



Crossref – Review of organisational stability

Preliminary Report

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Prepared on behalf of Crossref

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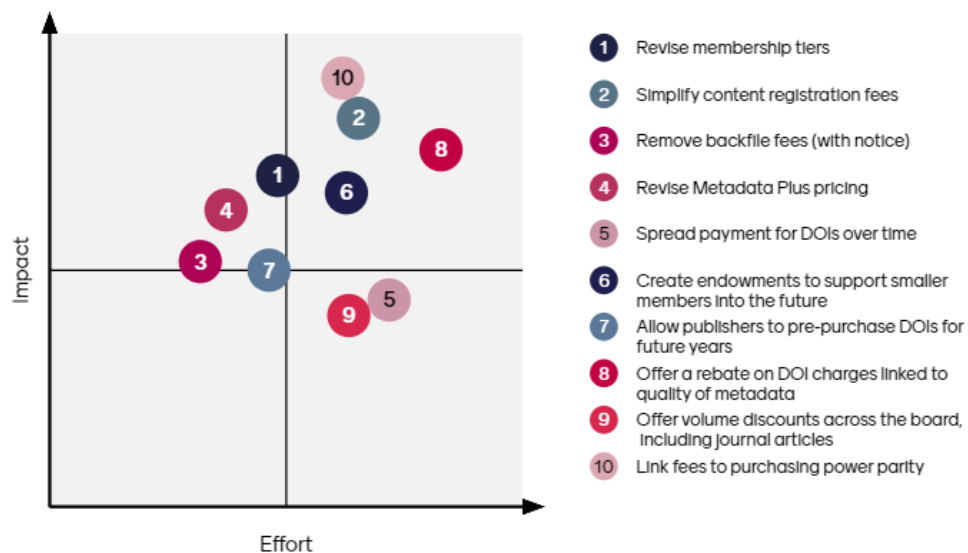
Executive Summary

Introduction	Crossref is a not-for-profit membership organisation that exists to make scholarly communications better. Research Consulting was commissioned to support a review of Crossref's resourcing and organisational sustainability. This preliminary review looked specifically at Crossref's current revenues, costs and charging model through review of relevant documentation and discussion with Crossref's five directors.
Crossref today	A SWOT analysis (page 4) and a not-for-profit business model canvas (page 10) were completed to prepare an overall picture of Crossref today. These indicate that Crossref has a clear mission, underpinned by significant financial strength, but it must continue to evolve in response to the changing composition of its membership, the possibilities afforded by new technology and the changing external environment.
The case for change	Two models were used to explore Crossref's organisational journey: path dependence theory and the Community Participation Model. These were used to further explore where Crossref is currently and its future direction of travel. Directors were presented with a number of drivers for change in Crossref's charging model and asked to rate the importance of these. The outcomes of this process indicate that the three primary reasons to change Crossref's charging model are to: <ol style="list-style-type: none">1. Make fees simpler and more transparent.2. Address inequities for existing members.3. Incentivise best practice in metadata creation and management.
Revenue drivers	Over the last decade Crossref has seen revenue growth across all its activities, but most notably from services. Despite this its revenues remain closely tied to journal article registrations and the number and distribution of publishing members, both of which are difficult for the organisation to influence directly. More positively, Crossref's pricing decisions for publishing members, content registration and Metadata Plus also have a significant impact on its revenues and are amenable to change. Metadata Plus was highlighted as an area where implementing changes would be comparatively easy, given the relatively small number of users.
Cost drivers	A smaller number of key cost drivers were identified than revenue drivers, and the relationship between these drivers and the actual costs incurred is necessarily more complex than for revenues. Membership numbers, content registration volumes and wage inflation (for existing staff) are all difficult for Crossref to control but have a significant impact on costs. However, increases in membership numbers and content registration volumes should also result in increased revenues to counterbalance any associated cost increases. This ability to scale revenues in line with activity and expenditure represents a key strength of Crossref's existing business model.
Crossref's future income streams	Crossref's directors envisage continued growth in its share of revenue from services, which is anticipated to rise from 16% of total income to 22% to over a third by 2028. Although content registration will remain the largest source of income, revenue from services is expected to overtake that from membership fees in the coming years.

Options for revising Crossref’s fees

10 options for revising Crossref’s fees were identified in the course of our work and were assessed by Crossref’s directors in terms of the effort they would require and the positive impact they would have. The results of this exercise are shown in Figure ES1.

Figure ES1: Impact-effort assessment of fee options



The identified options can be analysed into three groups: Evaluate, Explore and Exclude

Evaluate	Explore	Exclude
<ul style="list-style-type: none"> Revise membership tiers. Remove backfile fees Revise Metadata Plus pricing Enable pre-purchase of DOIs 	<ul style="list-style-type: none"> Link fees to purchasing power parity Simplify content registration fees Offer a rebate on DOI charges linked to quality of metadata Create endowments to support smaller members into the future 	<ul style="list-style-type: none"> Spread payments for DOIs over time Offer volume discounts across the board

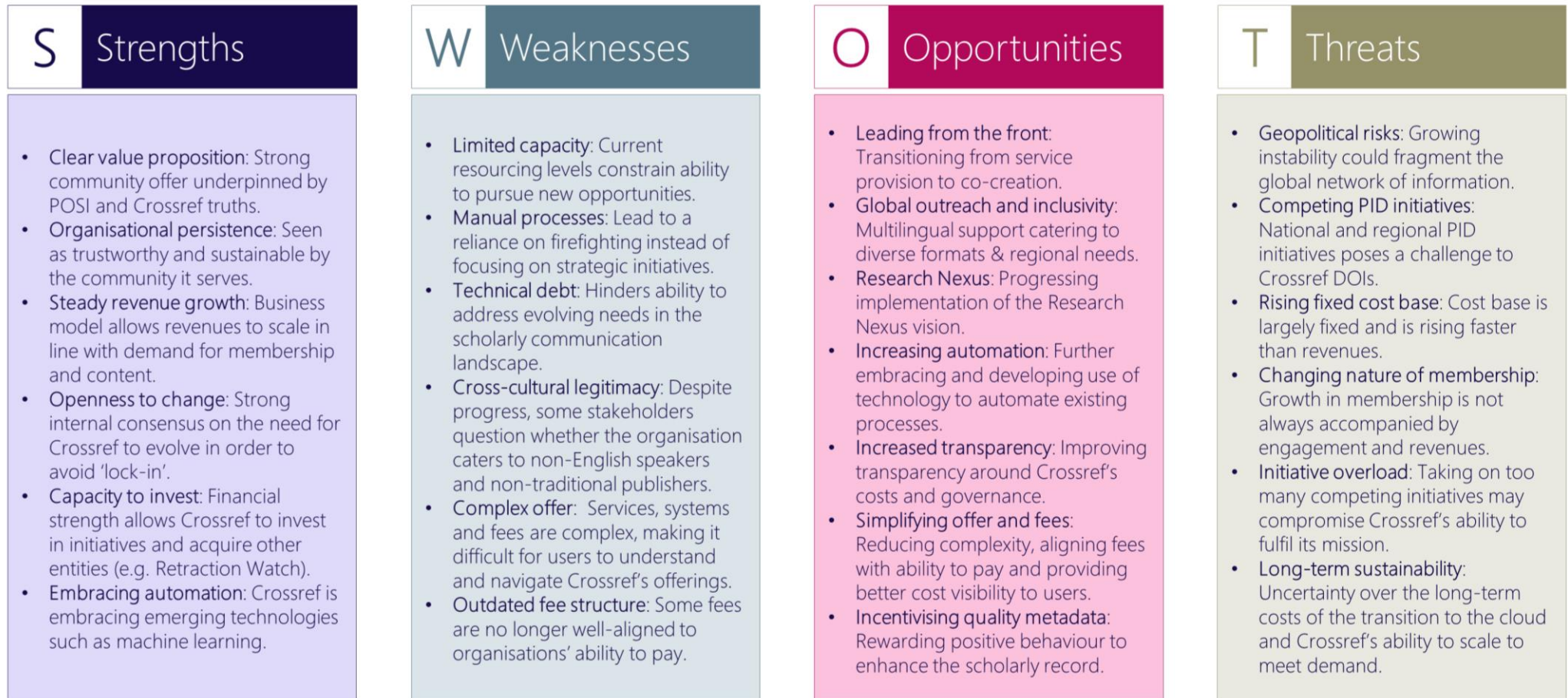
Next steps

This work has identified key drivers for revising Crossref’s charging model and, through a process of assessing cost and revenue drivers and subsequent ideas for fee revisions, a number of areas have been proposed for evaluation and exploration, as outlined above. Proposed next steps for this work are as follows:

- Board consultation and approval to proceed (Nov 2023)
- Budget modelling and review of fees (Nov 2023 – Mar 2024)
- Brief and mobilise the Membership & Fees Committee (Nov/Dec 2023)
- Community consultation (Jan 2024 – June 2024)
- Technical assessment and planning (Feb 2024 - June 2024)
- Approval of proposed fee changes (July 2024)
- Technical work to implement fee changes (July-Dec 2024)
- Communication and engagement (July-Dec 2024)
- Update for the membership at the Annual Meeting (Nov 2024)
- New fees in effect (January 2025)

An indicative implementation timeline can be found on page 26 of this report.

Figure 1: SWOT analysis – Crossref today



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1. Introduction

Crossref is a not-for-profit membership organisation that exists to make scholarly communications better. Research Consulting was commissioned to support a review of Crossref's resourcing and organisational sustainability. This preliminary review looked specifically at Crossref's current costs, revenues and charging model, through discussion with Crossref's five directors.

1.1 Reviewing Crossref's organisational sustainability

Crossref is a non-for-profit membership organisation that exists to make scholarly communications better

Crossref makes research objects easy to find, cite, link, assess, and reuse, and is aspiring to the vision of a **Research Nexus** of metadata and relationships. Founded in 2000, it now employs **45 staff** across Finance & Operations, Member & Community Outreach, Product, Technology & Research organisational functions.

With over 18,000 members from 146 countries, Crossref activities including rallying the community; tagging and sharing metadata; running an open infrastructure; playing with technology; and making tools and services - all to help put research in context.

Crossref wishes to define its current position and review the case for revising its fee structure

As outlined in the Board paper 'Resourcing Crossref' (July 2023), Crossref wishes to undertake a review of its organisational sustainability, aiming to align the desired impact of the organisation with the financial position required to support it. The objective of the review is to help Crossref define its current position as an organisation, clarify its long-term vision and plans and establish the case for revising its fee structure, if appropriate.

1.2 Purpose of this report

Our work was designed to support Crossref in identifying key drivers for change and possible next steps

Research Consulting was commissioned by Crossref to undertake a preliminary review of the organisation's financial stability by assessing the case for change, identifying revenue and cost drivers and reviewing options to revise the existing fee structure.

More broadly, this work began gathering evidence to address the following overarching goals of the resourcing review:

1. Identify the perceived right size for the organisation to thrive
2. Better understand the organisation's value to members and the community
3. Better understand the organisation's expense and revenue drivers
4. Identify options to simplify fees, where applicable
5. Promote equity and access for all to contribute to the scholarly record

6. Reflect on how scholarly communications has evolved and create a model nimble enough to continue to evolve with time.

1.3 Methodology

Our approach comprised desk research, facilitated workshops and interviews with Crossref’s directors

The methodology used in conducting this review comprised:

- Desk research using public information and other documents shared by Crossref to draft a not-for-profit business model canvas¹ (see section 2) and identify key revenues and costs and associated drivers.
- A facilitated workshop to review the draft not-for-profit business model canvas and revenue and cost drivers and agree areas for further consultation.
- One-to-one interviews with members of the Crossref directorial team to investigate the key goals outlined for this work, and to further explore the not-for-profit business model canvas as required.
- A second facilitated workshop to validate the review findings and confirm priorities for report writing.

This report is split into six sections

This report aims to provide an overview of the review findings, and is split into the following sections:

1. Introduction
2. Crossref today
3. The case for change
4. Crossref’s cost and revenue drivers
5. Options for the revision of Crossref’s fees
6. Next steps

Limitations included the timescale and sample of stakeholders

This preliminary review was subject to a number of limitations, including:

- This work was delivered from late August 2023 to October 2023 to ensure it met the required timescales of Crossref. This meant there was a limited timeframe in which to conduct research and engage stakeholders.
- Stakeholder engagement activities within this phase of work were limited to the five members of Crossref’s directorial team. Further consultation will be required with additional Crossref staff, Board members, partners and Crossref members to extend and validate the findings of this report.

Acknowledgements

The project team at Research Consulting gratefully acknowledge the support of Crossref in the delivery of this project. A complete list of individuals who contributed to this project can be seen in Appendix A.

¹ Our business model canvas template is adapted from www.strategyzer.com and is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported License.

2. Crossref today

A not-for-profit business model canvas and a SWOT analysis were completed to prepare an overall picture of Crossref today. These indicate that Crossref has a clear mission, underpinned by significant financial strength, but it must evolve in response to the changing composition of its membership, the possibilities afforded by new technology and the changing external environment.

2.1 Not-for-profit business model canvas

The not-for-profit business model canvas describes Crossref's current organisational structure, finances and value proposition

The not-for-profit business model canvas is used to document business models, simplifying and describing complex business concepts using nine common building blocks. Through discussions with Crossref's directors across two workshops and five individual consultations a not-for-profit business model canvas for Crossref was produced, which can be seen in Figure 2, below.

Several key discussions occurred throughout the development of the business model canvas, which are further explored below.

Crossref has a clear social value proposition

The importance of the [Principles of Open Scholarly Infrastructure](#) was emphasised throughout our discussions with the Crossref directors and is highlighted as a key aspect of Crossref's social value proposition, alongside Crossref's [truths](#). Adherence to these values is considered essential to fostering a high level of trust between Crossref and the community it serves.

The nature of Crossref's membership is changing

The nature of Crossref's membership is changing, with increasingly large proportions of new members joining via a sponsor or stemming from a GEM country. 98% of Crossref's 18,386 members are in the lowest membership tiers, for sponsored organisations and those with publishing revenues or expenses of less than \$1 million. These members typically publish content in very low volumes, with members who joined in 2021/22 accounting for 28% of the total membership but only 0.5% of Crossref DOIs.

There is a tension between being a membership organisation and a service provider

While many within the scholarly publishing community view Crossref as a service provider, Crossref's directors emphasised that its role is first and foremost that of a membership organisation and a provider of shared infrastructure. This question of Crossref's identity and purpose is of central importance when considering how its revenues might evolve in future. There is a strong desire to ensure that the opportunity for Crossref to generate additional revenues from services does not come at the expense of Crossref's primary role as an enabling organisation that exists for the benefit of its members.

Crossref's financial position is healthy

Crossref is currently in a strong financial position, having experienced steady growth in revenue and operating size over the past 20 years. Total [2021 revenue](#) was \$10m (up

from \$7.1m in 2017), and the organisation is on track to achieve revenues of \$12m in 2023. Growth has come from natural, broad adoption of membership content registration and the development of additional services like [Metadata Plus](#) and [Similarity Check](#).

While Crossref has consistently generated a surplus, its costs are rising

Crossref has consistently generated a surplus from its operating activities and has total assets of \$22m including \$10 million of reserves as of 30 June 2023. Year to date expenses are below budget due to savings on staff costs, with net income exceeding budget as a result, but there is upward pressure on staff costs as well as AWS and data centre expenditure.

Crossref is self-reliant in terms of revenue and does not need grants or public funds to support its operations. Core revenue lines, like membership dues (c.\$3m per annum) and content registration (c.\$7m per annum) have grown through volume rather than price increases. Basic content registration and membership fees haven't increased in over 15 years – the most used content type, the journal article, [had a fee of \\$0.60 in 2000](#).

2.2 SWOT analysis

The SWOT analysis summarises our findings

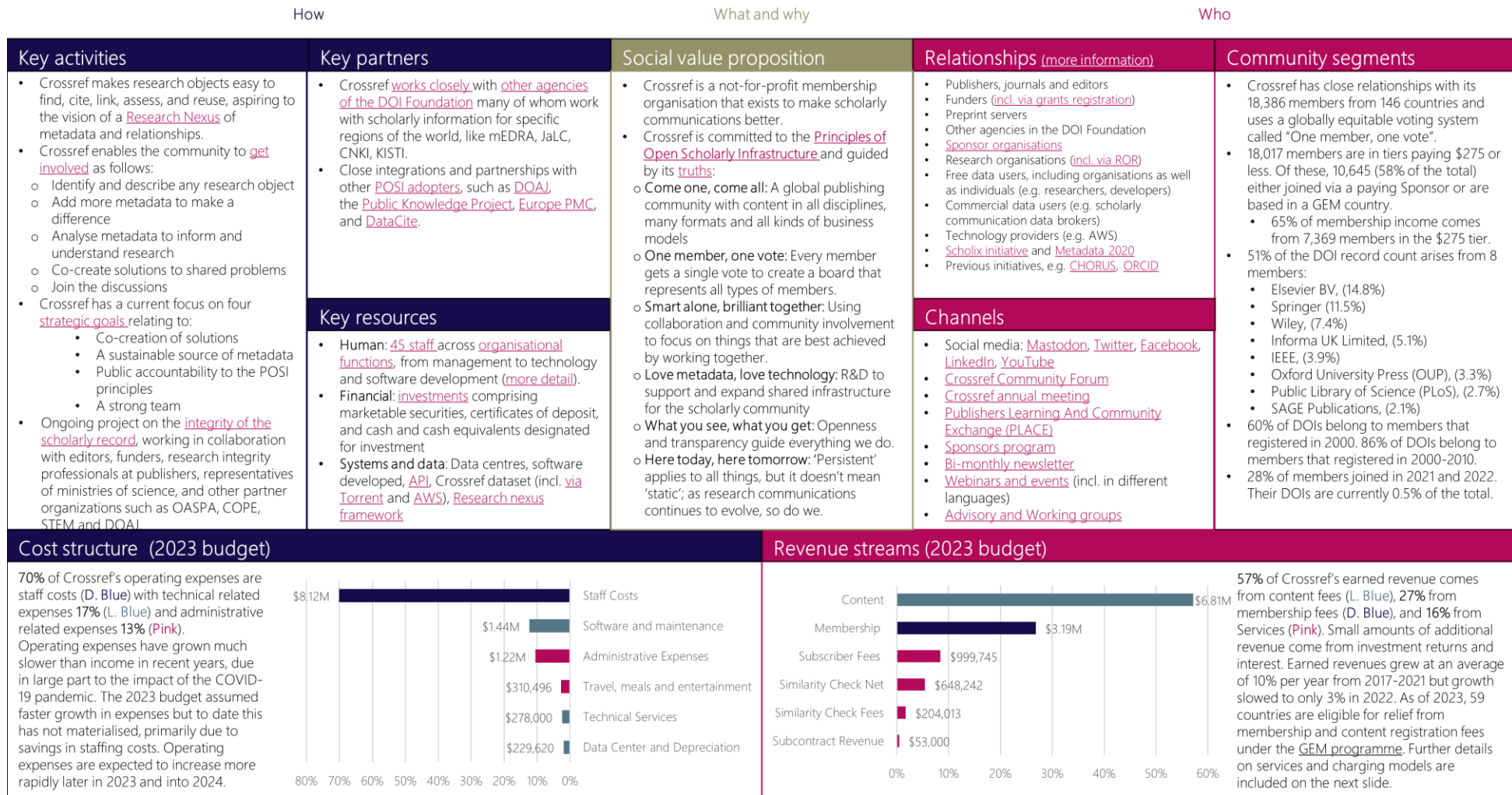
An analysis of Crossref's Strengths, Weaknesses, Opportunities and Threats (SWOT) provides an overview of our findings regarding Crossref's current position and can be found in Figure 1.

The SWOT analysis was validated with Crossref's directors and has been confirmed as an accurate representation of Crossref's position. Further information on the findings displayed in the SWOT analysis can be found throughout the remainder of this report.

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Figure 2: Not-for-profit business model canvas – Crossref



3. The case for change

*Two models were used to understand Crossref's organisational journey, path dependence theory and the **Community Participation Model**. These were used to further explore where Crossref is currently and its future direction of travel. Directors were additionally presented with a number of drivers for change in Crossref's charging model and asked to rate their relative importance.*

3.1 Path dependence

Organisational path dependence theory suggests past decisions can lead to rigidity and inertia

Path dependence is a phenomenon whereby history matters; what has occurred in the past persists because of resistance to change. In the context of an organisation, path dependence can be a useful tool to explain and interrogate organizational rigidities and structural inertia.

Sydow, Schreyögg, & Koch (2009)² outline an organisational development process characterised by a narrowing scope of options which can eventually result in 'lock-in':

- Phase I—the Preformation Phase—is characterized by a broad scope of action. Once a decision is made (such as this the adoption of particular fee structure, in Crossref's case), this choice may amount to a small event that unintentionally sets off a self-reinforcing process.
- Phase II—the Formation Phase—sees the adoption of self-reinforcing processes. A dominant action pattern is likely to emerge, which renders the whole process more and more irreversible. By implication, the range of options narrows, and it becomes progressively difficult to reverse the initial choice or the initial pattern of action—that is, a path is evolving.
- Phase III - the Lock-in Phase—is characterized by a further constriction, which eventually leads to a lock in scenario, where the dominant decision pattern becomes fixed and gains a deterministic character; eventually, the organisation's actions are fully bound to a path.

This model was introduced as a way of gauging the extent to which Crossref is able to change its pattern of actions and adopt alternative ways of operating.

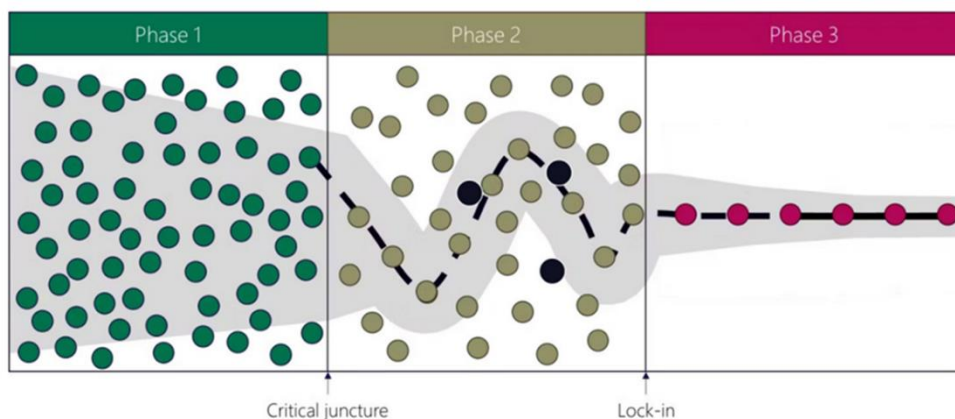
² Sydow, J., Schreyögg, G., Koch, J., 2009. Organizational Path Dependence: Opening the Black Box. AMR 34, 689–709. <https://doi.org/10.5465/amr.34.4.zok689>

Crossref is experiencing a narrowing of options but it is not 'locked in' to a fixed pattern

In the course of a workshop, a subset of Crossref's directors were asked to judge which phase of path dependence they felt Crossref was in. Responses indicated a consensus that Crossref is in Phase 2, characterised by a narrower range of options as a result of previous choices, however not yet bound to one path. These results can be seen in Figure 3, with directors' views represented by the black dots.

Participants agreed that some past decisions have served to constrain Crossref's current choices, such as the conflation of Crossref with the DOI 'brand' and the creation of bespoke charging models for content types such as preprints and data. However, in other respects they felt Crossref continues to be presented with a wide range of options and possibilities that it can pursue, meaning it is not locked-in to a single way forward. This flexibility stems in part from Crossref's strong financial position, which gives it a level of strategic autonomy which would not be present if its finances were weaker. Participants agreed that now is the right to make changes to Crossref's charging model, rather than waiting for a crisis or ending up in situation where financial pressures significantly constrain Crossref's available options.

Figure 3: Path dependence illustration. Black dots indicate views of internal stakeholders on Crossref's current position



3.2 Community participation model

The Community Participation Model describes four modes of member engagement

The Centre for Scientific Collaboration and Community Engagements **Community Participation Model** (Figure 4) was highlighted as an additional model of relevance to Crossref. It outlines three forms of information flow: transmissive, transactional, and transformational; and four major modes of community participation, convey/consume, contribute, collaborate, and co-create.

Crossref's directors observed that while the organisation currently falls towards the transmissive/transactional end of this model, Crossref aspires to move closer to a self-organised community characterised by co-creation in the future. This offers a pathway to increasing Crossref's influence and impact without this being tied to perpetual growth of resourcing and fees.

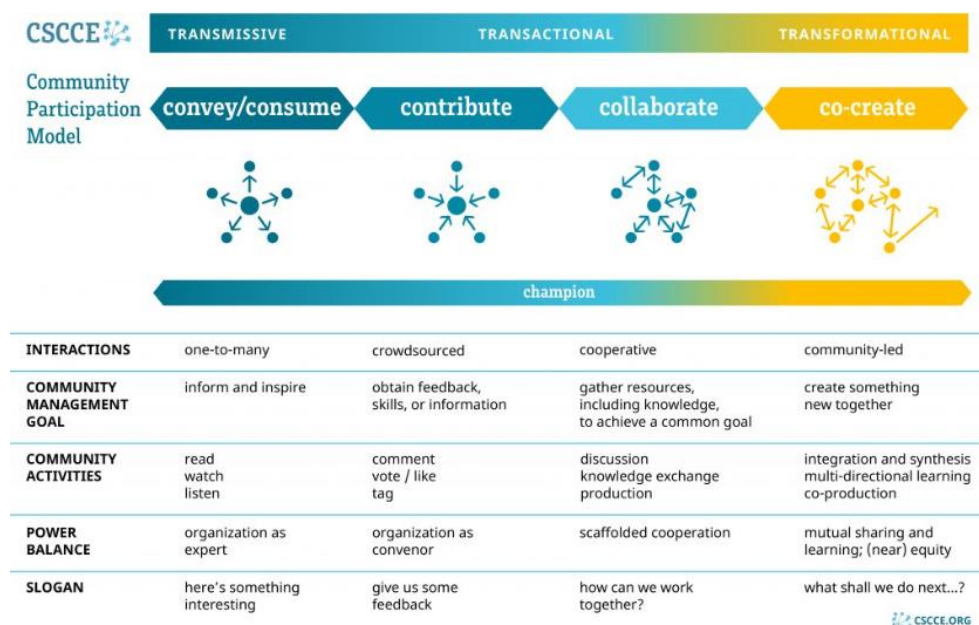
Community participation in technical infrastructure is possible but challenging

While this model is most applicable to Crossref's community and member engagement activities, it also has the potential to inform decision-making around software development and governance. However, it is important to note that this remains a social

model rather than a technical model and there are additional risks surrounding distributed systems and central authorities that apply in these alternative contexts.

Nevertheless, the goal of Crossref is to have others contribute to both the community and technical aspects of the organisation, such as with metadata, retraction watch and ROR, in a ‘curated crowd-sourced’ format. The *Software Carpentry* movement was highlighted as a model for ways that Crossref could move towards a true community model, with Crossref’s technical staff teaching others how to use and contribute to the system.

Figure 4: Centre for Scientific Collaboration and Community Engagement’s Community Participation Model



3.3 Drivers for change

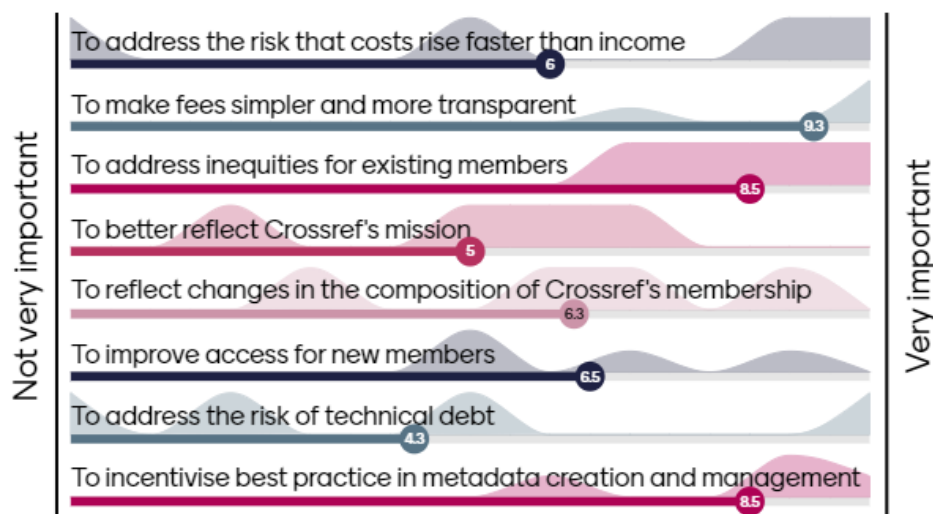
A number of drivers for change were identified in relation to Crossref’s charging model

Our work identified a number of potential drivers for change in relation to Crossref’s charging model, which were identified and explored through the first workshop and individual consultations. The project team at Research Consulting collated the views of the directors and synthesised these into eight potential drivers for change, as follows:

- To address inequities for existing members
- To improve access for new members
- To reflect changes in the composition of Crossref’s membership
- To address the risk that costs rise faster than income
- To address the risk of technical debt
- To make fees simpler and more transparent
- To incentivise best practice in metadata creation and management
- To better reflect Crossref’s mission

These challenges were presented to four of the Crossref directors as part of the second validation workshop, where they were asked to reflect the importance of addressing each of the challenges. The results of this exercise can be seen in Figure 5.

Figure 5: Perceived importance of drivers of change



Three main reasons to adjust the charging model were identified

These findings indicate that the three primary reasons to change Crossref's charging model are to:

1. Make fees simpler and more transparent.
2. Address inequities for existing members.
3. Incentivise best practice in metadata creation and management.

Other concerns such as addressing the risk that costs rise faster than income and addressing the risk of technical debt resulted in divergent views in terms of prioritisation. While it was felt by all that these need to be addressed, they are not the primary motivating factors for adjusting fees. There was agreement, for example, that cost increases stem from a combination of inefficiencies within the existing system, headcount growth and investment in cloud infrastructure, and that adjusting fees is only one of several potential ways to address these issues.

Achieving these goals will involve trade-offs

It is important to note that making fees simpler and more transparent and incentivising best practice in metadata creation and management may be mutually exclusive to some degree and there will be trade-offs that have to be made in achieving these goals. This can be addressed in part by taking a staged approach to their implementation, with an immediate focus on simplifying the current fee structure followed by a longer-term initiative focussed on incentivising better metadata.

4. Crossref’s revenue and cost drivers

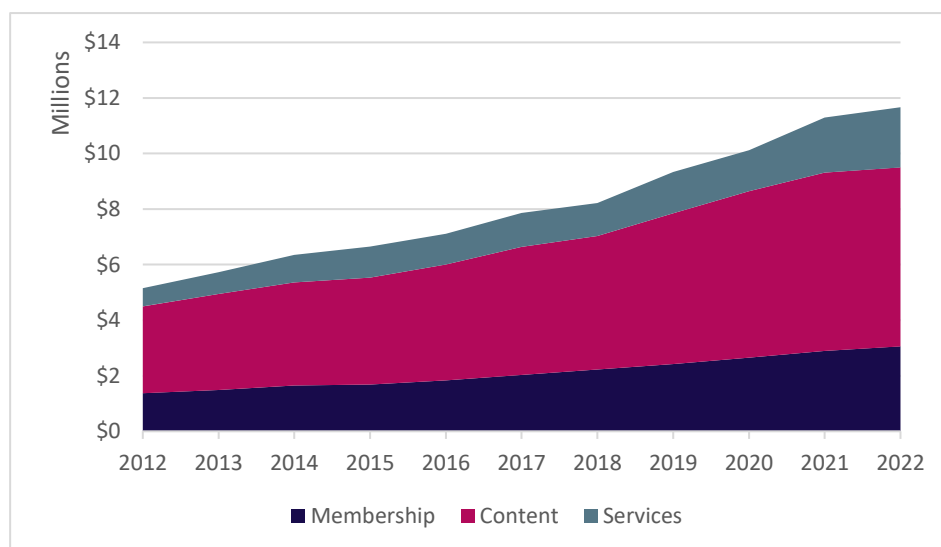
Over the last decade Crossref has seen revenue growth across all of its activities but most notably from services. The key drivers of its revenues and costs are identified and assessed in terms of their impact and the extent to which its management team can exert control over these elements.

4.1 Revenue growth over time

Crossref’s revenue comes from content registration, membership and services

As outlined in the not-for-profit business model canvas (Figure 2, above), Crossref generates revenue from fees for content registration, membership and services like Metadata Plus and Similarity Check. Over the last decade Crossref’s revenue from services has seen the fastest growth, increasing from \$655k in 2012 to \$2.16m in 2022, a 330% increase. Membership revenues have also grown rapidly, from \$1.4m in 2012 to \$3.06m in 2022, a 223% increase. While content registration remains by far the most significant source of revenue overall, it has grown slightly less rapidly, from \$3.13m in 2012 to \$6.44m in 2022, a 206% rise.

Figure 6: Crossref 10 year revenue trend



4.2 Changes in scholarly communication

Content revenues are closely tied to growth in scholarly outputs

Crossref has long benefited from a close alignment between its revenues, activities and growth in the volume of scholarly output. The volume of journal articles continues to grow, reflecting the expansion of research across numerous disciplines, and this has underpinned continued growth in Crossref’s content registration fees. Concurrently, we are witnessing an increasing recognition and acceptance of preprints and other forms of

scholarly output, including peer reviews and data. At present these other outputs account for only a small share of Crossref's revenues in both volume and per unit terms.³ There is no immediate reason to anticipate a decline in the volume of traditional scholarly outputs. Nevertheless, over the medium-term there may be value in narrowing the price differential between traditional and newer forms of scholarly output, so that changes in scholarly communication practices (for example a shift away from journal articles and towards preprints) do not lead to income volatility.

Membership revenues reflect the changing nature of publishing and publishers

While there is a broadly linear relationship between registered content and revenues, the picture for membership is more complex. Publishing has become progressively globalised and democratized in recent years, with research organisations and libraries increasingly assuming the role of publisher. Crossref's membership has grown accordingly, with the vast majority of growth having occurred within the lowest membership tiers (sponsored organisations and those with total publishing revenues or expenses of <\$1 million). Increasingly, membership organisations have benefited from sponsorship or relief from membership and content fees under the **Global Equitable Membership (GEM) program**. The significant growth in membership in recent years has brought in additional income and sponsoring organisations often act as a buffer between the smallest members and Crossref itself, providing technical, administrative and linguistic support. Nevertheless, the cost of onboarding and supporting new member organisations is non-negligible and is not always matched by additional revenues.

Demand for high-quality metadata has driven growth in services

There is a growing demand for high-quality metadata in scholarly publishing, driven by the need for better discoverability, interoperability, and data management. In the light of these changes, Crossref's role as a community-owned, global source of scholarly metadata has grown in significance over recent years. This has underpinned the significant increase in revenues from services.

4.3 Understanding Crossref's revenue drivers

Revenue drivers were assessed based on impact and management influence

In order to inform future scenario modelling efforts, work was undertaken to identify key drivers of Crossref's revenue through both desk research and consultations with key stakeholders. 15 identified drivers were collated and presented to the Crossref directorial team through the second validation workshop and broadly fall into three groups:

- The number of members and users of Crossref's different services.
- The distribution of these members and users by size.
- The pricing of membership and services.

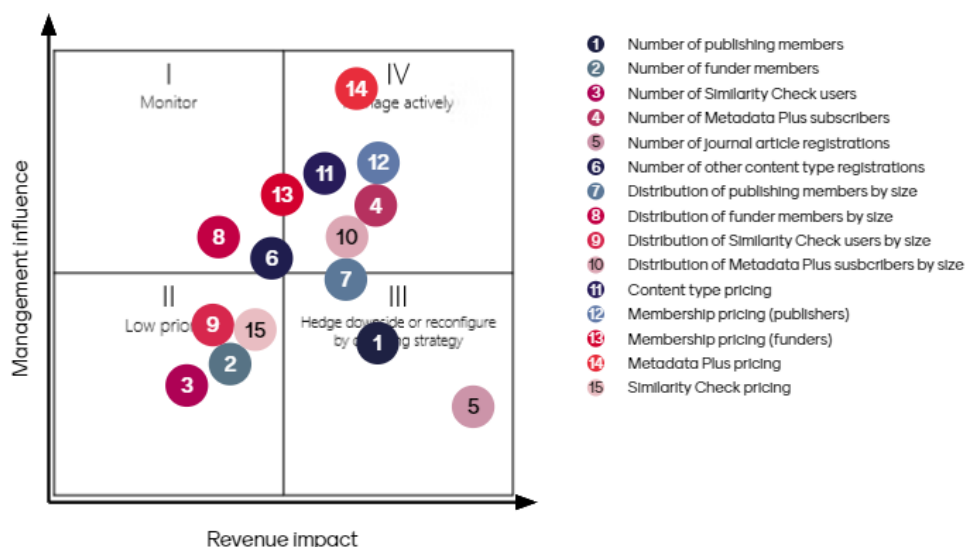
³ The registration fee for journal articles, book titles, conference proceedings and conference papers, technical reports and working papers, theses and dissertations is \$1, while for grants it is \$2 and for other records such as datasets and preprints it ranges from \$0.06 to \$0.25. See <https://www.crossref.org/fees/> for further information.

Participants were asked to rate the revenue and costs drivers in terms of the impact they had and the influence they had over them. Each scale went from 0 to 10, creating a 2x2 matrix with four sections:

- **I – Monitor** - Revenue drivers which are amenable to management influence but have limited impact on overall revenues
- **II – Low priority** - Revenue drivers which are *not* amenable to management influence and have limited impact on overall revenues.
- **III – Hedge downside or reconfigure** - Revenue drivers which are *not* amenable to management influence and have a significant impact on overall revenues.
- **IV – Manage actively** – Revenue drivers which are amenable to management influence and have a significant impact on overall revenues.

The results can be found in Figure 7, which reflects the average scores assigned by four Crossref directors to each driver.

Figure 7: Revenue driver results



The size and pricing of funder members, and the volume of other content types registrations should be monitored

The identified revenue drivers are distributed across four quadrants. In quadrant I, the number of other content type registrations, the distribution of funder members by size and funding membership pricing are areas where there is a higher level of management influence but comparatively little impact on revenue. These are areas which should be monitored but not prioritised for the implementation of changes.

The number of funder members and all aspects of Similarity Check are low priority

Similarly, Crossref is perceived to have very little influence over drivers in quadrant II, which relate to the number of funder members and variables concerning Similarity Check. However, these also have little influence over Crossref’s revenue and as such we recommend that these are largely left alone in the short and medium term.

Journal article registrations and the number and distribution of publishing members are business

The drivers located in quadrant III, to the bottom right, are the number of journal article registrations and the number and distribution of publishing members. These are highly influential in terms of Crossref’s revenue but are not easily amenable to management influence. Changes in these variables should be carefully monitored and strategies

critical but difficult to influence

developed to hedge any downturn, for example by gradually closing the gap in pricing between other content types and journal articles.

Pricing of content, publishing membership and uptake of Metadata Plus should be actively managed

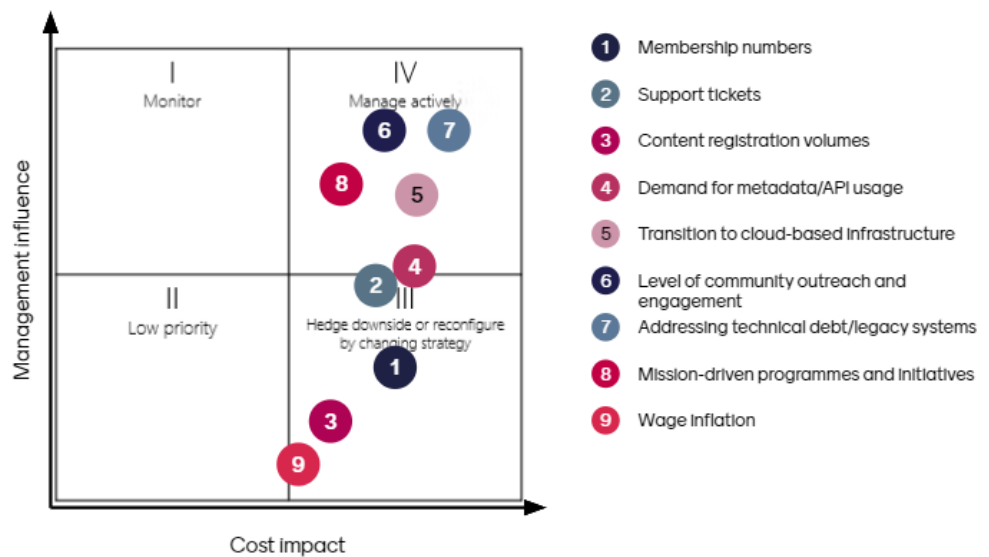
Drivers in quadrant IV are those that are seen to be highly impactful on Crossref’s revenue and over which Crossref’s management has a high level of influence. As such these are the key drivers that we recommend Crossref focus on in reviewing its resourcing requirements and fee structure. Unsurprisingly, Crossref’s pricing decisions for publishing members, content registration and Metadata Plus were considered to be in this quadrant. Metadata Plus was highlighted as an area where implementing changes would be comparatively easy, given the relatively small number of users, as discussed later in this report.

4.4 Understanding Crossref’s cost drivers

Cost drivers were similarly assessed for impact and management influence

A smaller number of key cost drivers were identified than revenue drivers, and the relationship between these drivers and the actual costs incurred is necessarily more complex than for revenues. The results of the cost driver assessment can be seen in Figure 8, showing the average scores for each driver. Results represent the average views of four of the Crossref directors.

Figure 8: Cost driver results



70% of Crossref’s costs relate to staff

The majority of cost drivers are considered to have a direct or indirect impact on Crossref’s headcount. This in turn drives staff costs, which account for 70% of the organisation’s total expenditure (see Figure 2, earlier in this report). Other key drivers of cost relate to technical infrastructure, most notably the transition from locally-hosted to cloud solutions, and the level of community outreach and engagement, in the form of travel and subsistence expenditure.

Membership numbers, content volumes and wage

The identified cost drivers were all considered to have a significant impact on costs for Crossref, however there remains a clear distinction between those amenable to low,

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inflation are difficult to influence and have a significant impact on costs

medium and high levels of management influence. Membership numbers, content registration volumes and wage inflation (for existing staff) are all difficult to control but have a significant impact on costs. However, increases in membership numbers and content registration volumes should also result in increased revenues to counterbalance any associated cost increases. The ability to scale revenues in line with activity and expenditure represents a key strength of Crossref's existing business model.

The costs of support ticket requests and demand for metadata/API can be partially mitigated

Support ticket requests and demand for metadata/API usage also have a significant impact on costs, but are at least partially susceptible to management influence. In the case of support ticket requests, a reliance on manual processes results in escalating costs which could be better controlled through greater automation. In terms of metadata/API usage, costs tend to be fairly stable until demand exceeds a certain level, at which point either additional investment in infrastructure is required or steps must be taken to constrain demand.

The cost drivers Crossref can actively influence are related to its mission, community and technical infrastructure

Contrastingly, drivers including the level of community outreach and engagement, addressing technical debt and legacy systems, mission-driven programmes and initiatives, and the transition to cloud-based infrastructure were all seen to have high impact and high levels of management influence. As such, these are the key cost drivers that can be actively managed to ensure Crossref's future sustainability. The directors further reported that these drivers are closely tied together, which increases understanding of these results.

While some factors such as engaging in mission-driven programmes and initiatives were reported to have high management influence, at least in the shorter term, participants further reflected that while they could choose to engage with initiatives or not, not doing so could have considerable follow-on negative impacts. Similarly, reducing investment in infrastructure and slowing the transition to the cloud could also yield short-term cost savings but cause long-term damage to the organisation.

5. Options for the revision of Crossref’s fees

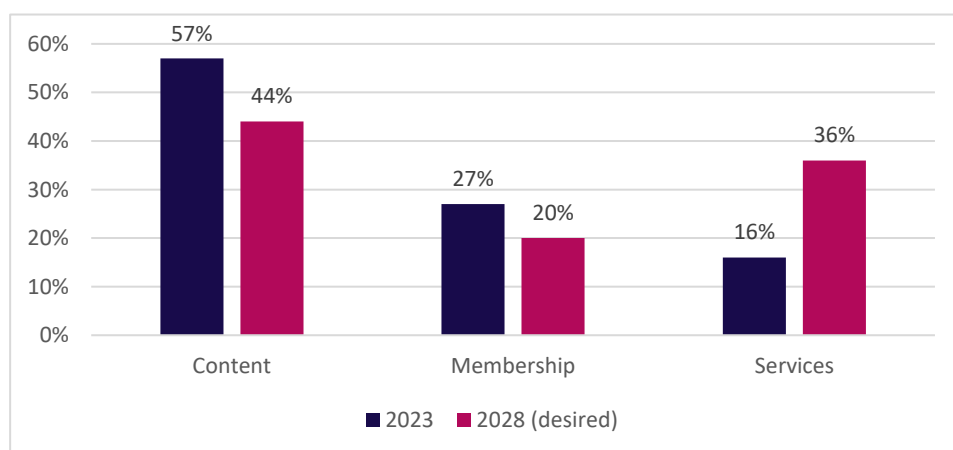
Following identification of the key drivers for Crossref’s costs and revenue that it is able to actively manage, discussions with Crossref directors considered the organisation’s desired income split in five years’ time and the available options for revising its existing fee structure.

5.1 Future income split

The majority of Crossref’s income currently stems from Content registration

Crossref’s current income split, as per its 2023 operating budget, can be seen displayed in Figure 10 below, alongside the desired income split in 2028. Results for 2028 represent the average views of the five Crossref directors. This chart confirms that the majority of Crossref’s current income stems from content registration fees at 57%, followed by membership fees at 27% and services fees at 16%, including Metadata Plus subscriber fees, Similarity Check and subcontractor revenue.

Figure 10: Crossref’s current income split and desired income split for 2028



Crossref’s directors anticipate that services revenue will overtake membership in the next few years

The 2028 results highlight the desire for a decrease in the proportion of revenue stemming from membership and content fees and an increase in the share coming from services. Although content registration will remain the largest source of income, revenue from services is expected to overtake that from membership fees in the coming years.

Participants agreed that membership fees must remain, albeit as a reduced proportion of overall income, as these foster a sense of ownership and community for members. This can be further linked back to the application of the community participation model to Crossref’s future direction in Section 3.2.

There was emphasis on the increase to services being in relation to services that meet Crossref’s mission rather than allowing services to become a dominant revenue source for an increase in income and risking distraction from the overall aims of Crossref. It was further reflected that content registration is itself a service in some respects, with other services such as Similarity Check and Metadata Plus contributing to a smaller proportion of income.

A further distinction was made between member and non-member revenue within the services contribution. While 36% of future revenues might relate to services outside of content registration, in many cases these services would continue to be provided to Crossref members, with only a small minority of total revenues (e.g. 10%) being generated from non-members.

5.2 Options for revising Crossref's fees

There is agreement that several elements of the existing charging model should be retained

Suggestions for fee options were gathered throughout the facilitated workshops and the individual consultations with directors. Throughout this, a number of characteristics of the current charging model were highlighted as being positive and/or integral to Crossref's business and identity and therefore these are factors that Crossref should ensure remain in any future iterations of their charging model. These included:

- The principle of having a membership fee - this is part of Crossref's DNA
- Retaining a link between revenues and costs
- Value-based rather than cost-based pricing of services

10 options for revising Crossref's existing fee structure were identified

Directors' suggestions for revising Crossref's fee structure were analysed by Research Consulting into a list of 10 options for revising Crossref's fee structure, as follows:

1. Revise membership tiers, especially at the upper and lower ends
2. Simplify content registration fees
3. Remove backfile fees (with 1-2 years' notice)
4. Revise Metadata Plus pricing to better reflect the value delivered to users
5. Spread DOI charges over time, to reflect ongoing commitment to maintain these
6. Create endowments to support smaller members into the future
7. Allow publishers to pre-purchase DOIs for future years
8. Offer a rebate on DOI charges linked to quality of metadata
9. Offer volume discounts across the board, including journal articles
10. Link fees to purchasing power parity

5.3 Impact-effort assessment

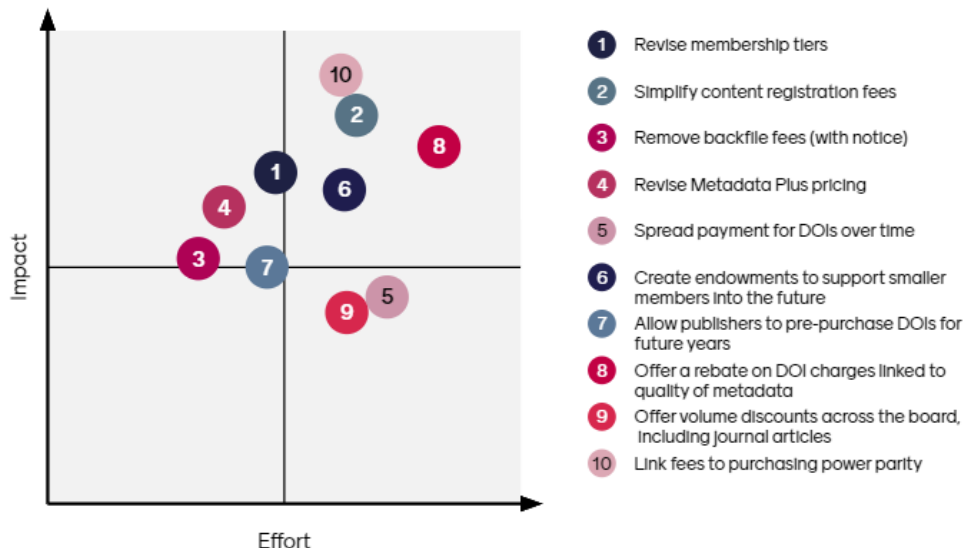
Participants fee options in terms of impact and effort

Directors were asked to assess the 10 options during the validation workshop, in terms of the effort they would require and the positive impact they would have.⁴ The results of

⁴ Impact in this context was considered to encompass both financial and non-financial benefits, such as furtherance of Crossref's mission.

this can be seen in Figure 10 and represent the average views of the five Crossref directors.

Figure 10: Impact-effort assessment of fee options



A set of options to prioritise were gathered

Results of the value-effort assessment are organised into quadrants, in relation to the positive impact they would have and the effort that they would take. Overall, the results indicate a positive correlation between the level of positive impact fee changes could have and the level of effort these would take. Overall, the options can be analysed into three groups: Evaluate, Explore and Exclude.

EVALUATE: revise pricing for membership and Metadata Plus; remove backfile fees; pre-purchase of DOIs

Four options have a high level of support from the directors and the level of effort required is expected to be relatively low vs. the positive impact anticipated. Their viability should now be evaluated through more detailed internal modelling and consultation with Crossref's external stakeholders. The options in this group are as follows:

- **Revise membership tiers** – paying particular attention to those within the upper and lower tiers.
- **Remove backfile fees** – demand for these is falling steadily but it will be important to give publishers advance notice of the change.
- **Revise Metadata Plus pricing** – the current pricing structure is not felt to be fully reflective of the benefit derived by users and changes are relatively easy to communicate and implement.
- **Pre-purchase of DOIs** – Small publishers often ask to pre-purchase DOIs using time-limited funds but this is not currently possible. Accommodating this would require some administrative changes but is considered achievable and would be well-received by the community.

EXPLORE: PPP-based fees, simplifying content

Four other options could have a significant positive impact but are complex and/or politically sensitive to implement. These should be explored to understand their

registration pricing,
endowments and rebates

technical viability and the potential for unintended consequences to arise before moving to a formal evaluation stage, if appropriate. The options in this group are as follows:

- **Link fees to purchasing power parity** – There is growing interest in the potential to link prices to purchasing power in other areas of scholarly communication.⁵ Adopting this approach would require careful modelling and consultation but could deliver significant progress in terms of equity.
- **Simplify content registration fees** – There is significant potential to simplify fees for content registration but this would require a number of changes to Crossref’s internal systems, modelling to identify its impact on edge cases and community consultation.
- **Offer a rebate on DOI charges linked to quality of metadata** – This would allow one of the three identified priorities for this work to be progressed but would be a complex undertaking that needs further exploration and consultation.
- **Create endowments to support smaller members into the future** – Creating endowments to support smaller members could help improve equity and support long-term sustainability but requires further exploration.

As all of these would take time and effort to implement the next step should be to explore them with Crossref’s board and membership community to determine which of them to take forward, and over what timeframe.

Conversations in the workshop further reflected that there may be a natural order or sequence to fee changes that would impact the effort involved and the impact that will result. For example, linking fees to purchasing power parity would be easier if content registration fees and membership tiers were simplified first. This sequencing would allow Crossref to begin making some changes while signalling its intention to implement others in the future, if these gain the necessary degree of community support.

EXCLUDE: spreading
payments over time and
offering volume discounts
across the board

Two further options - **spreading payments for DOIs over time** and offering **volume discounts across the board** - would take considerable effort for relatively less reward and so can be excluded from further consideration.

⁵ For further information on other industry initiatives in this area see <https://www.coalition-s.org/fair-global-pricing-consultation/> and <https://beta.elsevier.com/about/press-releases/elsevier-introduces-geographical-pricing-pilot-to-support-authors-in-low-and>

6. Next steps

This preliminary review has explored where Crossref is currently and how it may evolve as an organisation in the future, while identifying a set of options for revising its current charging model. This final section outlines potential next steps, building on the work done to date with Crossref's directors to secure input from a wider set of stakeholders.

Identifying next steps

This preliminary report has identified key drivers for revising Crossref's charging model, and through a process of evaluating cost and revenue drivers and subsequent ideas for fee revisions, a number of areas have been highlighted for evaluation and exploration as outlined in the previous section. Proposed next steps for this work are outlined below and summarised in the timeline in Figure 11, below.

Board consultation and approval to proceed

As outlined in the beginning of the report, this preliminary review has only sought the views of the five Crossref directors. Input from Board members and Membership & Fees committee members will need to be sought regarding the direction of travel outlined in this report, with any feedback reflected in the plans developed after this point.

Budget modelling and review of fees

Should the Board endorse the overall direction of travel, an immediate next step would be to develop a comprehensive data model of Crossref's existing membership and user base, bringing together information on current payments for membership, content and services together with relevant data on each organisation (e.g. membership tier). This would allow outliers under the current fee structure to be identified and would allow the impact of alternative fee structures to be modelled and assessed both in overall terms and for different stakeholders, including edge cases. A potential way to undertake this analysis would be via 'multi layered scenario analysis' within Microsoft's Power BI data visualisation tool.

Community consultation

A further critical step will be to undertake a wider consultation process with Crossref's community from late 2023 to mid-2024. This consultation would be expected to seek community feedback on a set of potential options for change. These would be based on the high-level options outlined within this report but expanded and refined on the basis of the internal modelling exercise above. We would recommend that this process incorporates both a quantitative survey to allow for breadth of community input as well as qualitative interviews or focus groups to understand stakeholder priorities and concerns.

Technical assessment

While the impact/effort matrix in Figure 10 provides a rough indication of the complexity of each option, a full technical assessment will need to be undertaken of the proposed changes, recognising that some would involve substantial revisions to Crossref's existing systems and business processes. As part of this it will be important to establish an approximate 'lead time' from deciding to implement a change and it being rolled out in practice. For example, it is understood that eliminating backfile fees could be adopted

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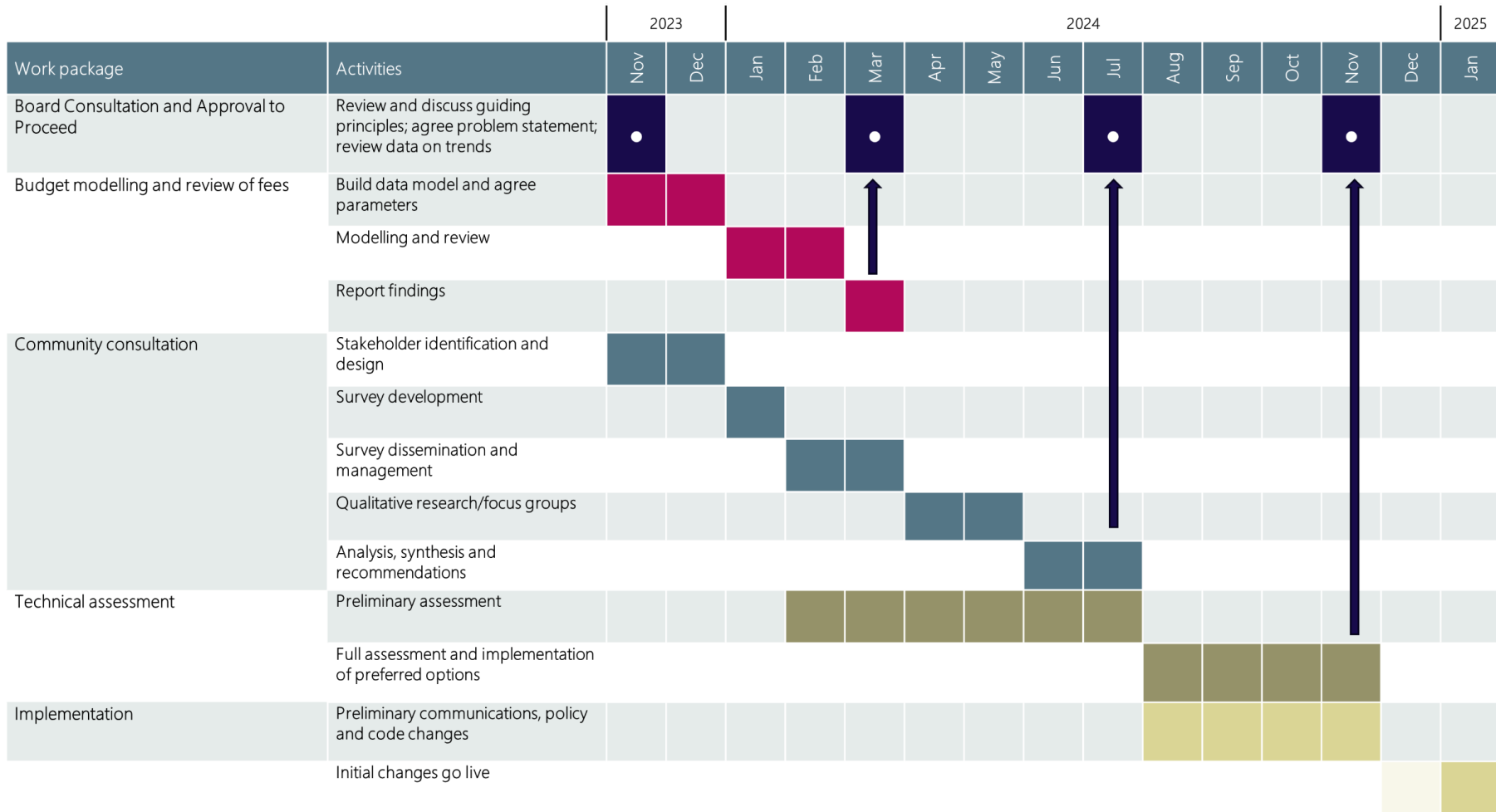
within a matter of a few months, but developing a mechanism to reliably link fees to metadata quality would need to be a long-term undertaking.

Communication and implementation

Drawing together inputs from the above activities, the intention should then be to prepare a timeline of changes, distinguishing between those which can feasibly be implemented in 2025 and those with a longer lead time. In the latter case it may still be appropriate to signal Crossref's intention to make these changes as a means of giving users and members as much time as possible to understand and prepare for their impact. Following approval of a new fee structure, relevant policy and code changes would need to be implemented and a communication strategy adopted, with implementation of the initial round of changes due to take place from January 2025.

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Figure 11 Indicative implementation timeline



Appendix A. Project Contributors

The table details the individuals from the Crossref team who contributed to this project.

Individual	Role
Ed Pentz	Executive Director
Geoffrey Bilder	Director of Technology and Research
Ginny Hendricks	Director of Member and Community Outreach
Lucy Ofiesh	Director of Finance and Operations
Rachael Lammey	Director of Product



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