditions and cultural practices, as well as the modern history of Qatar (Mitchell 2016, 63–67).

2.6 The 3-2-1 Qatar Olympic and Sports Museum

The 3-2-1 Qatar Olympic and Sports Museum is part of the Khalifa International Stadium. It will showcase "the positive value of sport" through "interactive exhibits, inspiring objects and unique activity areas", as well as the history of sports in Qatar (3-2-1 2018). Its opening is scheduled for 2019 (The Peninsula online 2018). Meanwhile, the museum curates exhibitions in other places, e.g. the *Muhammad Ali: Tribute to a legend*, held at the Museum of Islamic Art between July 2016 and February 2017 (Qatar Museums 2016b).

2.7 Other museums in Qatar

Apart from the aforementioned public museums under Qatar Museums, there are a number of private museums and collections in Qatar. The biggest one is the *Sheikh Faisal Bin Qassim Al Thani Museum* (FBQ) situated just outside Doha in a grand fort at Al Samriya Farm, displaying hundreds of thousands of objects on both the history of Qatar and the World (FBQ 2018). It is the personal collection of Sheikh Faisal Bin Qassim Al Thani himself, with four main themes: Islamic Art, Qatar Heritage, Vehicles, and Coins & Currency. The Museum serves exhibition, touristic, educational, research and scholarly purposes. Objects from the SFM museum are also displayed in other places in Doha, including malls.

Other private museums include the *Qatar Art Center* (art museum and artists residence, Qatar Art Center 2018), the *Msheireb Museums* (four museums hosting exhibitions on Qatar after the discovery of oil, Msheireb Museums 2018), the *Gallery Alriwaq* with a number of temporary exhibitions (Gallery Alriwaq 2018) and others.

3 Culture Counts

The Museum Big Data project aims to use Culture Counts in museums and in domains of cultural production in Qatar. A review follows.

3.1 The concept and the project

Culture Counts is a cloud-based system aimed to assess through standardised metrics the impact of cultural productions in various domains, such as theatre, dance, opera, cinema and museums. It has been developed in 2010 in Australia by Michael Chappell and John Knell from Pracsys and Intelligence Limited (now Counting What Counts Ltd.), in partnership with the Department of Culture and Arts in Western Australia (Knell and Whitaker 2016, 14). In 2012, a new trial was launched in Manchester. It involved Pracsys, the Arts Council

England (ACE), thirteen (13) cultural organisations, and the University of Manchester. Together, they defined some metrics to be rated by self, peer and public assessors and some metrics rated by self and peer assessors only[1] (Arvanitis et al. 2016; Gilmore, Glow, and Johanson 2017, 283–84; Gilmore, Arvanitis, and Albert 2018, 32). After the Manchester trial, ACE decided to explore Culture Counts on a national scale. One hundred and fifty (150) institutions took part of this trial, with nearly four hundred events (Knell and Whitaker 2016, 18–20).

3.2 The metrics

The survey is undertaken during or at the end of a cultural event through an app to be downloaded on smart devices. First, participants state their gender, age and postcode (Bunting and Knell 2014, 8). Then they evaluate the production with the following metrics: *Concept* (it was an interesting idea/programme), *Presentation* (it was well produced and presented), *Distinctiveness* (it was different from things I've experienced before) *Captivation* (it was absorbing and held my attention), *Challenge* (it was thought-provoking), *Enthusiasm* (I would come to something like this again*), Local impact* (it is important that it's happening here), *Relevance* (it had something to say about the world in which we live) and *Rigour* (it was well thought through and put together) (Knell and Whitaker 2016, 17). Three more are added for the peers and self-assessors: *Risk* (the artists/curators really challenged themselves with this work), *Originality* (it was ground-breaking), *Excellence* (it is one of the best examples of its type that I have seen) (*ibid.*). The metrics are rated by a sliding scale from strongly disagree to strongly agree. At the end of the survey, the online platform shows to the participant how are their answers compared to the mean (Bunting and Knell 2014, 8). Finally, participants have to describe their experience in three words. Some metadata are also provided by the organisations, such as the art category or the location of the venue (Knell and Whitaker 2016, 21).

3.3 The results

Positive feedback

The possibility to triangulate the survey between self, peers and public assessment was very valuable for the participating organisations when the peers were experts of the same domain (Nordicity 2016, 32). The short length of the survey and the relevant platform were easy to employ (Nordicity 2016, 34–35). Presenting the results and the dashboard were useful and user friendly (Nordicity 2016, 36).The few examples given by John Knell and Alison Whitaker from Counting What Counts Ltd. of the possibilities of data mining are promising, but they need a big amount of data (Big Data) to be collected on field (Knell and Whitaker 2016).

Other feedback

The costs in human resources is evaluated as too high starting with the efforts to recruit peers and to implement the survey (Nordicity 2016, 27-31, 40). The reliability of the data was a major concern as potential bias has been identified by stakeholders. The low number of peers and self assessors, as well as the recruitment of the public as forming non representative samples, were discussed (Nordicity 2016, 22). Consulters have identified problems of accessibility to different publics. Non-native English speaker might have some trouble to fully understand the metrics. The nature of the app and the sliding gesture might be inadequate to elderly or disabled populations. Textual metrics are unattractive to young audiences (Nordicity 2016, 18; 35–36; Knell and Whitaker 2016, 97–98).The lack of context and qualitative value to give sense to the data was found frustrating (Nordicity 2016, 24). There are also concerns relating to the ownership of the data, access to them, and the data protection issues (Nordicity 2016, 55). In Scotland, Liz Hill has concluded that quality metrics tell more about the audience than about the quality of the cultural productions (Hill 2017).

3.4 Exploring an Culture Count application in Qatar

The possibility to use the same metric system for all cultural productions in Qatar is promising, since for the very first time we could map audience reactions to a large and diversified cultural landscape, taking into account users' aforementioned feedback from previous attempts (Australia, Manchester, elsewhere), as well as new feedback from a pilot phase. The language access question is particularly relevant in a multi-cultural country as Qatar. Again, this will be addressed by a pilot phase.

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[1] The number of metrics changed slightly between the experiment in Australia, in Manchester and on a national scale in England. To avoid confusion here, we adopt the latter. To compare them, see Department of Culture and the Arts and Knell (2014, 12) for the Australian trial and Bunting and Knell (2014, 9) for the Manchester trial.

4 Sentiment Analysis

Sentiment analysis or opinion mining is a way to investigate opinions and emotions express in textual data. It started to be employed in 2000 and, since then, it has been developed in many disciplines from finance and trading to social sciences (Liu 2012, 2015; Pozzi et al. 2016). The plurality of disciplines comes along with a variety of aims, including creating sentiment profiles, predictive analysis, studying topics of discussion, opinions about certain topics, uncovering fake opinions, etc. (Liu 2015).

In some museums, sentiment analysis has recently been introduced to provide insights and answers to key questions relating to how museums engage with their audience. Sentiment analysis and the exploration of social media entries (e.g. tweets) have been used by institutions to evaluate their impact on the audience. Some examples follow.

4.1 Examples from museum sentiment analysis projects

Derby Museums

The Derby Museums have launched an evaluation on how the public are inspired by Derby Museums events in 2014 (Gerrard, Sykora, and Jackson 2017). The first difficulty was for them to define "inspiration" with the help of the curators. They used different ontologies, including Ekman's emotional dimensions (Anger, Disgust, Fear, etc.) They also used models, notably Russell's emotional circumplex (Russell 1980; Gerrard, Sykora, and Jackson 2017). They employed FrameNet as the lexical knowledge base for psychological approaches and specialised vocabulary. They applied this approach to two specific events monitored on Twitter. Results were not conclusive. The main difficulty related to the evanesce of the concept of "inspiration" in the short tweet messages. Also, tweets relate to an intention at an instant and not necessarily to real engagement and action, which "inspiration" calls. Moreover, long term monitoring required means that were not available at the time (Gerrard, Sykora, and Jackson 2017).

The Tank, Tate Modern

In 2012, the Tate Modern attempted to study positive and negative Twitter comments during the festival 'Art in Action' in 2012 (July to October). It was also the launching of a new gallery dedicated to live art: 'The Tanks' (Villaespesa 2013). One of the installation was a "Comments Wall", where visitors were invited to answer "What do you think?" with the hashtag #thetanks. Their comments were projected on the Comments Wall on live stream. They used *SentiStrenghth* and *Linguistic Inquiry and World Count* (LIWC) for their analysis. The 140 characters' limitation in Twitter has been reported as frustrating for researchers. A result has been the identification of the architecture as one of the main topic – the Tanks are an industrial site reconverted – that have divided visitors' opinions between like/positive ("amazing") and dislike/negative ("creepy").

ArsEmotica

Another attempt was made in Italy by the initiators of ArsEmotica (Baldoni et al. 2013; Patti, Bertola, and Lieto 2015; Bertola and Patti 2016). They created an application that enabled visitors of an online collection to query objects by emotion. To do so, they used sentimental analysis to explore tags and emotions expressed by visitors. Their ontology was based on Plutchnik's circumplex model (Bertola and Patti 2016) and they employed MultiWordnet, Wordnet 3.0, SentiWordnet and WordnetAffect. They have tested ArsEmotica with the data coming from ArsMeteo, a community of artists displaying their arts. Results are reported as good. The team are currently trying to add other languages to Italian (Bertola and Patti 2016).

4.2 Exploring Sentiment Analysis in museums in Qatar

As part of our Museum Big Data Project, we aim to create a digital path for museums to process unbiased feedback in digital format from museum real and/or online visitors, and to analyse it with regards to visitors-generated multi-lingual data, comments and sentiments, along with a dynamic data dashboard representing market benchmarks from direct and indirect competition. As a partner to this study / project, TycheTech Ltd, after processing provided datasets (public and/or custom), has undertaken the design and development to deliver a dynamic data dashboard upon the guidance of the author. The result has been the *SENSIOM*, a dynamic multi-functional data dashboard on Museum Big Data to serve research needs (i.e. Negative/Neutral/Positive sentiment analysis, analysis on visitors' views on different museum-related topics, such as price of tickets, queue, other assets and issues), benchmarked against other museums and/or cultural institutions and hotspots, etc.

We have employed word embeddings which we train on huge amounts of reviews, since data are closely related to our main application domain: relational sentiment and topic analysis of visitors' reviews for specific museums. We clean up the text from these reviews through NLTK (a Python NLP Framework for processing text) and various custom word processing techniques. Finally, we build up a corpus of data for processing via Neural Networks (NN). The Keras Framework along with Tensorflow as backend has been our main NN tools. Specifically for sentiment analysis, we build custom Train/Test/Validation datasets, handcrafted with sentiment values for each review. We then score them with the 10 Fold Cross Validation technique. We use a Deep Neural Network with three convolutional layers and one final layer for scoring the sentiment. ReLU Activations were used for the convolutional layers and a Linear Activation for the final regression layer. For the Topic Analysis work we have also used Neural Network frameworks, and built a custom Train/Validation/Test dataset with handcrafted topic analysis reference for each selected topic. We used four Convolutional Layers with ReLU Activations and Batch Normalization. The final layer was a Dense with Softmax Activation for scoring each topic.

5 The membership reward approach

The membership reward approach relates to a museum rewarding programme affiliation. The Dallas Museum of Art example of the DMA Friends project is presented below.

5.1 Reward program affiliation: the case of Dallas Museum of Art Friends Project (DMA Friends)

The project

Inspired by commercial affiliate programmes, The Dallas Museum of Art launched the DMA Friends project in January 2013. Before 2013, the museum conducted extensive research on their audience (Bonnie. Pitman 2010). The recruitment in 2012 of Robert Stein, who has a background in computer science and museums, and of Bruce Wyman, familiar with digital technologies and museums, has been is an important step for the project. The main aim was to increase public engagement, as their main audience has been local. They wanted to have repeated visits by their audience and see visitors participating in diverse activities in the museum (e.g. visiting the permanent collection, visiting all temporary exhibitions, participating in educational activities, attending lectures etc.). To achieve these goals, they opted for engagement at an individual level and creating long-term bonds. They also wanted to influence the choices of their audience (Stein and Wyman 2014, video recording). The DMA Friends project came along with a new policy including free entrance to the museum after eleven years of charging entrance fees. To balance it, DMA Partners scheme was launched also in 2013, which was a call for philanthropic participation at different scale (individual, corporation or foundation) (artdaily 2015).

DMA Friends is based on *BadgeOS*. The user subscribes to the membership program with their smartphone or with an iPad provided by the Museum. After sign-in, users receive a membership card with a barcode. Activities are proposed offering rewarding badges when achieved. At some point, the cumulated badges can be redeemed for rewards, such as free parking. Activities include visiting a gallery, bringing a friend to the museum and/or identifying favourite artworks. As the bond between the Museum and the member grows, the Museum can collect personal data (Stein and Wyman 2013, 2014). In autumn 2013, the DMA Friends Project received a 450,000 US dollar grant from the Institute of Museum and Library Services (IMLS) (artdaily 2015). According to the DMA website, the project ended in December 31, 2017 (Dallas Museum of Art 2018).

The results

During two years, the DMA registered about 100,000 members. Among those, 97.1 % were new members (artdaily 2015). They increased the overall number of visitors by 23%, the number of first-time visitors by 35%, and the number of minority audience by 29% (*ibid*.). The tens of thousands of members of the first years generated millions more records (Stein and Wyman 2014). With these data, the Museum mapped the geographical distribution of members by neighbourhood. Data proved useful in decision making: more staff were appointed to deal with and amend activities that were not attractive enough. They also had an impact on visitors' behaviour (Stein and Wyman 2014).

5.2 Exploring Culture Pass in Qatar

Qatar Museums have already launched a membership program called *Culture Pass*. Admission to museums is free and the Culture Pass provides other advantages: a 10 % discount on the gift shops and cafés, access to guided tours of public art installations (Qatar Museums 2016a). Museums in Qatar still struggle to attract certain audiences of Qatar's diversified population and a reward programme could be a solution in terms of attracting, mapping and addressing diverse audiences. This kind of programme would require front-end evaluation addressing needs and parameters, the employment of a technical team to further build the interface, a pilot phase of formative evaluation and a system to manage collected data, as well as considerable financial and human resource investments.

6 Concluding Remarks

As Museum Big Data relate to the four Vs of volume, velocity, variety and visitors, projects presented here share both common and diverse characteristics. Culture Counts refer to common-ground evaluation of cultural actions including museum exhibitions, activities and experience. Sentiment Analysis addresses visitor's emotions and perspectives attempting to provide an overall agreed point in terms of whether a museum has offered a positive experience or not. Membership reward schemes address visitor's services and their promotion, examining and exploring popularity and attempting constructive evaluation. Big Data feedback from visitors' actions, choices and comments is collected. To these ends, museums have devoted time, human resources and funds, and have established dedicated teams of experts and researchers. More publications on these and other projects will help.

In Qatar, the Museum Big Data in Qatar (MBD Qatar) project has initiated research towards the aforementioned three directions. In this early stage, diversity is expected due to the project's exploratory character and its objective to help towards a Museum Big Data Policy for the framework in which museums in Qatar operate. It is expected that 2019 will be the year of the first results and a website on the MBD Qatar project will be available online soon. Towards these ends, any involvement and feedback is most welcome, and please do not hesitate to contact us.

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