Above and Beyond: Creating a Travelling Exhibition to Portray the Last 100 Years of Astronomy

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"Above and Beyond — Making Sense of the Universe for 100 Years" is an exhibition created as part of the International Astronomical Union centenary, providing a journey through a century of astronomical research and its broader impact on technology and culture. After the opening in Vienna, Austria in 2018, it was on display across Europe throughout 2019, reaching an audience of many tens of thousands, with scaled-down versions displayed in 75 countries around the world. This article presents the development, from concept to implementation, and a preliminary analysis of the project, along with lessons learnt of potential interest to organisers of similar science outreach projects with global reach.

Introduction

One of the flagship initiatives to mark the 100th anniversary of the International Astronomical Union (IAU100) in 2019 *(Gonzales et al., 2018)* entailed the production of a travelling exhibition to showcase major achievements in astronomy in the last century, along with selected IAU milestones. Aimed at reaching a diverse audience – from the global astronomical community to national scientific societies, policy-makers, and the general public — the exhibition was replicated worldwide in various formats, also thanks to open-source materials, in combination with other IAU100 activities.

Eventually described as *"a humble attempt at navigating through some of the most important and spectacular achievements in modern astronomy"*[1], the project had an ambitious goal: to condense a century of scientific and technological advancements — and not just any century, but one in which astronomers moved from having hardly any clue about the size of the cosmos *(Trimble, 1995; Kragh & Smith, 2003)* or the energy source that powers stars *(Kragh, 2016)* to a comprehensive understanding of the Universe, which naturally opened new fundamental questions. The exhibition strived to convey the science breakthroughs along with their relevance to culture and society — how they fuel one another — to trigger a feeling of awe and wonder for astronomical discovery.

The production timeline was extremely challenging: with the IAU100 flagship programmes defined in late 2017 and the exhibition concept in early 2018, the show was to premiere at the XXX IAU General Assembly in Vienna, Austria in August 2018 *(Downer et al. 2018)*, ahead of many replications throughout 2019, the year of the IAU centennial.

In March 2018, a team of astronomers and science communicators brainstormed on the content and format, to be later approved by the IAU Executive Committee on IAU100. In April, the production team was defined, with quotes provided by two different companies and the contract awarded to the multidisciplinary science and strategic design studio Science Now[2]. After inspection of the available space at the Austria Center Vienna (ACV), the IAU General Assembly venue, development started with two workshops in May, design work in June, text production in July, manufacture and set-up in August. The inaugural exhibition was on display 20–31 August 2018 (Figure 1).

Figure 1. *Ewine van Dishoeck, then-IAU President-elect, presenting the exhibition during the opening in Vienna. In the foreground, telescope scale models built out of Legos. Credit: IAU/M. Zamani*

Figure 2. *The exhibition poster, highlighting the distinctive visual language and the three key questions guiding viewers throughout the show. Credit: IAU*

The full-scale show[3] would later travel to nine cities across Europe, which were selected from proposals by IAU members and IAU100 national organising committees; have a nine-month exhibition at the Leiden Old Observatory in the Netherlands, and be displayed in small-scale versions around the globe.

Distilling 100 Years of Astronomy

The initial definition indicated that, while celebrating major science achievements — including key milestones of the IAU's first century — the exhibition should present the interdisciplinary character of contemporary astronomy and its international scope. The content should portray science as a process, not a series of individual discoveries. This could be achieved by guiding viewers through multiple fruition paths via major questions about the Universe that the audience could also relate to, and by featuring the people behind the research — their stories and possibly also their voices. The use of objects was also recommended — historical artefacts and modern technology — to emphasise the relevance to everyday life. The target audience should include the general public, young children and families, but also science enthusiasts and professional astronomers; the format should be reusable, scalable, and localisable to achieve a global reach.

A request for input to all IAU Divisions, Commissions and Working Groups resulted in over 200 proposed highlights, organised over the ten decades between 1919 and 2019. A board, consisting of five IAU members with expertise in different areas of astronomy, received the full list, cast votes and down-selected the proposed highlights to 75 for the creative team to further focus on. A few additional highlights were added to cover themes such as space science and public outreach. There was no reporting back to Divisions, Commissions and Working Groups on the final selection, but no complaints were received.

To convey such a rich history to a broad audience, the team chose three fundamental questions in the history of modern astronomy to help navigate through the exhibition content (Figure 2 and 7):

1. What is the size and structure of the Universe?
2. How do stars form and shine?
3. Is there life elsewhere in the Universe?

The questions were selected to focus on broad topics that would lend themselves to different layers of storytelling, and also resonate most with the public interest. The story arch of the show was then built around the questions, which work as a leitmotif through the evolution of astronomy over the decades, enabling viewers to experience the exhibition either in a chronological or in a thematic fashion.

Even if the target audience included different publics, the text for the panels was developed with a non-expert public of non-native English speakers in mind, keeping written content minimal, plain language, and a strong emphasis on visual elements. The visual language included astronomical images, whose striking beauty is an established tool to engage with wide audiences *(Arcand & Watzke, 2009)*, alongside specially created infographics[4] on specific concepts, for example, the history of exoplanet discoveries (Figure 3, 6 and 11) or the development and growth of space exploration.

Design and Production

After an initial evaluation, it was decided to base the exhibition on analogue rather than multimedia experiences. This was partly due to budget constraints. The exhibition would not be staffed, so with visitors discovering the content on their own: this posed another constraint. Therefore, the visual language and visual storytelling had to play a significant role in the fruition of the show[5].

Given the originally allotted space for the inaugural exhibition in Vienna — a rectangle of 6.9m x 19.8m — the team

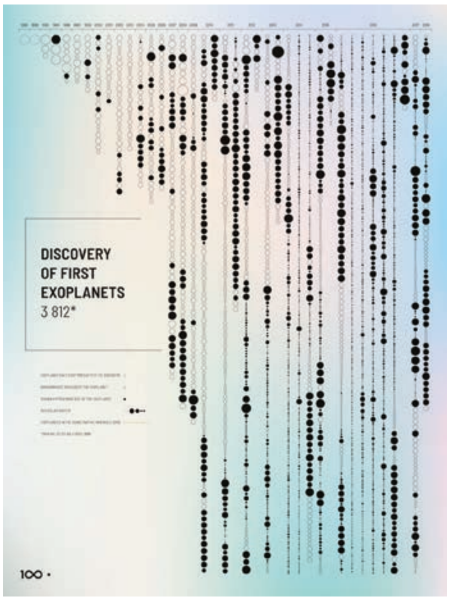

Figure 3. *An infographic summarising the discoveries of exoplanets, planets beyond the Solar System, as of July 2018. Credit: IAU*

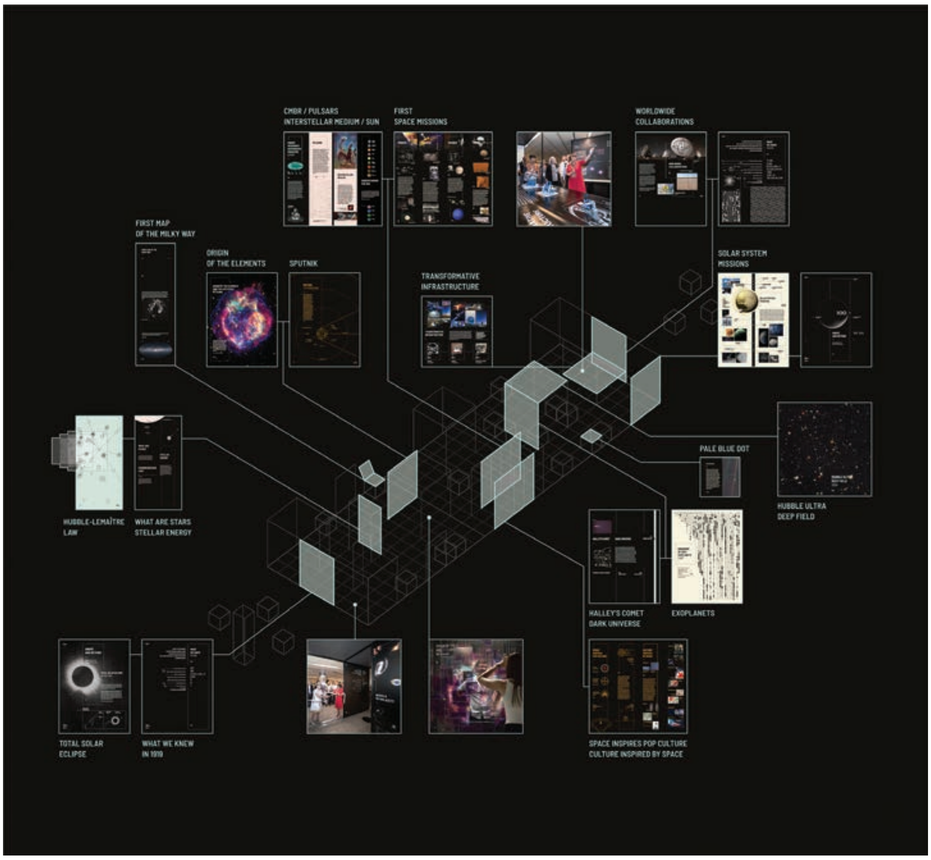

Figure 4. *The grid structure and story framework translated into the ensuing construction solution. Credit: Science Now*

developed the narrative arch starting at one end of the structure and leading to the opposite end in chronological, linear order (Figure 4).

The 75 highlights gave rise to over 200 individual content interactions[6], complemented by three "key experiences" — distinctive installations on crucial achievements: the origin of elements, the Moon landing, and the Hubble Ultra Deep Field (Figure 5 and 6). Two sets of "cubicles" were located at the beginning and at the end, to first set the scene in the early 20th century, and then reflect on how the key questions have changed over the intervening 100 years.
The spatial structure, using a modular grid concept, and the visual language were developed to enable three simultaneous layers of storytelling[7]. Viewers can thus experience the exhibition in a chronological fashion (as the paths progresses linearly), via the three questions (each highlighted in a different colour; see e.g. Figure 7), or via the contributions to science, technology and culture (each presented along a different trajectory: left, centre, and right).

Only a couple of weeks before the opening, the team was informed that the available space at the venue was not the previously agreed rectangle, but instead a triangle[8]. This posed a substantial and unforeseen challenge, calling for a rethink of the exhibition layout at very short notice, with all materials and content already produced for a different spatial logic. Eventually, a satisfactory solution was found by distributing the content along a V-shaped trajectory, displaying the chronological order from corner to corner to make the best use of the triangular space. While there were no complaints about the triangular format, it is the opinion of the team that the exhibition content was quite cramped in the opening show in Vienna, and that subsequent versions (for example, the one in Brussels) where the content was arranged according to the original design provided a more spacious and comfortable experience, based on casual observations of the audience and analysis of photographs.

Travelling Exhibition and Scaled-down Versions

After the inaugural show in Vienna, primarily visited by astronomers attending the IAU General Assembly, the same version of the exhibition was on display in science centres and other venues across Europe (see Table 1). The shows were organised by IAU100 partner institutions and were supplemented by additional content and/or public events featuring local astronomers. Meanwhile, an extended exhibition[9] was produced in Leiden, the Netherlands by Science Now (design studio) in collaboration with Stellar Fireworks (production company). It included extra content to showcase the local history of astronomy, in Dutch and English, with archival images, display objects, backlit panels, and a brand new section dedicated to astronomical futures portrayed by a number of design fiction posters (Figures 8–11).

In the open science spirit, all content and designs are available under an open-source license for adaptation and reuse. The designs allow anyone to reproduce the full-scale show, with the original modular design, and a scaled-down, low-cost version, with content adapted into 100 posters (a mix of A3 and B1 sizes) for easy replication in any printing facility worldwide and flexible space display (all materials are available via *Russo et al., 2018*). Sharing the source design files allows for local adaptation and translation.

Exhibitions based on these materials (often translated) were replicated through the IAU network of National Outreach Coordinators and national astronomical societies, bringing the show to Algeria, Aruba, Bulgaria, Canada, India (Figure 12), Japan[10], Spain, Tunisia, Uruguay[11].

The text and visual content were further condensed to create a set of twelve A0 posters (in English) featuring the exhibition's highlights, producing a budget version for display at meetings, universities and schools (posters are available via: *Russo et al., 2019*). Three hundred sets of posters, printed by the IAU100 secretariat, were distributed to 75 countries[12].

Location	Period	Number of visitors (type of audience)
Vienna, Austria (A)	August 2018	3000 (astronomers)
Bratislava, Slovakia (A)	Oct 2018—Feb 2019	13 000 (general public)
Brno, Czech Republic (A)	Feb—Mar 2019	4500 (general public)
Brussels, Belgium (A; B)	April 2019	500 (astronomers, policymakers)
Armagh, Northern Ireland, UK and Birr, Dublin, Cork, and Galway, Ireland (A)	Jul—Oct 2019	8000 (general public)
Matera, Italy (A)	Dec 2019—Feb 2020	3000 (general public)
Leiden, the Netherlands (C)	Apr 2019—Jan 2020	13 000 (general public)
Uruguay: Montevideo and several cities across the country (D)	Jul—Oct 2019	2000 (general public)
Sofia, Bulgaria (D)	May—June 2019	1500 (general public)
Bulgaria: 20 cities across the country (D)	Jan 2019—Jan 2020	1000 (general public)
Temse, Belgium (E)	October 2019	300 (general public)

Table 1. *Number of visitors to the travelling exhibition and selected local exhibitions.*

(A) Travelling exhibition

(B) On the occasion of the IAU100 Flagship Ceremony

(C) Permanent exhibition

(D) Local exhibitions (scaled-down version)

(E) Local exhibition (12-poster version)

While the open-source content remains available online for any venue who wishes to replicate the exhibition locally in the future, the IAU100 organisers have also been considering possible ways to keep the travelling exhibition alive in order to maximise the resources invested in its development. Plans to display the show in new locations throughout 2020 were halted due to the onset of the COVID-19 pandemic, and are being re-evaluated at the time of this writing. One of the possible courses of action could be to organise an open call for science institutions or visitor centres who wish to display the exhibition for six months or longer; this, however, would call for additional costs in terms of storage and partial replacement of any damaged exhibits. Discussions are also ongoing regarding a possible publication to preserve a permanent record of the panel texts.

Audience Engagement

The exhibition, in its different formats, was on display on four continents, reaching many tens of thousands of visitors (see Table 1 for information from several of the hosting venues.) The permanent version in Leiden received a formal, very positive review by the Dutch national newspaper NRC, which described the exhibition as *“small and beautifully designed”* and rated it with four out of five stars[13].

Due to several factors, including the short production timeline, a lack of dedicated personnel, and limited resources, there was no formal evaluation of the exhibition’s outcomes and its impact on visitors performed. A very preliminary analysis of public engagement was conducted using input collected as part of the overall evaluation of IAU100 activities. To this aim, all event organisers were invited to assess and report on some aspects, including: event duration; estimated number of participants; local budget and sponsors (if any); brief description of the event; aims of the event and IAU100 Goals covered; target audience; level of audience participation in the event; audience breakdown;

Figure 5. *XXX IAU General Assembly participants exploring the “Origin of Elements” installation at the inaugural exhibition in Vienna. Credit: IAU/Science Now/A. Majewska*

Figure 6. *The Hubble Ultra Deep Field “key experience” at the Vienna exhibition; on the right, the exoplanet timeline infographic. Credit: IAU/M. Zamani*

Box 1. Comments from local organisers

"A well prepared travelling exhibition, including all important material for installation and graphics package. It was just missing some interactive exhibits [...] All exhibition texts were in English, so not all visitors could understand them."

Barbora Procházková (Vida Science Center, Brno, Czech Republic)

"It was a very hard work due to lack of resources. On the one hand I had to get and learn to use a program to edit the original AI files to translate the texts into Spanish, and on the other to get the financial resources to print them [...] In most of the centers that hosted the exhibition, there was no adequate infrastructure or suitable personnel to unpack, assemble, care and pack the exhibition. However, the great effort and time invested was compensated by the interest it had on the public, especially educators, students and educated or expert public."

Andrea Sosa Oyarzabal (Centro Universitario Regional del Este, Universidad de la República, Uruguay)

"This was an awesome event. The AW Mercator team was present in the exhibition room to give some extra explanation to the public about the posters and we got very good reactions. So thanks again for providing the posters !!"

Kris Schoeters (VVS AW Mercator, Temse, Belgium)

"The exhibit [...] has been a real success in terms of impact on society, with regards to both the public and the excellent framework of institutional collaborations. For the Italian edition [...] we created a guided path with a yellow circle in every (suggested) step of the exhibition (both thematic and chronological steps) and a special map. Furthermore, we distributed a free booklet [...] where all the astronomical discoveries described in the English panels were explained in a very friendly and funny way [...] In the framework of the exhibit, daily interactive activities and science laboratories addressed to a specific age target were organised."

Rossella Spiga (INAF, IAU Deputy National Outreach Coordinator, Italy)

considerations on audience diversity, inclusion and accessibility; and lessons learnt. Several, though not all, partners who hosted the travelling exhibition or set up a scaled-down version using the open-source materials responded to this call for feedback. No partner reported on the presence of systems to gather feedback from visitors.

Figure 7. *Structural and visual elements – such as the key questions highlighted in different colours – at the Brussels exhibition. Credit: I. Ma – CC BY-NC 2.0*

In their feedback, partners listed informative and educational objectives among their aims, to generate curiosity and interest in astronomy and science by showcasing the beauty of the Universe and a broad range of scientific achievements. All partners targeted a mixed audience of adults and young people, experts and non-experts. One of the travelling exhibition hosts (Brno, Czech Republic) reported a detailed breakdown of the audience: 56.3% female, 43.8% male; level of education: 12.5% preschool, 34.4% elementary school, 35.5% high school, 30.2% university. Most partners reported a 'passive' level of engagement, with audience viewing panels and reading the texts; one of the partners explicitly flagged the lack of interactive exhibits; another partner noted some level of interactivity (e.g. audience asking questions to experts).

Partners praised the content quality and the straightforward design and installation. Some hosts of the travelling exhibition flagged the fact that all text was in English, and so it was not accessible to all visitors in non-English speaking countries; one of the hosts (Matera, Italy) reported supplementing the exhibition by distributing additional material in Italian. Several partners who set up scaled-down exhibitions using the open-source content translated the text to local languages (e.g. Bulgarian, Japanese, Kannada, Spanish); this did, however, entail a large deal of extra work by local partners. Outstanding comments from local organisers are reported in Box 1.

Lessons Learned

Several aspects discussed in the project definition were not eventually implemented, mainly due to budget and/or production timescale constraints.

Multimedia Exhibits

The team considered audiovisual material, e.g. interviews to IAU astronomers reflecting on the past, present and future of the discipline and the organisation. This could have served different purposes: 1) to provide a positive emotional experience for visitors by adding personal science stories and voices *(Burns, O'Connor, & Stocklmayer, 2003);* 2) to reflect the diverse community of IAU members in terms of

Figure 8. *Backlit panel featuring the timeline of space science missions at the Leiden exhibition. Credit: M. Shaw/Leiden University*

Figure 9. *A prototype of the Heterodyne Instrument for the Far-Infrared (HIFI) which flew on the European Space Agency's Herschel Space Observatory, on display at the Leiden exhibition. Credit: M. Shaw/Leiden University*

age, nationality, ethnicity, gender, sexuality, disability (fostering inclusiveness in the advancement of astronomy, in line with Priority IV of the IAU Strategic Plan 2020–2030[14]); 3) to produce multilingual content, leveraging on the many languages spoken by IAU members worldwide. However, it would have required content production, hardware support and maintenance well beyond the project budget, and could have been problematic to replicate for the smaller-scale versions, so it was decided early on to focus on an equally rewarding, analogue experience. In future projects, the hardware issue could be overcome by harnessing the storytelling opportunities for science museums offered by social media *(Jarreau, Dahmen, & Jones, 2019)*, though still requiring substantial effort to produce and maintain the digital content.

Objects and Interactive Exhibits

The original brief discussed the use of objects: historical images and artefacts, cutting-edge technology examples, and 3D-printed models of astronomical objects (Comet 67P/Churyumov–Gerasimenko, for example), along with interactive elements, for instance small telescopes or lenses. It was recommended that each host venue procure locally relevant objects; this was pursued, for example, in the Leiden exhibition, featuring an early 20th-century calculator and the prototype of a space observatory instrument (Figure 9). In the end, the travelling exhibition included, as 3D objects, three scale models of telescopes built with Lego bricks, to illustrate the size growth of astronomical instrumentation over time (Figure 1). Elements of interactivity are included in the three "key experiences" – where viewers are invited to be part of the elements created in a supernova explosion, walk on the Moon on the footsteps of Apollo astronauts, or look up at the immensity of the cosmos in the Hubble Ultra Deep Field (Figures 5, 6 and 10). In hindsight, the addition of 3D printed objects *(Arcand et al., 2017)* or other tactile exhibits *(Krauss, 2016)* could enable an extra layer of interactivity, while also providing content accessible to visually impaired visitors.

Diversity and Inclusion

One of the most challenging tasks in the content production was to steer clear of the mainstream Eurocentric narration while navigating through the proposed pool of highlights, which featured a disproportionate majority of white, male scientists from Europe and North America. On one hand, the team decided to include as many highlights as possible featuring astronomers from traditionally underrepresented groups and contributions to science, technology and culture from non-western/non-anglophone countries. This was not meant as a tokenism exercise but rather as an attempt to imagine an audience more diverse than the largely white, largely male scientific community of today, providing a broader variety of historical models to foster cross-cultural learning opportunities *(Dawson, 2014)*. On the other hand, the team acknowledged past (and present) issues of unequal representation in astronomy, highlighting gradual improvements over time where present, as a self-reflection exercise for the community itself. With this awareness, extra care went into crafting the text to avoid instances of misrepresentation that could be perceived as a form of cultural imperialism *(Dawson, 2018)*. This is a very first step, and future projects would have to prioritise diversity at concept level to develop more inclusive content and further engage with marginalised groups.

Accessibility and Language

As mentioned above, the exhibition included no dedicated content for visually impaired visitors, nor for other special needs audiences *(Ortiz-Gil et al., 2011)*. This highlights the importance to prioritise accessibility for disabled visitors at project definition, as explored by Inspiring Stars, another travelling exhibition developed for IAU100 to disseminate initiatives addressing inclusion in professional astronomy *(D'Antonio, et al., 2019)*. Another barrier that might have prevented a more widespread access is language *(Márquez & Porras, 2020)*. The content was originally produced in English and all source files shared for re-use and adaptation, meaning that local hosts could translate and adapt the content, which happened in many places around the world (Figure 12). This, however, relied on individual local initiative, requiring extra effort in terms of translation and layout. Besides, the travelling exhibition and the budget set

Figure 10. *The "Origin of Elements" installation at the Leiden exhibition. Credit: K. Mai/Leiden University*

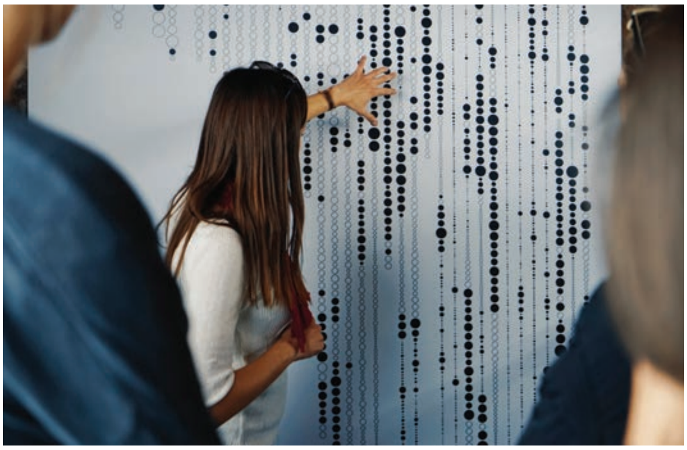

Figure 11. *The exoplanet timeline infographic at the Leiden exhibition. Credit: K. Mai/Leiden University*

of 12 posters were only provided in English. In retrospect, this raises again the question of priorities, and whether a smaller pool of content, translated centrally and provided to all global partners in their local language(s), could have had a broader impact. Regarding the barrier posed by the financial cost to visitors, the exhibition was free to access in most venues, and in a few cases entrance was included as part of the ticket to visit the hosting science centre.

Production Timeline and Interdisciplinary Team

The very tight production timeline – only five months to create the entire exhibition from scratch – posed several challenges, so the breadth of skills and expertise of the creative team was key to ensure the success of the project. The team included: producers, supervising the holistic content, design and production process; architects, envisioning spatial solutions for imagined content experiences; content interpreters/researchers, seeking engaging forms of presenting science, technology and culture-based content; graphics designers, responsible for design nuance, consistency and special infographics; concept artists, responsible for artistic interpretations of specific phenomena; set designers and builders, making sure the exhibition is executed in a reliable and safe format. It was this combination of competencies that, paired with the input of the IAU100 Organising Committee and IAU global nodes, allowed for a high-quality, inclusive and engaging project. Budgeting in a substantially longer time scale for planning and production is one of the major lessons learnt from all IAU100 activities *(Gonzalez et al., 2020)*. In retrospect, the project would have benefitted from a dedicated part-time coordinator/project manager with experience in the exhibition sector to look for the best venues across Europe 1—2 years before the inaugural show in mid-2018, to open a discussion with local organisers with substantial notice, secure high-visibility venues in advance, and start fundraising to cover the non-negligible costs for transportation early on.

Evaluation

A project manager dedicated to the exhibition would have also enabled a proper evaluation of its outcomes and impact, which unfortunately could not be conducted on this project due to lack of resources. Such a project manager could have defined early on key performance indicators to assess whether the exhibition objectives were reached, both globally and locally, along with identifying relevant evaluation methods and outlining guidelines for local organisers to collect visitor feedback; later on, they could have followed up with all hosts, collecting and analysing the locally gathered feedback (or liaising with external experts on the analysis) to produce a thorough evaluation report. The team agrees that gathering and analysing quantitative and qualitative data, including a survey of at least a small fraction of the visitors before and after the experience, would have provided valuable input to inform future projects, and that an "evidence-based" approach *(Jensen & Gerber, 2020)* would have to be prioritised at concept – and budget – level since inception for similar science communication activities in the future.

Conclusions

Our preliminary analysis shows the exhibition was successful in its goal of reaching a wide audience of experts and non-experts in many parts of the world, showcasing major achievements in astronomy and selected IAU milestones while portraying science not as something static but as a human endeavour that is *"still in the making or still being debated" (Hine & Medvecky, 2015)*. Could it have reached and/or engaged more people? Probably. As discussed in the "Lessons Learned" section, and reported to the relevant IAU Officers to improve similar processes in the future, several issues encountered along the way point to the need to prioritise certain aspects at definition rather than implementation. Finally, on the basis of private conversations with IAU members and other astronomers who collaborated to produce, hosted or simply visited the exhibition, we argue that the project served not only as a public outreach activity but also as a beneficial exercise for the organisation and the overall astronomical community to reflect on their identity, image and reputation *(Davies et al., 2019)*,

Figure 12. *A poster-based exhibition in Bengaluru, India, with translated text in Kannada next to the original English, during a public event as part of the IAU100 "100 Hours of Astronomy" project in January 2019. Credit: Dr M.Y. Anand – CC BY 2.0*

providing valuable insight to approach the challenges facing astronomy in future decades.

Notes

[1] Above and Beyond exhibition website: https://100exhibit.iau.org

[2] Science Now website: https://sciencenow.studio

[3] The costs (around 50k Euro for concept and production, and 5-7k Euro for transport and poster production) were part of the IAU100 budget; additional transport and on-site installation costs for the travelling exhibition were covered by local hosts.

[4] Data visualisations and graphics: https://www.behance.net/gallery/78642081/IAU100-exhibition-data-visualization-and-graphics

[5] Branding and visual design: https://www.behance.net/gallery/78641137/IAU100-exhibition-branding-and-visual-design

[6] The full-scale exhibition is intended for display in an area of 120–140 square metres. It includes 23 small scale objects with printed panels on one or more faces (width: 68 cm; depth: 68 cm; height: 75 cm) and 50 large panels of various dimensions (maximum height: 260 cm), plus the Moon landing "cubicle" (width: 190 cm; depth: 190 cm; height: 240 cm). Further details in the exhibition manual (included in *Russo et al., 2018*).

[7] Travelling exhibition concept: https://www.behance.net/gallery/78641695/IAU100-travelling-exhibition-concept

[8] Floor plan for the Vienna exhibition: https://astronomy2018.univie.ac.at/typo3temp/pics/ca9f00fdd4.png

[9] Exhibition at the Leiden Old Observatory: https://www.universiteitleiden.nl/en/news/2019/04/experience-one-hundred-years-of-astronomy-at-the-old-observatory

[10] The exhibition in Tokyo, Japan: https://www.iau-100.org/aboveandbeyond-tokyo

[11] The exhibition in Montevideo, Uruguay: http://www.iau-100.edu.uy/galeria-de-la-exposicion-itinerante-iau100-mas-arriba-y-mas-alla/

[12] IAU100 Final Report: https://www.iau.org/static/archives/announcements/pdf/iau100-final-report-ann20019.pdf

[13] "Na een eeuw is het helaal veel groter," NRC article, 19 April 2019 (in Dutch): https://www.nrc.nl/nieuws/2019/04/19/na-een-eeuw-is-het-heelal-veel-groter-a3957561

[14] IAU Strategic Plan 2020–2030: https://www.iau.org/administration/about/strategic_plan/

[15] Full credits: https://100exhibit.iau.org/#stripe11

References

Burns, T.W., O'Connor, D.J., & Stocklmayer, S.M., 2003, "Science communication: a contemporary definition," Public Understanding of Science, Vol. 12, pp. 183–202

D'Antonio, M.R., Canas, L., & Diaz Merced, W., 2019, "Inspiring Stars - the IAU inclusive world exhibition," Under One Sky: The IAU Centenary Symposium. Proceedings of the International Astronomical Union, Vol. 349, pp. 470-473

Davies, S.R., et al., 2019, "Science stories as culture: experience, identity, narrative and emotion in public communication of science," Journal of Science Communication, Issue 18, A01

Dawson, E., 2014, ""Not Designed for Us": How Science Museums and Science Centers Socially Exclude Low-Income, Minority Ethnic Groups," Science Education, Vol. 98, Issue 6, pp. 981-1008

Dawson, E., 2018, "Reimagining publics and (non) participation: Exploring exclusion from science communication through the experiences of low-income, minority ethnic groups," Public Understanding of Science, Vol. 27(7), pp. 772–786

Downer, B., Canas, L., & Rivero Gonzalez, J. 2018, "IAU100 Celebrations Launched at the IAU General Assembly in Vienna", CAPJournal, issue 24, pp. 5–6

Hine, A., & Medvecky, F., 2015, "Unfinished Science in Museums: a push for critical science literacy," Journal of Science Communication, Issue 14, A04

Jarreau, P. B., Dahmen, N. S. & Jones, E., 2019, "Instagram and the science museum: a missed opportunity for public engagement," Journal of Science Communication, Issue 18, A06

Jensen, E. A., & Gerber, A., 2020, "Evidence-Based Science Communication," Frontiers in Communication, issue 4, p. 78

Kowal Arcand, K., & Watzke, M., 2009, "On the Journey From Earth to the Universe," CAPJournal, Issue 7, pp. 14–20

Kowal Arcand, K., et al., 2017, "Bringing Cosmic Objects Down to Earth: An Overview of 3D Modelling and Printing in Astronomy and Astronomy Communication," CAPJournal, Issue 22, pp. 10–13

Kragh, H., & Smith, R. W., 2003, "Who Discovered the Expanding Universe?," History of Science, vol. 41, p.141-162

Kragh, H., 2016, "The source of solar energy, ca. 1840-1910: From meteoric hypothesis to radioactive speculations," The European Physical Journal H, Volume 41, Issue 4, pp. 394

Krauss, S., 2016, "Astronomy for the Blind and Visually Impaired," CAPJournal, issue 21, pp. 36–38

Márquez, M.C., & Porras, A.M., 2020, "Science Communication in Multiple Languages Is Critical to Its Effectiveness," Frontiers in Communication, issue 5, p. 31

Ortiz-Gil, A., et al., 2011, "Communicating Astronomy to Special Needs Audiences", CAPJournal, issue 11, pp. 12–15

Rivero Gonzalez, J., et al., 2018, "IAU100: Uniting Our World to Explore the Universe," CAPJournal, issue 23, pp. 5–6

Rivero Gonzalez, J., et al., 2020, CAPJournal, issue 28, pp. 14–21

Russo, P., et al., 2018, "Above and Beyond: Making Sense Of The Universe For 100 Years exhibition" (Version 1.0). Zenodo: http://doi.org/10.5281/zenodo.1491839

Russo, P., et al., 2019, "IAU100 Above & Beyond Exhibition Posters" (Version 1.0). Zenodo: http://doi.org/10.5281/zenodo.3238344

Trimble, V., 1995, "The 1920 Shapley-Curtis Discussion: Background, Issues, and Aftermath", Publications of the Astronomical Society of the Pacific, v.107, p.1133.

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