

Fig. 1. The storage of the physical collection (150,000 art objects) of the Gemeente Museum in The Hague (February 2018). Source: <https://www.gemeentemuseum.nl/>



# On the Economics of Physical and Digital Collections in Museums

## Introduction

Museums have been studied by economists in terms of their contribution to the economy, by the creation of jobs or attraction of tourists, and in terms of their structure and behaviour as firms. In this chapter, we will draw an organizational framework to discuss the market conditions where museums perform, determined by costs and use of technology, which define market concentration and product differentiation as well as ability to innovate. We close with a discussion on organizational performance as it may be applied to museums managing physical and digital collections.

## The museum as a firm

Firms can establish the most efficient use of scarce resources by measuring inputs and outputs and by establishing the most optimal allocation. For museums, inputs include labour (of which 20% are specialized staff), and capital stock, including the collection, the building, and hardware stock (e.g. information systems, equipment for preservation and restoration, and security systems) (Hutter, 1998; Johnson and Thomas, 1998). One curious thing about museums is the presence of multiple outputs, which include a combination of visitor services (e.g. exhibitions, education programs, the shop) and collection services (e.g. collecting, preserving, documenting, researching).

Museums are characteristic in that they operate with high fixed costs, as the collection needs to be created, researched, and exhibited before any consumer can enjoy it. At the same time, an additional visitor would require marginal added investment, unless visitors increase to such degree that new staff and installations are required (Frey, 2006). This cost structure is magnified with the digital collections, as the costs related to the physical collection must be met before a start can be made at the acquisition, research, and online dissemination of digital collections. On the other hand, a digital copy and online re-publication represents practically zero marginal costs while exponentially increasing viewer reach.

As example of the inputs and outputs we can study the Rijksmuseum in Amsterdam, with a yearly budget of €80 million. Income sources include public sales (tickets, shop)

amounting to 37%, annual subsidy (38%) and project grants (14%), sponsors (7%), and indirect income sources (4%). Expenses posts include labour (36%), rent of space (21%), and the various departmental activities (27%), made up of exhibitions (4,7%), educational activities (3,1%), IT (2,6%), marketing (1,8%), publications (1,8%), conservation (0,5%), curatorial research (0,5%), research information services (0,4%), storage (0,1%), and security (0,1%) (Rijksmuseum annual report 2016).



Fig. 2. The online collection of the Naturalis Biodiversity Center (42 million animals, plants, stones, and fossils; February 2018); <https://science.naturalis.nl/en/collection/naturalis-collections/entomology/>

The museum reported organizing a total of 33 exhibition openings (28 in house), showing nearly 1% of the collection<sup>1</sup>. In addition, the museum is involved in a collaborative capital investment project of nearly €63 million to create a national collection storage. A scientific centre is being developed to stimulate innovative research involving art history, conservation, and natural sciences (Rijksmuseum annual report 2016). It is clear that exhibitions are not the only (or most important) output of museums, so we could not argue that an exhibition at the Rijksmuseum costs €2.4 million (total budget divided by total exhibitions). However, annual budget by size of collection (€34 million per object and print in the museum and library) can be used as classification of institutional size.



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European-wide exercises to define the costs related to the digital collection ran into the lack of an accounting system to isolate the digital activities of an individual at work. Unless there is an allocated fund, as digitization projects or acquisition of digital equipment, little standardized data is available. From a 2015 survey of 355 European museums, results suggested museums spend yearly €75,000 towards digital activities, of which 51% came from incidental project funds (mostly from the institution's own budget) (Nauta and van den Heuvel, 2015). It is not clear how much digital publication took place in the given year, but museums reported having 31% of their collections digitized (digital catalogue entry with image) and making 13% available online. Data is not available to estimate the annual budget for digital activities by size of the digital collections.

Digital activities are seeping into all other activities across the institution, from marketing, to education, publications, conservation files, and curatorial research. More than an activity in itself, it is a technology that supports all other activities. It would be misrepresenting to state that the cost of digitization only leads to a digital *exhibition*. As in the case of the physical collections, the costs related to the acquisition, care, research, and disseminations of digital collections has multiple uses, one of which is exhibitions. According to the International Council of Museums, museums are defined in terms of their collections, which are acquired, conserved, researched, communicated, and exhibited, for the purpose of education, study, and enjoyment (ICOM, 2007).

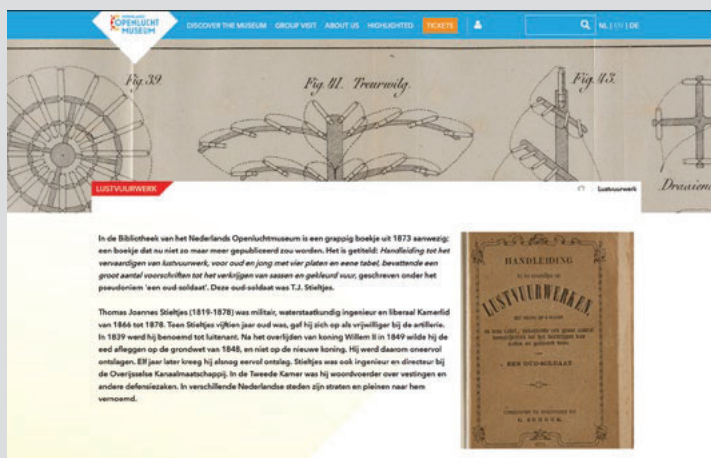


Fig. 3. Museum collections often include books and other documentation materials. Here a 'Manual for fun fireworks' from the Open Air Museum (February 2018); <https://www.openluchtmuseum.nl/boek-lustvuurwerk>

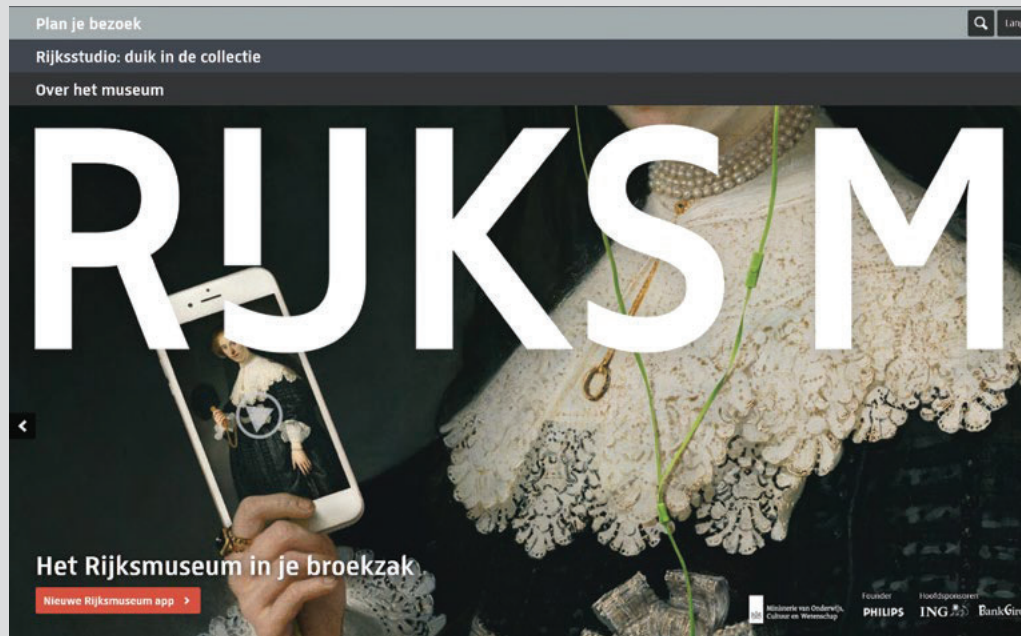


Fig. 4. The Rijksmuseum Amsterdam website (February 2018); <http://www.rijksmuseum.nl>

Fig. 5. Stedelijk Museum website (February 2018); <https://www.stedelijk.nl/en>





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The choice of how to use resources most efficiently in a museum depends on the definition of the key objectives and strategic goals. If the museum is meant to increase visitor numbers, a free entrance may maximize access but may also decrease the available resources to conduct other activities. In 2016, Dutch museums reported earning 45% of their income from ticket sales (SM, 2017). Management of museum collections involves a balance to provide access to collections, as a form of exploitation of existent value, to ensure preservation, as minimization of value loss, and to develop the collection, as investment to increase value and assets (Brokerhof, 2006).

Economists have argued that museums make an inefficient use of their collections, because less than 10% are ever on display (Frey, 2006). All past expenditure related to acquisition, preservation, research, and documentation are a loss when an object is continuously stored, in addition to preventing allocation of resources towards other activities. Collection mobility has been identified as alternative solution to greater efficiency in consumption, where number of exhibits and number of visitors represents the main museum output. In 2016, art museums in the Netherlands reported exhibiting 23% of their collections, either in their own museum or in other museums (19% of objects are exhibited in-house)<sup>2</sup>, and reported organizing 2,323 temporary exhibits<sup>3</sup>. Arguments for the low collection mobility are linked to cost of travel and insurance, to the great risk of damage and loss, as well as to the lack of an overview of the total reserves available in museum vaults.

A second alternative has been identified in the online dissemination of collections, which can potentially reach all Internet users, at all times, all over the world. Digital dissemination further solves the challenges posed by the physical mobility of collections named above. From the last European 2017 survey on size of the digital collections where 363 museums participated, 77% (or 279 museums) reported having digital collections of which 8.7% are *exhibited* online (Nauta, et al., 2017)<sup>4</sup>. Arguments for the low dissemination of collections online are linked to the costs of proper digital publication, to legal restrictions, and to an unnecessary competition with the physical counterpart.

An important challenge in estimating museum costs (and effectivity of output) is the lack of a clear accounting of museum collections. The Netherlands embarked in a 15-year inventory project of all collections in museums which led to a rough estimate of a

national collection of 45.2 million objects (Veeger, 2008). This estimate largely excludes the natural collections, which amount to over 42 million objects<sup>5</sup>. An important note to make is that accountability of collections has focused on the so-called *museum* collections, even though museums also care for libraries and archival collections, and have extensive information management systems filled with various types of data (e.g. conservation reports). In the case of the Rijksmuseum, the collection can be divided into a *museum* collection ( $\pm 1.2$  million objects), a *print* collection ( $\pm 700,000$  objects), a *library* collection ( $\pm 450,000$  volumes), and an *archive* collection ( $\pm 1$  kilometre of vertical files)<sup>6</sup>.

Comparing physical collections to digital collections poses methodological challenges, as the digital collection is comprised of a digital catalogue, and a digital reproduction, which are both accompanied by various metadata. In the 2017 European survey, museums reported having 58% of their collections in a digital catalogue, of which 33% is available online (or 19% of all metadata), and having 31% of collections linked to a digital reproduction, of which 28% is available online (or 8.7% of the entire collection) (Nauta, et al., 2017). In addition, some objects have no physical counterpart (e.g. audio-visual media).

It could be argued that the digital collection is in fact one additional type of physical collections in museums, as it requires physical storage (e.g. servers, terabytes), physical exhibition spaces (e.g. computer terminals in the museum), and physical management (e.g. software, manual input of contextual information). We consider museums to manage physical collections of four types: *museum*, *library*, *archive*, and *digital*<sup>7</sup>. This is not surprising, as each object type would illustrate one different aspect of the content at hand. An example is a painting of an instrument being played, a musical instrument, a sound recording, sheet music, and a book about history of music, all different object types with specific qualities to provide a complementary view of music. Judgmental comparison very much depends on the need of the user, so that an art lover may prefer the painting while a musician may prefer the sheet music. The main difference between the different types of collections is found in the *technology* used to transmit the content.

This lead us to the topic of technology, of great interest to economists. Technology can lower costs of production and increase reach to consumers, can determine the ability to change and innovate, and greatly influences the position of the firm in its environ-



ment. Investment in technology, in fact, enables an organization to develop. Technology used for physical collections includes information systems to document acquisition and movement of objects, climate control in storage, photography and tracking devices for object control, as well as cases and exhibition lighting, to name a few. Technology used for digital collections has great similarity in purpose, where software and hardware are involved in the acquisition, management, preservation, and dissemination.

Technology can do something else: besides giving access to formerly inaccessible resources, technology expands the definition of what a resource is (Chang, 2014). This is clearest in the use of collections after digitization, which has been named the ‘new Renaissance’ (EC, 2011) because objects are rediscovered and repositioned, generating new value. Little research has been done on the impact of digital collection availability in the loan requests for physical objects in museums, but it is expected that greater online visibility would lead to greater digital and physical reuse.

Museums that invest in the development of new exhibition technology will attract more visitors—one example being temporary exhibitions, where visitors tend to spend more, which attract new visitor groups, and that represent a news item featured on television, radio, and print media (Frey, 2006). Projects to gain popularity also include the construction of new buildings by renowned architects. A classic example is the Guggenheim building in Bilbao designed by Frank Gehry, setting a trend in museum capital investment. A new trend can be found in the construction of open storage facilities. On the digital front, new websites represent greater visibility, which can serve to increase findability of the institution as part of the marketing activities (along with social media), or can serve to facilitate access to and discovery of the collections. This last point is of interest.

Imagine you buy a new house and there is no water coming from the tap because the water line stops a kilometre away, or even worse, there is no tap even though water pipes run throughout the house. Most people just want to drink a glass of water and care little about the infrastructure (the water pipe and the tap). The same happens in the museum. Users of museums just want to enjoy the exhibit or access the collection remotely. A website with little content is like a tap with no water. This takes us to the second part of this article: the place of the museum in the market.



## Museums in the market

From the first section, we can deduce that characteristics of the firm such as costs and technology influence market structure, defined by the firm's share of the market and product differentiation. In which market do museums operate? And what are the products being offered? This takes us back to the initial discussion on the purpose of the museum, which following ICOM's definition centres around supporting the development of society, involves education, study, and enjoyment, and relies on the acquisition, conservation, research, communication, and exhibition of collections.

In the Netherlands, 694 museums spent €1 billion and received 34.4 million visits in 2016<sup>8</sup>. One way to establish the place of a firm in the market is to measure the percentage of market share accounted for by the four (or eight) largest firms, which can range from a monopoly to a perfect competition (firms are generally somewhere in between). Translating this to museums, we find a low market concentration based on revenue (CR4=15.5% and CR8=23.7%), and a similar low concentration based on visitor numbers (CR4=18.4% and CR8=25.2)<sup>9</sup>. That means that museums compete to attract visitors to see their exhibits by developing the museum brand, by innovating in exhibition design, and by prominently displaying the uniqueness of their top collections.

Even if objects are, for the most part, relics from the past, museums can innovate in the newness of a good acquired (e.g. new art period, digital collection), or a service provided (e.g. exhibition topic, guided tour style). This is known as cultural innovation (Castaner, 2014). Regarding the digital collection, innovation can be found in the content being made digital, such as a repository of museum, archive, and library collections positioned side by side, as well as in the form in which the content is being made available, as is the case of the publication of machine readable data in a public hub containing all basic collection information. In fact, the market expects museums to constantly innovate (Castaner, 2014).

Establishing the market share of museums as part of the entertainment industry reflects the modest role of museums in the enjoyment of society, again taking the example of the Netherlands, with a market of €4.5 billion including performing arts and audio-visual firms (excluding sports, gambling, and all the rest)<sup>10</sup>.



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Considering the market of education and study, or research, places museum work in another context. The expenditure of education amounted in 2016 to €42.9 billion in the Netherlands<sup>11</sup>. There is no annual report on the expenditure linked specifically to education and research activities in Dutch museums, even though their annual reports increasingly mention collaboration projects with university institutions. The market share of museums reduces substantially when placing museum's output as part of the information market, in which international firms control a large share of online traffic (e.g. Google, Facebook, Wikipedia). Because the total size of collections is not reported by the ENUMERATE report, availability of digital collections in percentages represent the state in development of the institution. Unfortunately, every year there is a different pool of respondents and the anonymized averages prevent us from understanding actual development.

Fig. 6. The iconic building of the EYE Film Museum (February 2018), <https://www.eyefilm.nl/en>. Photo: [https://commons.wikimedia.org/wiki/File:EYE\\_Filmmuseum.jpg](https://commons.wikimedia.org/wiki/File:EYE_Filmmuseum.jpg)



Product differentiation is thus key for museums to attract visitors, either for enjoyment or study. Except for the large international collaborative exhibits, temporary exhibits are unique to the one location. This is because of the uniqueness of museum collections which, enhanced and complemented by selected loans, provide an entirely new product each time. Museum collections are referred to in economic terms as a non-renewable

good with fixed supply, making preservation and restoration activities essential. Even though collections continue to grow, each object is irreplaceable if lost or destroyed. Objects are hence an irreplaceable asset of the museum.



Fig. 7. On the Van Gogh Museum webshop it is possible to custom print a painting on canvas (180x140cm cost €760 with frame shown) (February 2018); <https://www.vangoghmuseumshop.com/en/>

Digital collections are by nature *copies*, at least of themselves, yet they also are irreplaceable if lost. Digital preservation measures are hence of essence to ensure future access to the digital repositories. Digital collections, particularly born digital objects, rely on sound policies to back up, migrate, and update. Museums have realised, together with other memory institutions, that a joint strategy is of essence to ensure long-term access to digital collections. In the Netherlands, a national effort is underway to coordinate the pooling of resources for the creation of joint digital repositories, the broad adoption of best



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practices (e.g. standards, URIs), and the collaboration and distribution of responsibilities for a sustainable digital heritage network<sup>42</sup>.



Fig. 8. The Twitter account of NEMO reviews the successes of the year, including a program in July where 400 children take part in a programming workshop, <https://twitter.com/NEMOamsterdam>

As mentioned before, collections management involves ensuring present development without compromising the future ability to also make use of the collections. The care of collections resembles the care of the environment, also a physical capital with irreplaceable goods (Throsby, 2001). Physical collections have been transferred across generations enlarging the nation's cultural fixed capital, but have also contributed to increase the knowledge and skills of those engaging in education, study, and enjoyment. Those objects that were accessed in the past can also be accessed in the present, particularly by disadvantaged groups, as well as in the future, fostering equity of access across times. Museums further support the maintenance of a diverse collection, including the preservation of the entire *ecosystem* of knowledge creation, visible in the collection information systems. As with extinction of species, museum objects are irreplaceable. This applies to all forms of physical collections, including the digital.

If such a line of thought is followed, the number of visits and views in a given year are a partial, short-term efficiency measure for the use of museum collections, physical and digital. A long-term analysis of the usability of collections would be required to capture the efficiency of use across generations. It is to be expected that certain objects

gain or lose popularity depending on the social preference of the time, as social values and morals favour one theme, style, or type of work (Beckert and Aspers, 2011). A study on the usability of collections during a 100-year period showed preference for 2% of the collection, while 90% of the objects were not exhibited at all in the last century (Borowiecki and Navarrete, 2016).



Fig. 9. The Anne Frank Museum has developed a discussion program in collaboration with the National Centre of Expertise for Social Diversity (February 2018); <http://www.annefrank.org/en/Education/For-Police/Society-thats-for-you/>

The sustainability of accessing a diverse collection, enabled by years of collecting, preserving, and researching, is one key output of the museum often overlooked by economists. Museums in fact feed new capital formation, such as the design of physical new works inspired by the collection (e.g. Rijkstudio awards), or intangible applications of old ideas in new innovations. The museum hence has a market role of providing access to rich information capital, that can be used by anybody, and that generates new knowledge to further stimulate innovation and development. Measuring the dissemination of ideas originating from encountering the museum collection is of course a colossal task, involving the development and collection of new data metrics.

One approach to understand the mechanism for the production of new knowledge involves the study of the groups that form around the use and application of content (Potts and Hartley, 2015). In the case of museum collections, analysis of the use of digital images of paintings from museum collections within the Wikipedia user group has provided a





first overview of the potential for knowledge dissemination through the reuse of digital collections (Navarrete and Borowiecki, 2016; Navarrete, 2018).

The investment strategy of a museum can hence contribute to the production, preservation, and dissemination of society's information infrastructure. In other words, investing in the collection, preservation, research, and accessibility of objects, either physical or digitally, contributes to the enrichment of the available capital of information.

### Museum performance

Besides the key indicators of a company's performance, economists consider four dimensions in the performance of a firm from a social perspective (Hoskins, et al., 2004). We will discuss each dimension as it applies to the work of museums, with focus on the physical and digital collections. First, there is allocative efficiency, which has to do with the allocation of resources towards the goods and services needed by consumers. One example of such allocation of resources can be found in digitization on demand projects, which prioritize the digitization of objects based on consumer preference. Generally, museums work with a long-term plan and can develop strategies that complement the short-term consumer preference. Balancing the short-term consumer interest with the long-term construction of a stock is of essence to ensure diversity of available content, in the present and in the future.

Second, productive efficiency refers to a firm producing at minimum total costs, given the state of technology. This is linked to the available technology in house (or available resources for outsourcing). There is great disparity in adopted technology in museums, as well as available know-how, resources, and size of the task (Nauta, et al., 2017). Even though museums compete for visitors, joint efforts prove beneficial for the adoption of new technologies. Further, efficiency does not necessarily mean producing more for less. Museums may choose to focus on quality documentation of a small portion of the collection even if it represents greater resources, or use specialized technology (e.g. megapixel imagery, 3D rendition), or publish digital collections following the sector agreed standards (e.g. for stability and sustainability). Depending on the goal, museums may produce less for more.

Third, technological progress can refer to increase in output with the same resources, or to the introduction of new products or services (new in content or form). As discussed above, innovation is an inherent part of museum work. Even though few institutions can afford to introduce innovation in the sector, most museums will be able to still adopt proven successful work forms adapted for their specific context. Linking collections to international structures and making them available to individuals and machines has proven a task for museums during the past decade.



Fig. 10. Rijksmuseum Schiphol – Dutch masterpieces at Amsterdam Airport Schiphol. Source: <https://youtu.be/t05DOeFix4E>

Fourth, equity of distribution of resources which, in the case of the museum, refers to providing access to wider audiences, but also supporting broad representation of the collections. Efforts to increase collection mobility realise that context can determine the value realisation of museum objects. Allowing objects to be positioned outside of the museum walls, either through a system of loans or by positioning digital collections on public repositories, can increase equity of findability and usability of collections. Regarding equity of audiences (and online users), the museum goal can guide allocation of resources. If indeed the institution is meant to serve society, to support enjoyment and study, then resources should clearly be directed towards all relevant activities.



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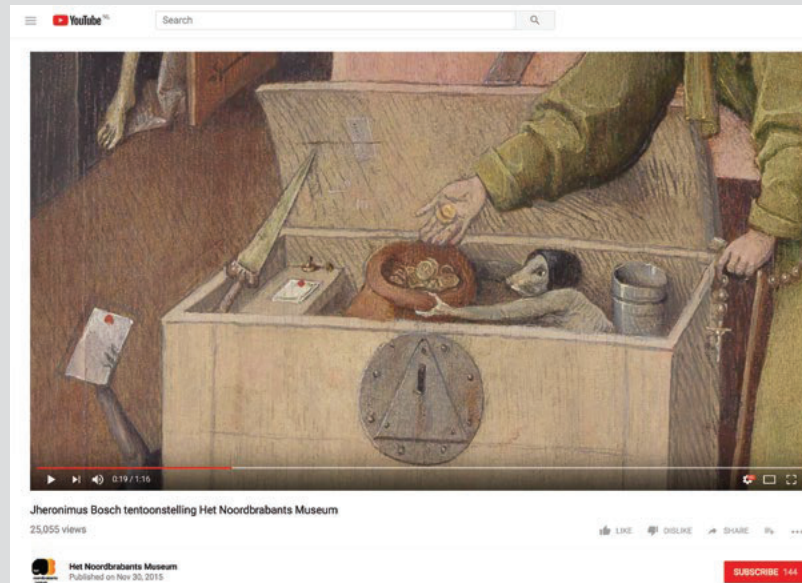


Fig. 11. The Noordbrabants Museum received a record 422 thousand visitors during their Blockbuster exhibit 'Hieronymus Bosch - Visions of Genius' in 2016. The exhibit was the culmination of a 10 year project funded by the Bosch Research and Conservation Project, involving works held in twenty-five different collections across ten countries and using the most advanced techniques by a group of specialists, with a budget (<https://www.nytimes.com/2015/11/11/arts/international/bosch-revolutionary-and-master.html>). The YouTube promotional video also received a record 25 thousand views. <https://www.youtube.com/watch?v=UU23oFS29o0>

In the four points sketched to establish the performance of the museum, the role of the organizational mission stands out, where the strategy and set goals guide activities in one direction or another and therefore determine performance. Key to all exercises is the collection of long-term data to inform allocation of resources. Understanding the use of the collections can shed light into the role of the museum in society, which may vary from institution to institution (depending on size, location, type of collection, age, and so on). Exhibitions are a traditional and essential social activity of museums, which can further flourish assisted by the technical possibility to reposition the core asset of museums, the collection information in all its forms, into new markets. The information market, though of another scale, lacks the quality transgenerational content structure of knowledge housed in museums. It can be the task of museums to feed the information infrastructure with quality and diverse content to feed further innovations. An effort to

track the effect of collection information dissemination across time and space (in physical or digital form) should not be underestimated.

## Notes

- 1 <https://www.slideshare.net/saschel/consolidating-openness-developing-rijksmuseum-research-services>.
- 2 <https://www.erfgoedmonitor.nl/indicatoren/museale-collecties-locatie-van-de-objecten>.
- 3 [http://www.egmus.eu/nc/en/statistics/complete\\_data/country/the-netherlands/](http://www.egmus.eu/nc/en/statistics/complete_data/country/the-netherlands/).
- 4 The apparent decrease in the dissemination of collections online from the 2015 survey is attributed to the type of institutions participating in the survey. Because results are anonymized, institutional growth cannot be properly tracked and average totals fluctuate from year to year.
- 5 <https://science.naturalis.nl/en/collection/>.
- 6 <https://www.slideshare.net/saschel/consolidating-openness-developing-rijksmuseum-research-services>.
- 7 A discussion on the definition of a physical object is outside of the scope of this paper. Indeed, methodological challenges are posed when accounting for dynamic content (e.g. a website). Similarly, idiosyncrasies of physical objects can raise eyebrows (e.g. accounting for museum, libraries, archives, audio-visual, and monument 'objects'), as encountered by the ENUMERATE project.
- 8 At the time of writing, the data from the Dutch statistics office was being redesign. An overview per country can be found at the EGMUS website ([http://www.egmus.eu/nc/en/statistics/complete\\_data/country/the-netherlands/](http://www.egmus.eu/nc/en/statistics/complete_data/country/the-netherlands/)).
- 9 Based on the 2016 annual reports of the Rijksmuseum Amsterdam, Van Gogh Museum, Anne Frank House, EYE Film Institute, Stedelijk Museum Amsterdam, NEMO, Gemeentemuseum Den Haag, and Netherland Open Art Museum. List from [https://en.wikipedia.org/wiki/List\\_of\\_most\\_visited\\_museums\\_in\\_the\\_Netherlands](https://en.wikipedia.org/wiki/List_of_most_visited_museums_in_the_Netherlands).
- 10 <https://opendata.cbs.nl/statline/#/CBS/nl/navigatieScherm/thema?themaNr=50230>
- 11 <https://opendata.cbs.nl/statline/#/CBS/nl/navigatieScherm/thema?themaNr=3540>
- 12 <http://www.den.nl/pagina/521/houdbaar/>

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