dpp®

THE TRUTH About Standards

Enabled by

ROSS®

Foreword

Standards. Isn't that a topic many of us have a love/hate relationship with? I don't think anyone disputes their value, and indeed, their critical importance to our industry. From the first film-related standards of over a century ago through physical connections of hardware of more recent history, all the way to today's world of standards being primarily software oriented, one common thread remains. When interoperability is needed, standards are the answer, whether they are developed by a true Standards Development Organization (SDO), by a trade organization, or if they emerge as de facto standards due to widespread adoption, they all try to solve the same problem – making things work. I think all of us can also agree that making things work in today's world is an increasingly complex proposition. So many vendors, platforms, architectures and really just so many variables in today's on-prem/cloud/hybrid world means that things don't just plug and play without real work going into making that happen.

I think it's fair to say that media as we know it today wouldn't exist without standards. However, it takes real work to not only develop them, but then to implement them in the real world.

Anything as complex as standards is by definition not easy, but then, is anything truly worthwhile easy?

I hope you find this report enlightening as a reality check on where we are today with standardization, as well as where we should be headed. It certainly contains some real surprises and learnings for me, and I hope it does for you, as well.

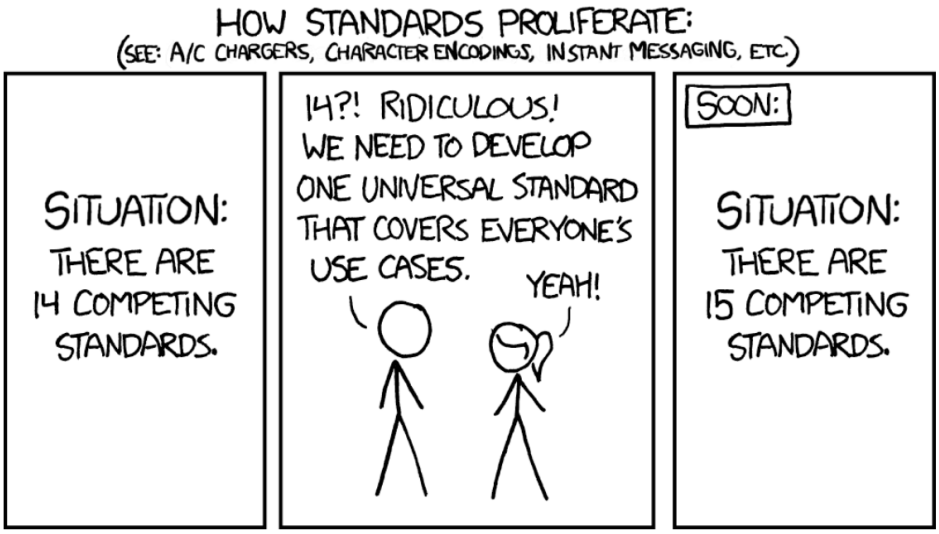
Chris Lennon
Director of Standards Strategy, Ross Video

Contents

Introduction

It's often said that the best thing about standards is that there are so many to choose from.

Indeed, the problem of having too many standards is so famous that it became the subject of the popular web comic, ***XKCD***.



Yet it is not uncommon for engineers and executives alike to call for greater standardisation in key areas of media technology.

So what is the right balance of *enough* standardisation to meet the needs of the modern media industry?

Interoperability is crucial to an effective global media supply chain

DPP members also tell us that standardisation processes can be slow, political, and difficult to navigate. But few would deny that interoperability is crucial to an effective global media supply chain. So what is the right approach to achieving interoperability? How are standards evolving, and what other approaches are available?

These are fundamental questions that define how we work together as an industry. That's why the DPP has conducted a unique survey, to find out what the industry really thinks and does about standards.

Executive Summary

1

Adoption matters above all else

Content companies and vendors seek confidence that the formats and protocols they implement are well supported. Standardisation can help provide this confidence, but evidence of widespread adoption is far more important to users than process formality.

2

Today's standards processes are frustrating

Engagement with standards groups is high, but survey respondents were vocal about frustrations with current standards processes. They are slow, resource intensive, and it's hard to measure the ROI. They often deliver broad and over-engineered solutions, with a lack of business focus.

3

There are many paths to success

There are more approaches to standardisation than ever before, including formal standards, de facto standards, and open source protocols. Many respondents claim to prefer formal standards, yet satisfaction ratings from implementers reveal that no single approach is inherently superior.

4

One approach does not fit all

Different problems require different standardisation approaches. Inflexible areas such as hardware interfaces and foundational protocols need rigour and thoroughness. But APIs and metadata structures - both of which would benefit from more standardisation, according to our survey - require a new approach.

5

Standards development is a form of product development

Standards processes of the future should more closely resemble the methods of agile software development and open source. They need active facilitation in order to be simpler, more business focused, faster, and more iterative. And their resulting standards need to be marketed and supported by testing tools, media, and sample code.

Contributors

The content for *The Truth About Standards* has been gathered through an industry wide survey, which received responses from 224 experts from 129 companies. We are grateful to each of them for their time and consideration.

Valuable input has also been provided by Ross Video, whose support made this work possible.

Contributions were received from individuals at the companies listed below. It should be noted that the views expressed in this report are formed from the aggregate of all survey responses, and it must not be assumed that every respondent shares all the views presented here.

7FiveFive
A+E Networks
ABC News
Ad Signal
Akamai
Amazon
Arqiva
Ateliere
Authorwave
Avid
BBC
Blackbird
Blackmagic Design Technology
Brightcove
BT Media & Broadcast
Carrick Skills
Cerberus Tech
CGI
Channel 4
Cinnafilm
Codemill
Comcast
Convergent Risks
Dalet
Data Language
DAZN
dB Broadcast
Dell
Disney
Dolby
EBU
EditShare
Endava
Envy Post Production
Euro Media Group
Eyevinn Technology
Fabric
Fastly
FooEngine
Fox
Fraunhofer Institute for Integrated Circuits IIS
Fusion Media
Globecast
Google
Hiventy
Humans Not Robots
IMG
InSync Technology
ITN
ITV
Iyuno-SDI Group
Limecraft
M2A Media
MainConcept
Marquise Technologies
MediA Digital Nutty
Media Tailor
MediaSaaS

Contributors

MediaWR
Meta
Microsoft
Mirriad
MovieLabs
Mr MXF
Multiview Media
National Geographic Channel
NEP Group
Nomalab
Nostairway Creative
NRK
nxtedition
Open Broadcast Systems Ltd
Overcast
Paramount
PBS
Pebble
Pixel Power
Premiere Digital
Prime Focus Technologies
Q3 Media Training
Qvest
Red Bee Media
Redacted Shiny
ReMake
Reuters
Rev
Rightsline
Rogers Sports & Media
Rohde & Schwarz
Ross Video
Royal Opera House
RTE
RTL Nederland
Samsung
SDVI
Signiant
Sinclair Broadcast Group
Singular.live
Sky
Sony
Starfish Technologies
Stats Perform
Sundog Media Toolkit
TAG VS
Telestream
The Finish Line
Three Wise Monkeys
Tin Can Post
Tinkerlist
Tinopolis
TMT Insights
Touchstream
TV2 Denmark
U.S. Library of Congress
University of Surrey
V-Nova
Verizon
Vimond
Visual Data Media Services
Vizrt
Vubiquity
Warner Bros Discovery
WaveOne
x.news information technology
Xytech Systems
ZDF
ZDF Studios
Zixi
ZOO Digital

1 The benefits of standards

It would be impossible to deny that, in many cases, some form of standardisation is hugely beneficial.

Global trade would be far less efficient and valuable without standardised shipping container sizes

Global trade would be orders of magnitude less efficient and valuable without the standardisation of shipping container sizes, for example. And in our own industry, viewers would not be able to watch television were it not for a plethora of standards around transmission over the airwaves, encoding of video and audio, and so on.

In this report, we'll use the responses of over 200 DPP members to understand where standards play a valuable role, where they cause frustration, and how they must evolve for the future.

WHAT'S IN A NAME?

Throughout this report, we use the word 'standard' very broadly, to refer to any format, interface, or protocol which is defined and published in such a way that multiple parties can implement it.

It could be published through a Standards Development Organisation following peer review, or it could be a proprietary format unilaterally published by one company, or one of many options in between.

As such, our broad definition of 'standards' includes de facto standards, specifications, published best practices, and much more besides.

Where we wish to differentiate a formal Standard, published by an ISO recognised Standards Development Organisation, we will specifically refer to a 'formal standard'.

THE NEED FOR INTEROPERABILITY

The basic promise of standards, in the most general sense, is to enable interoperability. Multiple products, vendors, and organisations should be able to exchange messages, information, and media seamlessly.

> When you send a signal, the receiver must know the decoding algorithm. This was true since the invention of Morse code and the first telegraph.

> Standardisation is meant to bring clarity between stakeholders and systems, to enable systems to better understand each other, and make interoperability achievable.

Standardisation makes interoperability achievable

> Standards are critical to our ability to be able to interconnect and interoperate with our customers' content and signals. They are also critical to our ability to procure equipment competitively.

Well adopted standards increase user confidence by reducing variability and risk.

> Using standards gives us the confidence to invest in new technology that will have the best chance of interoperability and longevity.

> Standards drive precision, reducing ambiguity and margin for error.

Using standards gives us the confidence to invest

The benefits begin when choosing systems and products to purchase.

> It's simpler for a customer to include a standard in an RFP or general requirement specification.

Standards should then make it easy to build solutions using multiple vendors and partners.

> When proven standards are adopted industry wide, software and equipment just seem to work.

> Products using standards more often work together the first time. We still have to spend a lot of time fixing or dealing with products that do not implement standards.

When proven standards are adopted, equipment just seems to work

In turn, the reusability of components should result in reduced costs.

> We note the huge reduction in costs when all productions can be passed through the same pipeline.

In principle, strong standards also enable workflows and systems to be adapted, changed, and improved over time, by making it easier to swap out tools, processes, and partners.

> Standards are essential for giving us flexible and reconfigurable workflows. The components of the workflow need to interoperate for them to be composable.

Standards give us flexibility

At their best, standards provide a shared understanding of how data should be exchanged, encoded, or operated on, enabling vendors who implement them to focus on points of differentiation.

> Standardisation saves time from reinventing the wheel and allows us to focus on the features that make a difference.

> Standards provide a common playing field that helps accelerate the time to market for new products.

For media companies, meanwhile, standards can also help to avoid unnecessary duplication of work.

> Choosing to align to an industry standard can simplify operations. Many companies are solving nearly identical problems, and using standards to align solutions can save the trouble of each company devising the equivalent of their own rail gauges and shipping container sizes.

The development and adoption of a standard can create a community around a particular format, which is often highly beneficial to all involved.

> It's very beneficial when an active community comes together around a technology, leading to a better collection of ideas and usable tools.

If we don't adopt a minimum set of standards, it will stifle agility and innovation

A lack of standards, by comparison, increases the cost and complexity of building multi-vendor solutions or multi-company workflows.

> The risk is that if the industry doesn't adopt a minimum set of standards, it will unduly add cost and stifle agility and innovation.

AN EVOLVING CONTEXT

Historically, it was often the case that formats and interfaces fell into one of two opposing camps: formal open standards created by a recognised standards body, or closed proprietary formats only used by one vendor.

This was especially true with hardware, although similar patterns are still seen in some software and file based workflows.

Proprietary formats are often viewed as a way for vendors to lock users into their tightly integrated ecosystem of products.

> **Proprietary interfaces create vendor lock-in. When you wish to change vendor or renegotiate, that lack of flexibility increases the cost of transition.**

Proprietary interfaces create lock-in

> **We all need standards in order to ensure interoperability and avoid vendor lock-in. Without them, there is no guarantee your content will play on another system, and it may not play on consumer devices either.**

In software products, the proprietary hardware interface is often replaced by an Application Programming Interface (API). This may be based on an open standard, or kept private. Often, however, a third way is used. APIs are frequently defined by one company but published for anybody to integrate against.

The ability to connect to well documented APIs can mean that the effort required to integrate some products is dramatically reduced.

> **As an API first SaaS platform, we are fortunate to be able to quickly connect and integrate to any system subject to API protocols and documentation.**

We can quickly integrate any system with APIs and documentation

However, while it might be quicker to integrate APIs than hardware interfaces, it is also quicker and easier for APIs to change, for new APIs to appear, and for different vendors to diverge. To some, this creates a new type of integration complexity and risk.

> As broadcast systems have moved from the plug and play of SDI to be an IT industry, it has become more time consuming to try and get systems to work together.

The flexibility of software means that some capabilities - such as live video production - may be less standards-based than they used to be. This can add cost and time to integrations.

> We have spent a long time developing interconnection between us and another company for a major event - if we'd both used traditional methods of delivery this wouldn't have been needed.

> Traditionally, systems have been interconnected using baseband formats. As components have been virtualised, there is less need to go back to baseband. Instead, suppliers have invented virtual interconnects best suited to their applications and ecosystems. These are rarely open, and often prevent us taking advantage of process efficiency.

Current standards processes are not well suited to the modern software world

Nevertheless, the world of software based media production and distribution undeniably moves faster and requires more flexibility than the hardware based world of years gone by. This has left many questioning whether the traditional approach to standards remains valid.

> Current standards processes in our industry are not well suited to the modern agile software world. They are frequently stuck in a mindset that comes from the hardware world.

It is clear that interoperability is essential, and that standards are central to achieving it. But in order to understand the path forward for standardisation, we must also consider the drawbacks and compromises of standards today.

2 The problem with standards

Our contributors were as forthcoming about their frustrations with standards as they were about the benefits. A few common themes emerged when examining the pain points that users feel.

KEEPING PACE

The most common complaint was that the creation of standards - and formal standardisation processes in particular - is too slow.

> The process takes far too long, and risks failing to adapt to realities on the ground.

> The main problem with standardisation is that it takes too long. The pace of industry change and development is simply too fast now for the traditional methods of standardisation to keep up.

The pace of industry change is too fast for traditional methods of standardisation to keep up

It's in this area that Standards Development Organisations (SDOs) came under some criticism from survey respondents.

> We've been materially frustrated with standards organisations, for multiple reasons. They're inherently slow, and they come out with incredibly complicated approaches sometimes.

Slow pace is more than just an annoyance. If standards take too long to develop and deploy, they either slow down the industry's pace of innovation, or they become irrelevant.

> Standards often lag innovation. Capabilities of new technologies compete before the standards are finalised.

> Time to standardise isn't keeping up with the time within which customers need solutions.

When standards take too long, alternatives will appear, such as proprietary formats or in-house solutions.

> The risk can be that agreeing on a standard takes too long. In the meantime, inferior or half-baked non-standards can achieve faster adoption.

As we wanted to be transformational, the standards organisations were not looking at the right things

> As we wanted to be transformational, the standards organisations were not looking at the right things to enable us at that moment. So what we've done is take recommended practices and then go off in our own direction, in the belief that we have enough scale that as long as we were working in a consistent way internally, we were big enough to have our own standards.

RETURN ON INVESTMENT

While the time taken to complete a standards process is seen as a problem, so is the time investment required to make the process work.

The rigour of a traditional standards process requires a great deal of time invested by a range of stakeholders. For many companies, it's difficult to demonstrate the return on investment for this time.

> It can be an enormous time sink, with the payoff measured over so much time it's difficult to justify and maintain.

> Getting a standard published is a time consuming, resource driven, political process. The main risk I have encountered is wasting time.

A useful standards process requires strong input from its potential customers, so media companies' involvement is crucial. But many were particularly vocal about the difficulty in resourcing this involvement.

> 25 years ago there were teams within broadcasters whose job was to develop standards. But now there is no standing team for that. And the processes are such a time suck, with an endless cadence of meetings, that we just can't dedicate staff to that. Increasingly, everything in our world is a speed to market conversation.

Years ago there were teams whose job was to develop standards, but now there is no team for that

Once a standard is finalised, there is considerable additional investment required to implement it. The vendors in our survey were especially aware of the development effort that's needed, and the payoff which may or may not come.

> The issue with standards is a classic capitalist vs socialist situation. You have this idea that we all invest in standards and everyone shares the benefit. But in real life, it's very unusual that you'll invest in standards unless you're going to get a certain number of sales from it. The financial model doesn't support people actively investing in standards.

> It's a chicken and egg. No vendor implements a standard without a customer requirement. No customer calls for a standard to be implemented without vendor support.

The financial model doesn't support actively investing in standards

Media companies are also highly aware that implementing new standards is far from free. Such investment must be backed by an expected return.

> When dealing with the adoption of new standards, there are often no mechanisms to actually achieve these goals, especially when faced with legacy systems and complex integrations that are deeply embedded in our business.

One contributor summarised the problem succinctly:

> Clear business value has to be felt by all the stakeholders otherwise, adoption will not happen.

REPRESENTATION AND DEMOCRACY

There is a significant risk that lack of engagement becomes a self-perpetuating problem. Companies do not invest resources into standards development, because they cannot see immediate value. But their absence from the process increases the likelihood that the solutions developed fail to meet business needs.

> There are not enough end users, business-oriented people, and subject matter experts in the standards process. This causes standards to be insufficiently market oriented and too broad to deliver the desired benefits.

> The standardisation organisations would benefit greatly from enhanced participation by end users, who can properly input and validate requirements. And preferably, user representatives should be directly connected with real world business operations.

Standards organisations need representatives of real world business operations

Companies that do invest resources see a greater likelihood of their interests being met, of course. The problem that some respondents raised was that these organisations may have their own vested interests.

> **Standards can slow down the pace of innovation when they're driven by the agenda of a small number of companies.**

> **There's a risk that a specific party (most often a vendor) can manipulate a standard with extra complexity or 'bloat' that slows its progress down or makes it less useful, to protect their position. The compromises that result can weaken a standard.**

Of course, this is the inherent risk in democratic standards organisations: companies who can afford to invest resources into the process will have their voices heard more clearly. That may mean they advocate for their own technology, or slow down progress of alternatives.

> **There is a disproportionate weight of a few vendors in international standardisation bodies.**

> **Many companies (particularly wealthy ones) have used standards processes as a tool to further their own business interests, rather than to create a level playing field.**

Some companies use standards processes to further their own business interests

In many cases, companies or individuals do not do this maliciously, but it is only natural that each individual brings their own and their company's perspective to the discussion. It was also felt by some that 'big name' companies receive special attention.

> **Some standards organisations bend their administrative rules to accommodate the larger and older studios and industry technology leaders.**

ALL THINGS TO ALL PEOPLE

Where some standards groups are dominated by one or two large players, others suffer from the involvement of too many parties, according to our participants.

The result can be standards that are too broad, and standards groups taking too long to reach agreement.

> Standards almost always suffer from the “too many cooks” problem. They end up with features that are never used, and the need for consensus makes it harder to create a comprehensive ecosystem solution.

> There’s a risk of design by committee, where the resulting standard isn’t actually useful for anything in the real world.

Standards almost always suffer from the “too many cooks” problem

In fact, the tendency of formal standards to become all-encompassing was a common theme in survey responses.

> Standards tend to grow as they are written, in order to include everything the various stakeholders want.

> Standards stop being practical when they become so broad as to be unhelpful.

By attempting to address such a broad set of use-cases, standards become ‘bloated’, meaning they are overly arduous to understand and implement.

> Canvassing a stakeholder group too wide can create a standard that is bloated and requires too much effort to implement. You have to draw the line somewhere and accept that this might create outliers.

> Bloated standards crafted by standards bodies are a pain to work with.

Bloated standards are a pain to work with

Another descriptor commonly used was that standards are 'over-engineered', meaning that they are designed in too complicated a way where a simpler solution would be equally effective.

> Some bad standards are the results of several years of work, leading to over-engineering.

> If standardisation is not agile enough, it can take too long to develop standards that can be over-engineered.

It is notable, however, that while broad and heavily engineered standards may be troublesome for implementers, they can nonetheless be highly successful. This is evidenced by the extremely widely used media file packaging format, MXF.

> Some standards are horribly over-engineered. Printed out, MXF is over 10cm of paper. It needs interpretation, engineering guidelines.

Some standards are horribly over-engineered

CHOOSE YOUR FLAVOUR

Such broad and flexible standards often are not implemented in their entirety. Instead, different companies implement different subsets of the standard, which can create new interoperability challenges.

> Large open standards can lead to different implementations across organisations making interoperability more challenging.

> The need to support multiple distinct variants often eliminates the benefits of having a standard in the first place.

The existence of multiple variants eliminates the benefits of having a standard in the first place

When customers implement different variations of a standard, it creates development overhead for vendors.

Meanwhile, vendors' development effort will often be guided by customer demand, so they may themselves implement only the parts of a broad standard that are required by current customers. This in turn becomes a pain point for other users.

> The risk is that no vendors actually follow a standard. See FIMS as an example, where everyone picked and chose the parts they wanted to implement.

In other cases, implementers may create different variations without meaning to, because the standards leave too much room for interpretation.

> The interpretation of standards and hence the subtlety in specific implementations leads to incompatibility issues which directly impact time and cost when putting systems together.

> Even within standards there is often too much room for interpretation or variation. Timed Text Markup Language (TTML) is a great example of this. Several companies adopted their own flavour of TTML - all of which are compliant to the standard - but all of which end up requiring bespoke development to accommodate.

It is also worth noting that the different issues raised can sometimes be highly interrelated. One contributor noted, for example, that one of the reasons there are so many variations of TTML is that the slow standardisation process led to many organisations creating implementations based on early drafts of the standard.

TOO MANY STANDARDS?

If proliferation of variations is a problem within one standard, it becomes even worse when we consider situations in which there are multiple competing standards.

> We're getting it wrong. We need less standards.

> When there are too many standards competing in the same area it creates greater challenges for interoperability.

**We're getting it wrong.
We need less standards.**

This is one of the key tensions facing the world of standardisation: whether it is better to have fewer standards that meet broad needs, or multiple, more constrained standards.

> Sometimes there is a lack of standards (e.g. each camera supplier has their own format), whereas sometimes there is a zoo of standards (e.g. there are over 100 subtitle file formats).

Of course it is impossible to make a general statement that applies to all areas of standardisation, but multiple contributors favoured a pragmatic approach to accepting some parallel standards; just not too many.

> Having more than one standard is not ideal, but is better than a free-for all.

> Competing standards should be tolerated, but in small quantities.

Having more than one standard is not ideal, but is better than a free-for all

INTELLECTUAL PROPERTY

A final, but significant, area of controversy around standards is their licensing. When multiple companies contribute to the development of a standard, there may be multiple sets of intellectual property at play.

> Underlying patents and their inclusion or exclusion from standards are always a risk.

> There is no such thing as “IPR free” or “royalty free” standards - they all come with costs, sooner or later.

Underlying patents are always a risk for standards

Some feel that standards must be free to be useful, but others argue that if there is no way to monetise intellectual property then companies may either de-prioritise research and development, or cease to contribute new developments to standards.

> I avoid any standards that cost per user/use and limit consideration for any that have a one time fee. Standards need to be free to be viable. Let the customer’s choice of product win, not who can pay for a standard.

Whatever the cost model, we have seen in the development of new codecs in recent years that the agreement of licensing and royalty structures can become a major factor in the slow pace of standards being finalised.

> It takes time for standards to be developed, even more time for patent pools to be formed, and then even more time for the remaining patent owners to show up, try to litigate, and then see where it all concludes. It all takes time. Years. Sometimes decades.

Agreeing licensing and royalty structures causes delays to the finalisation of standards

We have seen from the opinions of our survey respondents that the world of standards is in constant tension.

Users appreciate the rigour of formal standards processes, but they certainly do not appreciate the time such processes take.

They want to be represented, yet they struggle to assign resources to participate, because any potential return on investment is far into the future.

Implementers want tightly scoped and well defined standards, yet every participant wants their use cases to be covered. And nobody wants too many standards or variations of standards.

The world of standards is in constant tension

But if this is what our contributors felt about standardisation at large, how do they feel about the individual standards - and standards groups - that they interact with today?

3 Engaging with standardisation

In order to understand how our contributors' overall views on standardisation translate into real world experience, we asked a number of detailed questions about specific standards, and specific standardisation groups.

When it comes to implementation, real world experience sometimes differs from the aims of the standards creators. Individuals' ideals for standardisation are not always translated into practical application. As one contributor put it:

> Despite the standards organisations, we all have our own standards.

Despite the standards organisations, we all have our own standards

Herein lies one of the biggest challenges of standardisation: while companies are attracted to the idea of easy interoperability, they are frequently unprepared to invest the money, time, and resources required to make changes within their own organisation in order to implement new standards-based approaches.

> Standards are like toothbrushes. Everyone wants one, but nobody wants to use someone else's.

Standards are like toothbrushes: everyone wants one, but nobody wants to use someone else's

CUSTOMER ENGAGEMENT

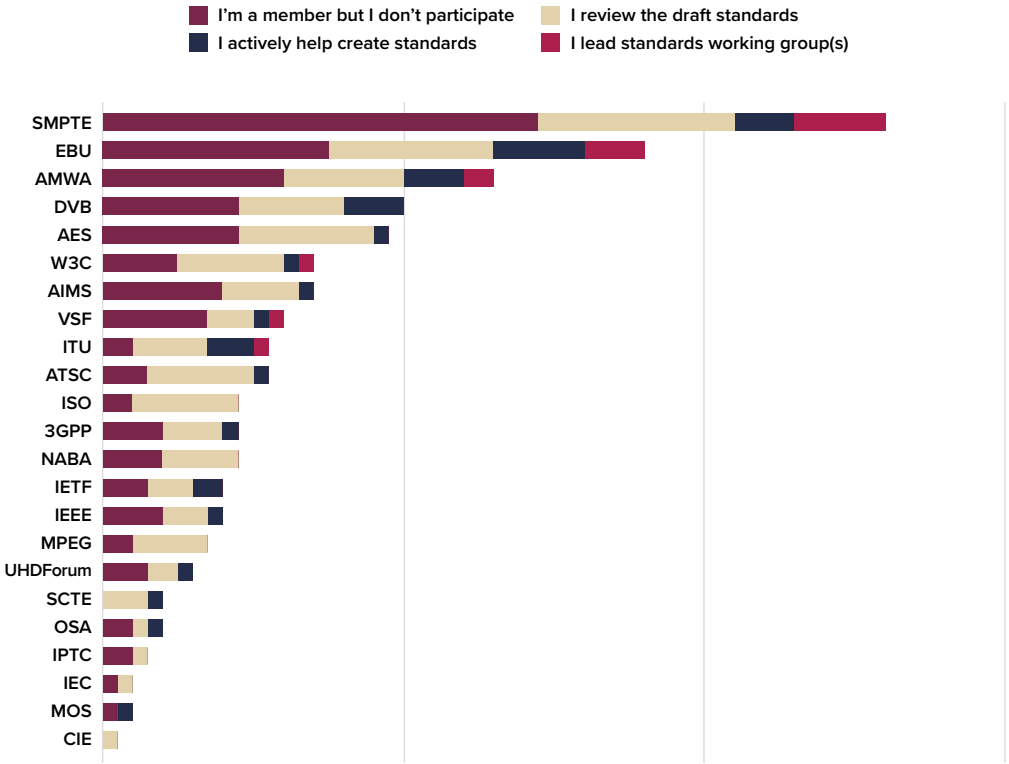
As noted previously, concern has been expressed about whether enough end-users are involved in standards creation. As a result, we set out to examine which standards groups our respondents from media companies engage with.

Over 60% of them were members of one or more standards organisations, which is a more positive result than many might have expected. (A very large number are also involved in the DPP's own technical efforts, however we have excluded these responses from our analysis, due to the natural bias inherent in responses to a DPP survey.)

60% of survey respondents from content companies are members of at least one standards organisation

The most popular groups to be involved in were the Society of Motion Picture and Television Engineers (SMPTE), European Broadcasting Union (EBU), and the Advanced Media Workflow Association (AMWA).

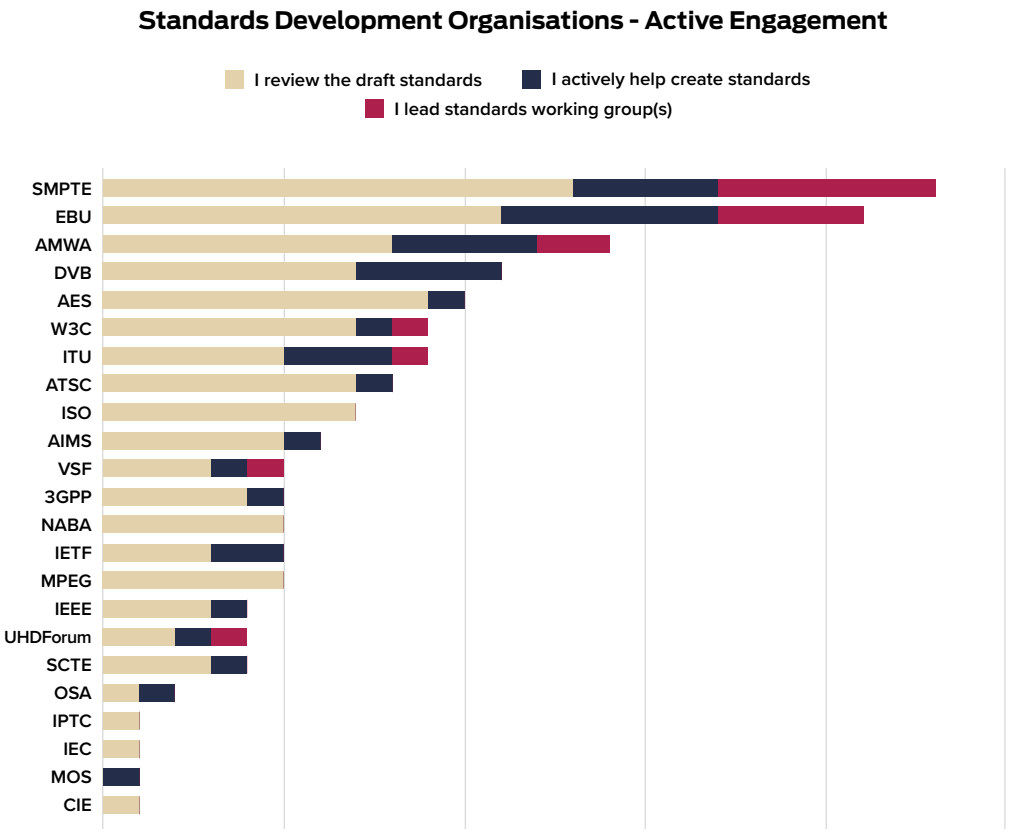
Standards Development Organisations - Membership and Engagement



However, as can be seen in the chart above, a significant proportion of respondents are members of the standards organisations but do not actively participate.

If we look only at those who engage more actively - at least by reviewing draft standards before publication - the results become a little clearer.

When examined through this lens, the top three standards organisations remain unchanged, although the margins are narrow. And in fact, when considering the proportion of members who actively contribute to creating the standards (as opposed to just reviewing them), the order of the top three is reversed. Only 45% of SMPTE members in our survey choose to actively help create standards, compared to 58% of EBU members.



Of course, this data is based on a limited survey of DPP members, and not the whole membership of each of the standards groups. However, given the broad range of companies and roles represented in our survey results, we believe they give a good indication of overall industry behaviours.

It is unsurprising that regional groups which set distribution standards - the Advanced Television Systems Committee (ATSC) in the USA and Digital Video Broadcasting (DVB) in Europe - garner strong engagement within each territory.

Internet standards groups will become ever more important as media creation and distribution moves online

One interesting result is that W3C, the consortium which sets world wide web standards, makes a strong showing, in position number six. Alongside other internet and mobile standards groups such as the IETF (Internet Engineering Task Force) and 3GPP (3rd Generation Partnership Project), these groups will continue to become more important as media creation and distribution relies ever more on internet technologies.

When we dive deeper into the underlying responses, we can see that nobody from management and non-technical roles reported actively engaging in the creation of standards. This seems to underline the sentiment expressed in *Representation and democracy* above, that there are not enough business representatives involved in standards setting.

Nobody in management and non-technical roles actively engages in defining standards

Further questions were asked about the specific standards efforts (working groups) that individuals were involved in.

Here we see interesting results, with SMPTE groups making up the top five spots, each with a roughly even split of participants in senior roles (Directors, Vice Presidents, and so on) and those in more junior roles. However, those senior representatives were much more likely to be active in groups around file formats and metadata, than in those related to networking and broadband media (in which they tended only to review the draft standards).

ATSC, DVB, and W3C groups also had respectable amounts of engagement, though they had lower levels of senior involvement.

In summary, end-user involvement in standards groups is healthier than we might have expected. However, it falls to relatively few individuals to actively engage in the work of writing standards, with a greater number of observers. And while there are some exceptions, many groups suffer from low engagement from operational and senior roles.

It falls to relatively few individuals to actively create standards

4 The reality of implementation

Contributors to *The Truth About Standards* were also generous in providing their feedback on real world applications of existing standards, and the results were enlightening.

In this section we explore the adoption of different standards in specific groups, along with the satisfaction of implementers.

To assess user satisfaction, we asked users from content companies, "*How would you rate your experience of the implementation of these standards?"* Vendors were asked, *"How would you rate the ease of implementation of these standards?"*. Responses on a scale of 1 to 5 were averaged.

IP VIDEO FOR CONTRIBUTION AND PRODUCTION

There is no better place to start than the world of IP video production. It has become a microcosm of the discussion around the best ways to create standards, as media companies have pressed ahead with replacing or augmenting baseband SDI infrastructure with IP alternatives.

IP video production is a microcosm of the discussion about the best ways to create standards

The primary approach to live video production using formal open Standards is to use SMPTE ST 2110. Meanwhile, a number of alternatives have emerged which are not based on traditional formal standards approaches.

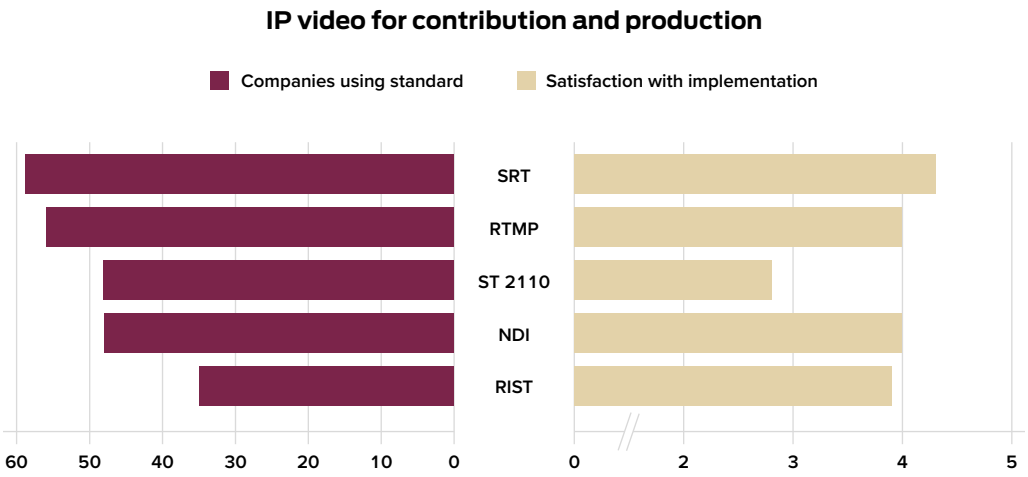
Both NDI and SRT were created by single companies (NewTek, now part of Vizrt, and Haivision, respectively). NDI is provided royalty free, while the SRT protocol is open source.

Used largely for video transmission over the internet, RTMP was originally a proprietary format developed by Macromedia, and has been published publicly by Adobe (which acquired Macromedia in 2005).

Some contributors to our survey felt strongly that formal open standards are important, and that alternative approaches such as those taken by NDI and SRT are inferior.

> NDI is not appropriate for most professional applications but media customers don't know the pitfalls of using NDI.

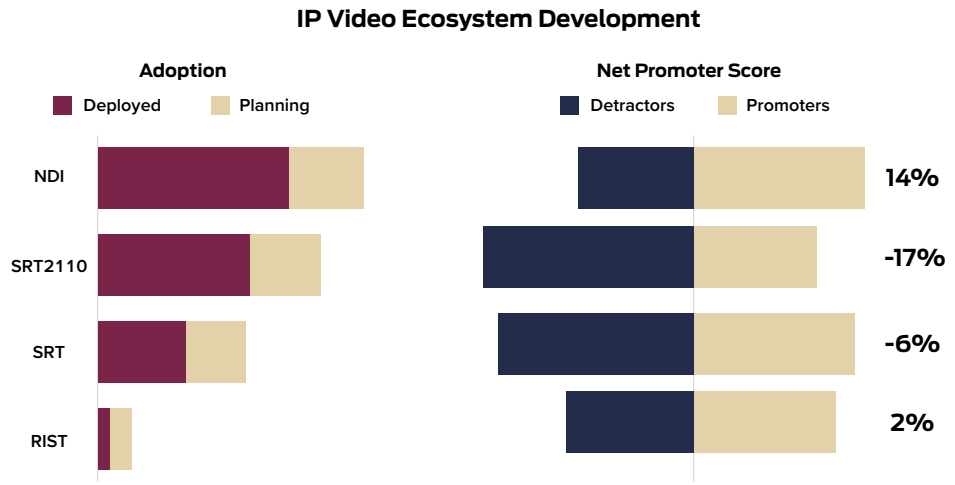
However, when we asked respondents who reported using each standard how they felt about them, the results were clear.



The satisfaction scores were stark, with ST 2110 gaining the lowest rating of any standard surveyed, while NDI and SRT both scored highly.

SMPTE ST 2110 had the lowest satisfaction score for any standard surveyed

The methodology chosen here was very similar to that used by Devoncroft Partners in their *Big Broadcast Survey*. Their responses show very similar results, albeit using the Net Promoter Score rather than our simpler 1-5 satisfaction scale.



Source: 2021 Devoncroft Big Broadcast Survey

The Devoncroft results show a preference for NDI over SRT, while the DPP results showed the reverse, but in both cases satisfaction leads that of ST 2110 by a large margin.

RIST is an alternative protocol based on a more traditional standards process, governed by the Video Services Forum (VSF). It has not yet emerged as a dominant force (especially seen in the Devoncroft results, though the newer DPP analysis shows it being more popular), however, satisfaction is high.

Satisfaction from implementers of SRT and NDI was much higher

Many user comments were positive about NDI especially, with some specifically praising the fact that it's governed directly by one company without a formal standards body.

> **I'm a big fan of NDI. It has a clarity of product direction and management that can only come from a focused entity (rather than design by committee).**

Given the rapid adoption of NDI and SRT, some wondered whether formal standards can compete. Others felt that none of the existing solutions is sufficient for the needs of the industry.

> **The adoption of proprietary NDI is immense, how can more open standards compete in such a competitive market?**

> SMPTE 2110 and NMOS are too complicated. NDI is proprietary and has limitations. Something new is needed which is cloud native, works in on-prem studios and in the wide-area, and is ratified by a standards body.

When a proprietary format is so widely adopted, how can open standards compete?

It is interesting to note that while ST 2110 received low satisfaction scores overall, it scored slightly higher with respondents from content companies than it did with vendors. SRT and NDI, by comparison, were loved by end users, but even more so by vendors who've implemented the protocols.

As one of the most active areas of standardisation in our industry today, it is worth looking more deeply into our survey responses about SMPTE ST 2110.

SMPTE ST 2110

More comments were received about ST 2110 than any other standard we asked about. Many experts see it as vital to the future of professional media production, but both media companies and vendors are disenfranchised by its implementation today.

At the DPP ***Leaders' Briefing 2021***, BT Sport's Chief Engineer expressed the ROI challenge with ST 2110.

> If I look at the amount of work and the money we've spent in the last twelve months, and the pain, the tears that I've seen in the engineers faces as they've gone through putting this infrastructure in, has it actually brought the business benefit? Has it reduced my cost base and reduced headcount? No. Have our audiences seen any tangible difference or benefit to their sport content consumption? No. So is this really such an exciting benefit? Has this really moved us forward? We had to spend the money, we had to do the project, but it hasn't really bought any tangible business benefit, which is actually really frustrating when I want to put my money on screen and bring that experience to customers.
>
> ANDY BEALE, BT SPORT

Has implementing ST 2110 actually brought business benefit? No.

Similar frustration was expressed by survey participants. ST 2110 is unfortunately seen by some as simply recreating the working practices of SDI on an IP network.

> The focus of the standards organisations has been to recreate the past based on modern infrastructure. They keep reinventing the wheel. A ST 2110 control room works the same way an analogue control room worked 40 years ago.

> ST 2110 has not enabled the reimagining of anything in the industry. It's allowed us to put more COTS hardware in a control room, but that control room is still a $10m build, and now it's more complicated with more opportunities to break.

The sentiment that increased complexity introduces more risk was echoed by multiple responses.

> The most publicly awful outages we've had are because of the complexity of ST 2110. We went all in with 2110 control rooms, and we were 3 years in before we realised some of the ways it could shoot you in the face.

> The approach to timing in ST2110 adds cost and complexity which in many use cases is hard to justify. It seems to have been borne of traditional thinking about timing, whereas what's really needed is an approach that can work asynchronously in the cloud.

The most publicly awful outages we've had are because of the complexity of ST 2110

Some contributors commented that the creation of ST 2110 has been more agile than many standards processes, yet it is still seen as too slow.

> **The pace of change and development is simply too fast now for the traditional methods of standardisation to keep up. ST 2110 is a great example of that. By the time standardisation has been widely agreed it will be a lot less relevant than when the standardisation process started.**

Of course, any significant foundational standard will have teething issues. Early adopters rarely have a smooth experience. Thankfully, multiple stakeholders across the industry are now coming together to help bridge the gaps. This includes the AMWA's work on NMOS control and management specifications, and the interoperability testing programme created by the Joint Taskforce on Networked Media (JT-NM).

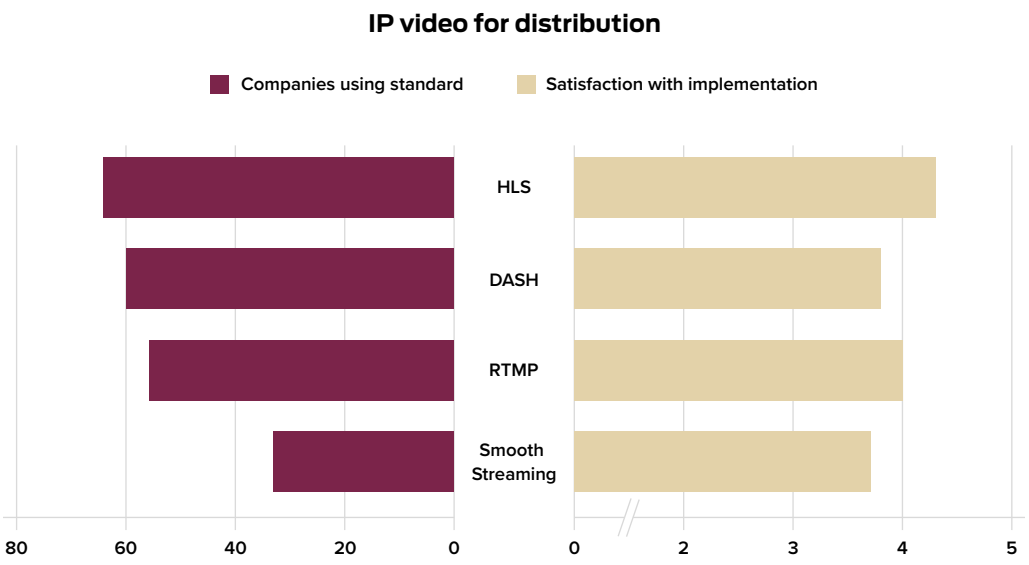
> **Publishing ST 2110 without thinking about NMOS IS-05 was madness.**

> **New standards are always tough, and most standards organisations do not arrange testing. JT-NM had to step in for ST 2110.**

Stakeholders across the industry are now coming together to bridge the gaps

IP VIDEO FOR DISTRIBUTION

The world of IP video distribution is perhaps a little less complicated. Although RTMP and Microsoft's Smooth Streaming are still used relatively widely, the majority of internet video distribution is now powered by Apple's HTTP Live Streaming protocol (HLS) and MPEG's Dynamic Adaptive Streaming over HTTP (DASH).



Any party looking to distribute video over the internet is likely to support both, given the need to support users on both iOS and Android devices. Hence the adoption numbers vary very little.

Satisfaction does differ somewhat, and the gulf widens when we look at responses from users who have personally been involved in implementing the standards. (Such as those writing code to build a video streaming server or player.)

HLS was favoured by those with direct experience of implementing it

From these users, DASH received an average of 3.4, while HLS received 4.5. Perhaps this again reflects the simpler experience of implementing a format which is tightly controlled by a single entity, even if this might cause other frustrations.

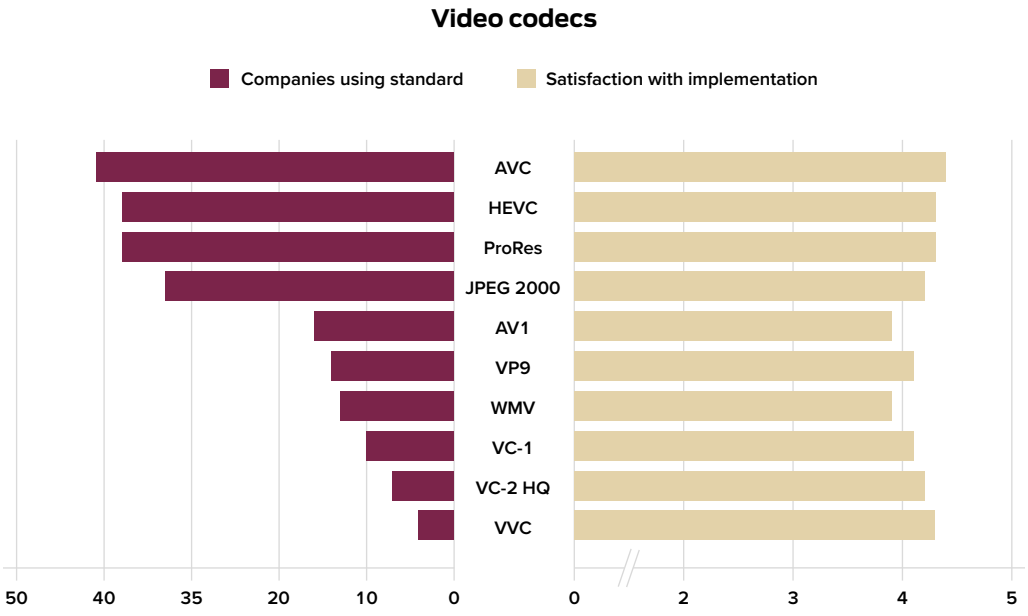
VIDEO CODECS

Another area that receives a great deal of attention is the development of video codec standards.

In general, the need to play media on many different devices tends to favour open approaches. That may mean standards definition happens in long standing standards bodies such as the Motion Picture Experts Group (MPEG), or in newer consortia such as the Alliance for Open Media (AOM).

The need for playback on many devices favours open standards approaches to codecs

There were some proprietary codecs considered, however. These included ProRes (created by Apple, and now published as a SMPTE Registered Disclosure Document) and Windows Media Video (created by Microsoft).



Perhaps unsurprisingly, AVC (Advanced Video Coding, also known as H.264) is the most widely used codec. It is generally seen as versatile and scalable, and is therefore implemented in both professional and consumer use-cases. It is also interesting to see that its successor, HEVC (High Efficiency Video Coding, or H.265) is also very widely used.

Apple's ProRes and JPEG 2000 were also popular. An oversight of the survey design was not to include VC-3, a codec created by Avid as DNx and later standardised as SMPTE 2019. We would expect to see similar usage levels as with ProRes and JPEG 2000.

When it comes to satisfaction levels, the margins of difference between these codecs are relatively small. However the average score for JPEG 2000 masks a gap between the views of end users (who rated it equally with ProRes and only just behind AVC), and vendors (who placed it third to last, beating only VC-1 and WMV). Perhaps this speaks to the complexity of the codec's implementation.

Vendors rate implementation of JPEG 2000 lower than end users

There is an interesting subset of video codecs which warrants specific consideration. A number of 'next generation' codecs have been put forward for more efficient internet distribution of video - especially 4K and higher resolutions - and they have been locked in somewhat of a war for supremacy in recent years.

A full comparison is well beyond the scope of this report, but the most notable contenders are:

AV1, which is published by the Alliance for Open Media, including Netflix, Google, Microsoft, and Intel. It is based on open source codecs VP9, Daala, and Thor.

VVC, which is the successor to HEVC. It is developed by the Joint Video Exploration Team (JVET), which combines input from the ITU and MPEG.

Licensing is as contentious as technology, if not more so

Licensing is as contentious as technology - if not more so - for these codecs. Despite the open source roots, AV1 still has licensing issues, with the European Union undertaking a preliminary investigation into AOM's licensing policy. VVC's predecessor HEVC suffered years of patent and licensing issues, with fragmented and incomplete patent pools causing challenges for implementers.

This is a war that is unlikely to have a single victor. Most observers agree that AV1 and VVC will both be important for many years. DVB, for example, has already implemented support for VVC and is working on adding AV1. Having been finalised around two years before VVC, AV1 is gaining adoption in consumer devices, but VVC is also expected to grow in popularity.

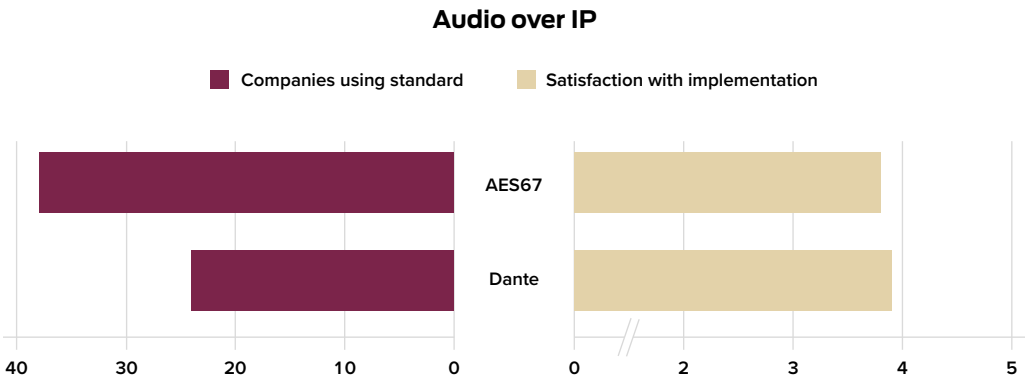
In our survey results, VVC was preferred by respondents, with a satisfaction rating of 4.3 to AV1's 3.9. However, it should be noted that AV1 was used by over three times more companies, so perhaps it is too early to read a lot into these results.

It is clear that the story of next generation video codecs is still being written.

The story of next generation video codecs is still being written

AUDIO OVER IP

Our survey asked contributors for their experiences with ten audio over IP formats, but there were a significant number of responses for only two: AES67 (a formal open standard) and Dante (a proprietary system created by Audinate).



AES67 is more widely deployed by our respondents, though Dante received higher praise from all groups of users. Those directly involved in implementing it rated it an average 3.7 out of 5, while AES67 received 3.3.

It was particularly notable that multiple comments raised the challenges of interoperability between these audio standards and video over IP standards, such as ST 2110.

> Dante and AES67 are good standards in audio, but largely meaningless if you are truly working in a ST 2110 IP television production environment. You'll be using gateway somewhere, because the number of native ST 2110 IP audio products can be counted on one hand.

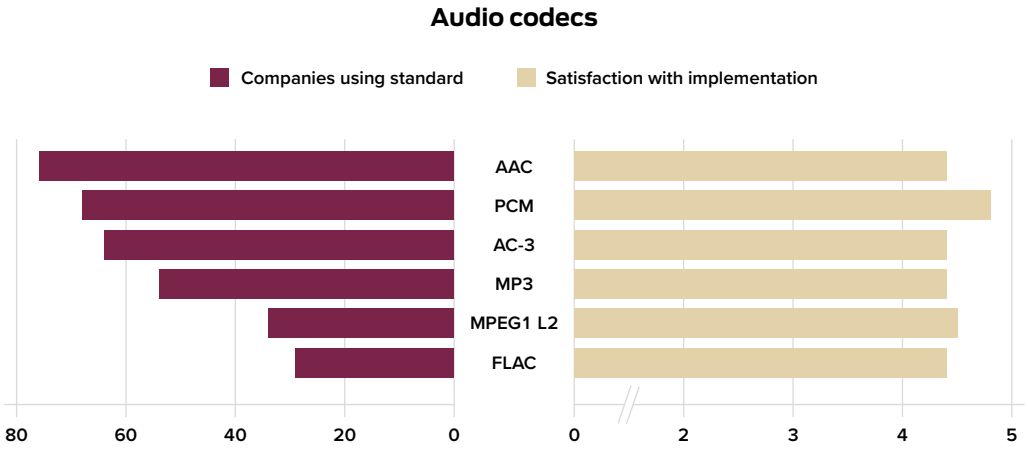
> Thinking about live IP we need to see easier interoperability between ST 2110 / NDI and AES67 / Dante as they will inevitably need to co-exist.

Better interoperability is needed between audio and video over IP standards

This is now being recognised in the industry, as the Alliance for IP Media Solutions (AIMS) promotes the Internet Protocol Media Experience (IPMX), which builds on both ST2110 and AES67.

AUDIO CODECS

The world of audio codecs is no simpler than that of video codecs, with 12 different options on our survey. However, only half received enough responses for us to be able to offer meaningful analysis.



Advanced Audio Coding (AAC) is the most widely implemented format among the companies who responded to our questionnaire. It is a formal open standard, published by ISO and IEC as part of the MPEG-2 and MPEG-4 specifications. It is extremely widely supported in consumer devices, making its use across our industry unsurprising.

Pulse Code Modulation (PCM) is a method of digitally representing audio without data rate compression. Its uncompressed nature makes it both highly widespread in professional situations, and appealing to implementers, who gave it one of the highest scores in the survey, at 4.8.

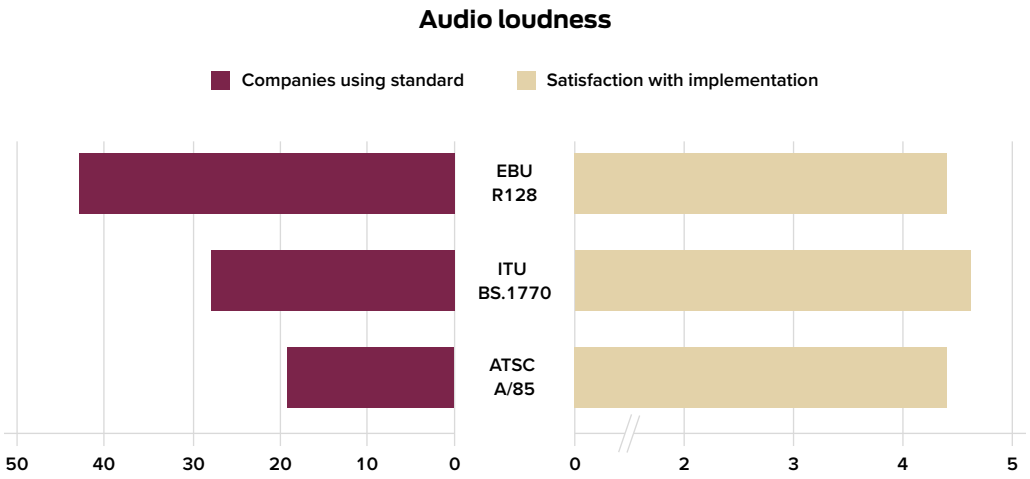
Open source audio codecs are less widely adopted in professional media companies

In contrast to some of the results in other areas (such as Video Over IP), open source approaches fare less well in terms of adoption. The Free Lossless Audio Codec (FLAC) is adopted by relatively few organisations, and Ogg Vorbis received so few responses that it was excluded from further analysis.

LOUDNESS MEASUREMENT

Audio loudness measurement has become a matter of not just standardisation, but legislation. As such, approaches are largely centred around the prevailing measurement standard in a given territory.

Audio loudness is a matter of not just standardisation, but legislation



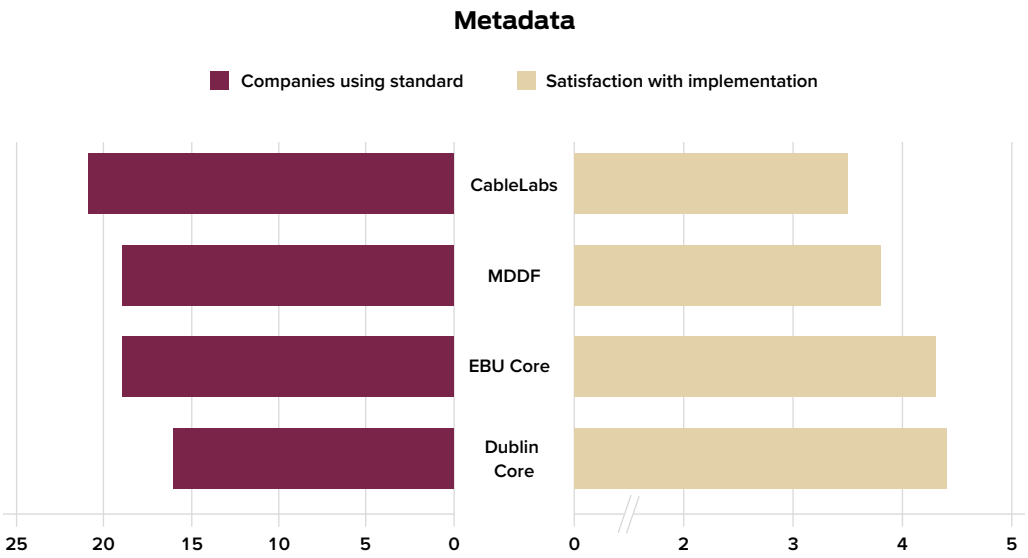
The European Broadcasting Union's Recommendation 128 has been widely adopted across Europe, with compliance mandatory in many countries. The USA also has regulation around loudness (under the Commercial Advertisement Loudness Mitigation Act, or CALM Act). This requires the use of ATSC A/85, which in turn references ITU BS.1770.

The most striking characteristic of this set of results is that all three standards receive broad praise for their implementation. Vendors and users alike gave nearly identical scores to all three, indicating that they are largely seen as clear and helpful.

All three audio loudness measurement standards generated high satisfaction

METADATA

In the DPP's 2020 report, ***Supplying the VOD Revolution***, we said that "*a highly fragmented landscape of metadata formats causes inefficiency*". Yet in 2022, speakers at the ***Media Supply Festival*** were still calling for better standardisation of metadata. So why has so little changed in two years?



As in other areas, there are additional metadata formats which we considered but which are not widely enough adopted for us to comment on. Of those that remain, the MovieLabs Digital Distribution Framework (MDDF) and the CableLabs ADI standards are comparable as delivery formats, while EBU Core and Dublin Core offer more foundational frameworks.

Although the results look positive, we are cautious to draw conclusions about the satisfaction of EBU Core and Dublin Core, as in each case fewer than 5 of the respondents had personal experience implementing them.

MDDF and CableLabs are both widely used and were represented by a range of implementers in our survey results. It is interesting to note that among the responses from content companies, slightly more use MDDF than CableLabs; it is in the vendor community that more users reported using CableLabs.

MovieLabs MDDF is adopted by more content companies than CableLabs, with higher implementation satisfaction

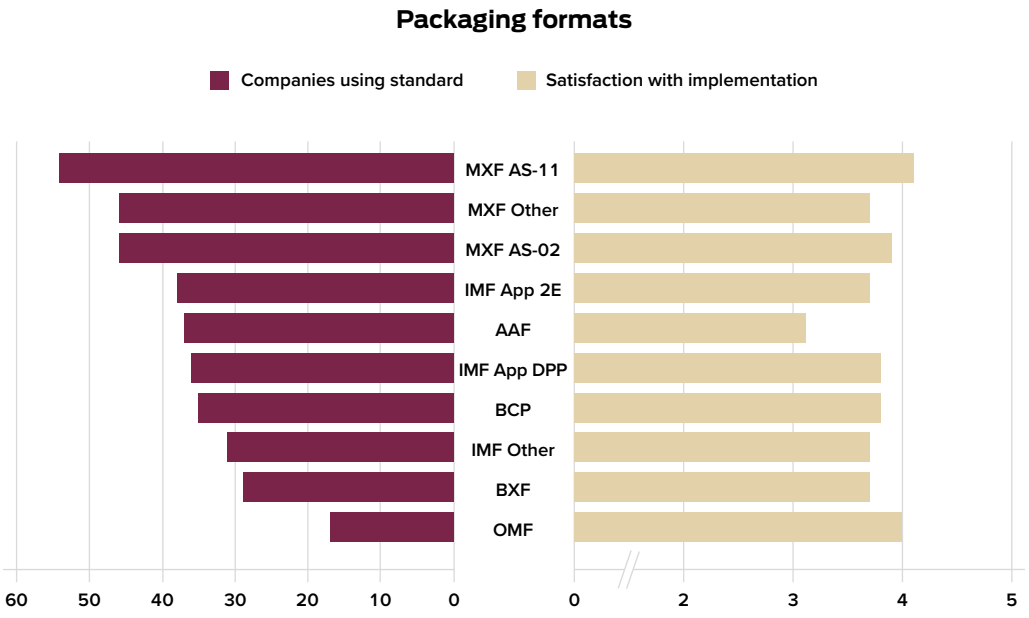
Indeed, the proportions of content companies using each standard largely match those reported in 2020, with around 10% higher usage of the MovieLabs formats. Satisfaction from MovieLabs users is also notably higher, although it did not receive a particularly high score in the overall context of the survey. This could be because the extensiveness of the framework makes implementation daunting (although much like other standards such as MXF, there are constrained profiles and subsets available).

MovieLabs as an organisation is backed by five major movie studios, making it somewhat comparable to the consortia behind some other standards, rather than being either a single organisation or a fully open standards body. However, it also actively engages with other organisations through the Digital Supply Chain Alliance, including DEG, OTT.X, and the DPP, as well as seeking broad industry input and feedback.

The need, or otherwise, for additional standardisation in the realm of metadata is discussed further in the next section, *The future of standards*.

MEDIA PACKAGING

Video, audio, and/or metadata are packaged into files or other structures using a variety of formats and standards. It would be difficult to survey every format, but survey participants gave their views on a wide range. These included specific variations of the Material Exchange Format (MXF) and the Interoperable Master Format (IMF).



It is unsurprising that a DPP survey was answered by a large number of companies familiar with AS-11, the file format used by the DPP to set delivery requirements for broadcasters in the UK and elsewhere. Other MXF applications including AS-02 were also widely used, as were IMF (we asked about Application 2E, a SMPTE standard, and Application DPP, a SMPTE Recommended Disclosure Document authored by the DPP).

The Advanced Authoring Format (AAF), a professional data interchange format designed for post production and media authoring, is also widely used. It was created by the AAF Association, which later evolved into the AMWA.

AAF received the lowest satisfaction score, 3.1. Scores from users and vendors alike were low in comparison to other formats, but AAF received an especially low rating of 2.8 from those who have been personally involved in implementing it. As no comments were received to explain this, we assume it largely to be due to the complexity involved in this expansive and flexible format.

AS-11 had a strong ROI due to its simultaneous adoption across the UK

AS-11 received the highest satisfaction rating, perhaps due to its specific constrained use-case and broad industry support making it comparatively easy to implement. It also had a strong return on investment for many vendors due to its simultaneous adoption by all UK broadcasters.

The Open Media Framework (OMF) was close behind in terms of satisfaction, albeit with fewer users. This is likely due to its well established application in specific use-cases, such as in audio post production. This would be consistent with the general trend that simple and constrained use-cases are easier to implement and therefore deliver better implementation experience.

Standards with simple and constrained use-cases deliver better implementation experience

There is little to separate the other variants of MXF and IMF, along with the Broadcast Exchange Format (BXF). These are all formally standardised formats, and are well established, with reasonably strong (though not outstanding) satisfaction scores.

Perhaps the one surprise is that IMF scored so well, since as one contributor put it, “implementation of IMF is still a work in progress”. This could indicate some success for the various efforts and communities set up to support implementation of IMF, notably the Hollywood Professional Association’s IMF User Group, and support from other organisations including the DPP.

The satisfaction of IMF implementers reflects success of industry efforts to support implementation

TRENDS IN THE RESULTS

In this chapter we have presented a huge volume of data about adoption of, and attitudes to, a large range of standards.

Each set of standards has its own context, and its own reasons why some standards are more widely used or more liked than others. But there are some trends which emerge.

Although users are nervous of one company having too much control over a format or protocol, they report better implementation results from standards that have a clarity of purpose, direction, and scope. This may be through the overarching control of one company (as in NDI, Dante, ProRes, or HLS), or the focus of a small group or consortium (such as studios in MovieLabs, or broadcasters in the DPP). Or it may be due to the simplicity of the format (such as in PCM audio).

Users report better experiences with standards that have a clarity of purpose, direction, and scope

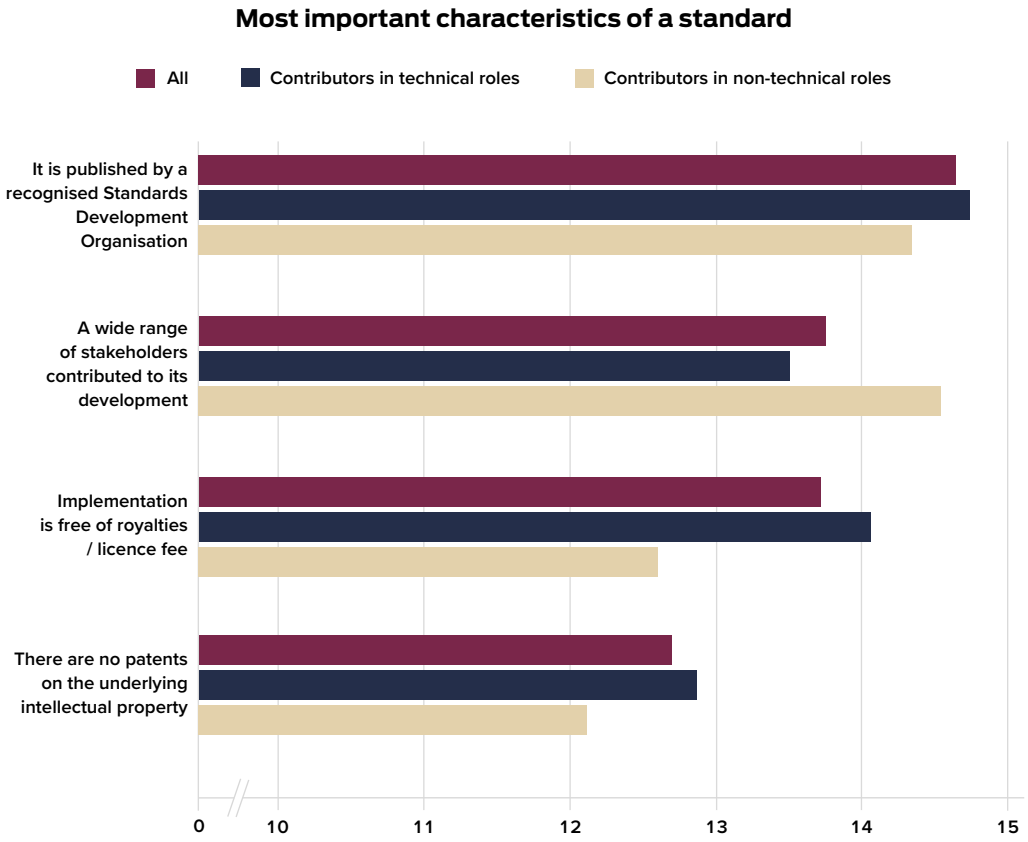
Simultaneously, however, respondents expressed a high level of satisfaction with the implementation of a number of standards which have followed traditional formal processes, such as MPEG video and audio codecs.

So we must ask: what lessons can be learned for the future of standardisation in the media industry?

5 Choosing standards

In perhaps the most revealing part of *The Truth About Standards* survey, we asked contributors a series of questions about how they choose one standard or another to implement.

The first such question asked participants to rate (on a scale up to 20) how important certain characteristics of a standard are to them, when choosing a format or protocol to implement.



It is remarkable to see that the factor users chose as the most important was the standard being published by an SDO.

SDOs will of course take heart from this. But the result is incongruous when seen against the rise of NDI and SRT, for example. This dichotomy will be explored further later in this chapter.

The preference for SDO generated standards is incongruous with the popularity of protocols like NDI

While no factor was seen as unimportant overall, the presence of underlying patents came last, perhaps recognising the fact that patents are a fact of the commercial world, and often a justifiable protection of companies' intellectual property. The absence of royalty or licence fees was seen as slightly more important.

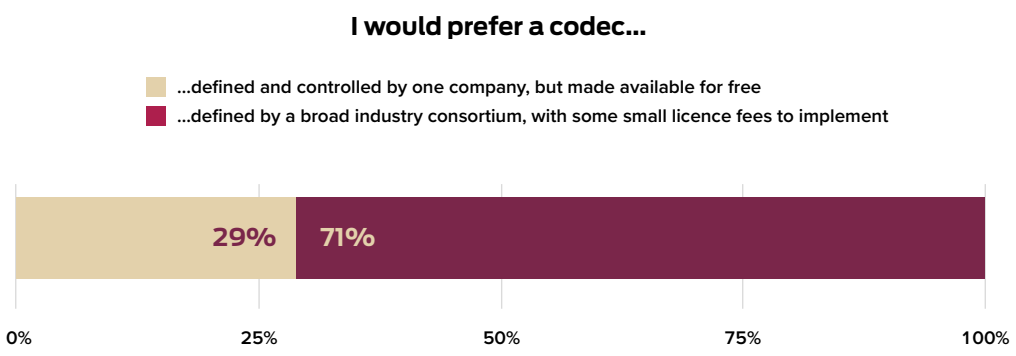
But perhaps the most striking insight comes when comparing the scores from users in technical roles with those in non-technical (or at least less technical) roles such as senior management, finance, or creative disciplines.

One might have expected the managers to be the ones who cared more about finances than solution design. Yet it was technical respondents who cared more about the presence of licence fees than they did about the range of stakeholders involved in developing a standard. Non-technical users expressed the reverse.

Technologists were more concerned about licence fees than managers

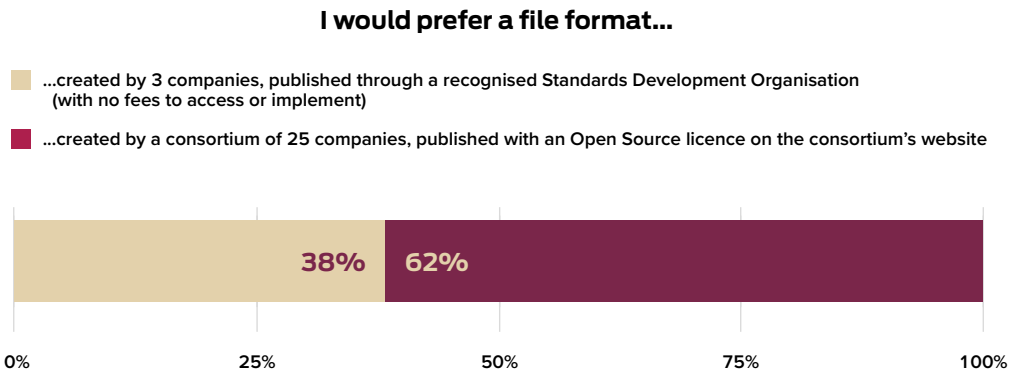
In order to further probe these preferences, survey respondents were also asked to make some binary choices between two alternative standards to implement, in each of three hypothetical scenarios.

We asked whether they would choose a codec defined by one company and made available for free, or another defined by a broad industry consortium but bearing some licence fees.



The response here correlated with the preference for SDOs, and for standards that have a broad range of contributors. Responses to this question were highly consistent across content companies and vendors, with those in more senior roles expressing a preference for the paid standard even more strongly than the group at large.

Contributors were also asked to choose between a file format created by 3 companies working in an SDO, or one created by 25 companies and published open source through a consortium.

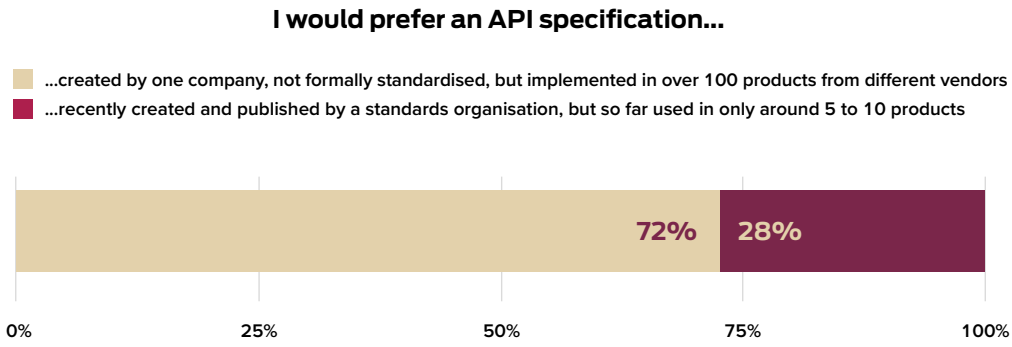


In this case, the consortium solution was chosen by almost two thirds of respondents. Content companies felt more strongly still, with 71% of their representatives choosing the consortium standard.

This calls into question the responses to the previous ranking of standards characteristics. Asked in the abstract whether it is more important for a standard to be published through an SDO or to have a wide range of contributors, people chose the SDO. But when given a specific (albeit hypothetical) example, the same people chose the opposite.

When presented with a specific example, respondents chose a consortium over an SDO

The last of our hypothetical choices offered an API specification created by one company with no formal standardisation but implemented in over 100 products (i.e. a de facto standard), or one published by an SDO but with only modest adoption in around 10 products.



Once again, users' preference for SDOs crumbles when faced with these specific situations.

Senior respondents voted overwhelmingly for the de facto standard, with 81% choosing that option. Vendors also chose the de facto standard more often than content companies (75% vs 69%), perhaps indicating a more consistently pragmatic approach from those whose revenue may hinge on such choices.

But undeniably all users felt safety in numbers, choosing a more widely adopted standard over one with more formality.

What can we learn from these results? Should we revel in the amusing self contradiction of some respondents' answers? Of course not.

The message behind these seemingly conflicting results is clear: adoption rates matter above all else.

Adoption rates matter above all else

A format or protocol that is already widely implemented offers lower risk for adoption and likely greater support from vendors, customers, and partners.

One that has the input of a wide range of companies may be more widely useful, but in particular it is more likely to gain wide adoption. This applies whether it is free or has fees, and whether it is created by an ISO recognised SDO or an informal consortium.

Investing in implementing a standard is a risk, whether for a vendor building support into their products or a user adopting it in their systems and processes. Implementation costs time and money, and so companies want to be confident that they're making the right choice.

They want to choose a standard that will enable them to interoperate with the biggest range of partners, or sell to the widest pool of customers. One that will be supported by the rest of the industry.

Investing in a standard is a risk; users need confidence in their choice

As a result, choices are made based on confidence. Knowing that a standard has input from a range of companies and experts offers increased confidence that it will be successful. Seeing that it is already widely adopted offers an even higher degree of confidence.

Historically, the rigorous process of standards development organisations, and their broad engagement with the industry, has offered this same level of confidence. The backing of an SDO was perhaps seen as an indicator of a standard's future adoption.

The question now facing the SDOs - and the industry as a whole - is how to maintain that confidence in a software driven world, where de facto standards can become broadly adopted at a dramatically faster pace.

Can SDOs inspire the same confidence in a world where de facto standards become widely adopted at a rapid pace?

6 The future of standards

We have established that interoperability is crucial to an effective global media industry, but also that today's standards processes are fraught with challenges and frustrations.

Does this create an existential crisis for structured standards creation, as some contributors suggested?

> In a world where the FANG companies just open source things and they become de facto standards, what is the role of the standards bodies anymore?

In a world where huge companies create de facto standards, what is the role of standards bodies?

Or is there a better way? Can the industry come together to improve the way we generate and implement standards?

STANDARDS ARE NOT ALL EQUAL

Standards are crucial in some instances, but they are not the right solution to every problem. Internally within an organisation, for example, it is often unnecessary to use formal standards, provided internal stakeholders agree on a common way of working.

> Officially, we don't care any more. If something gets the job done, it doesn't matter if it adheres to a standard or not. Particularly if there's a mechanism to convert it back to a standard later, I have no problem living in a custom environment within our own organisation.

If something gets the job done, we don't care if it adheres to a standard or not

Standards, in the broadest sense of the word, most often show their value when interfacing between organisations.

> Standardisation can dramatically simplify the onboarding of new partners as it reduces the need for bespoke integrations. Well documented standards, whether created by standards bodies or de facto standards, avoid ambiguity and give all parties an external point of reference that can help avoid finger pointing.

In general, the less flexible a technology or workflow (e.g. where hardware is involved), the more formality is needed in the standards. These standards must be precisely defined, thorough, and stable.

> Standards are beneficial when dealing with interoperability concerns that require stability; where the cost of change is high, and it is difficult to propagate change.

> Adherence to standards reduces market risk, especially in areas that require large capital investments (e.g. core infrastructure, silicon chip designs, etc).

The less flexible a technology the more formality is needed in the standards

However, for areas of rapid change (such as software), flexibility and speed are more critical.

> Traditional notions of standardisation do not apply to software-defined, API-led systems.

> A widely adopted and well maintained open source library in GitHub is at least as valuable as an industry standard created by an official standards organisation.

This means that a single approach for all industry standardisation is impractical. We must accept that multiple forms of standards will coexist.

Multiple forms of standards will coexist

APPROPRIATE FORMALITY

Formal standards will be accompanied by a range of different documents, software, and other deliverables that serve different needs.

The DPP publishes *Recommendations* and *Guidance*, for example. These offer formal technical recommendations and suggested practices or guidelines, respectively. They are supported by our technical insight reports, because we also see the sharing of ideas, experiences, and best practices as crucial to facilitating real world interoperability.

Sharing ideas, experiences, and best practices is crucial to facilitating real world interoperability

Meanwhile, the EBU has long published its *Recommendations* alongside other documents such as *Technical Reports*, while SMPTE creates both *Standards* and *Recommended Practices*, among other documents.

MovieLabs has also recently shared some thoughts on interoperability in the context of media creation workflows. Building on their 2030 Vision papers, they plan to publish a set of principles to help advance interoperability, covering areas such as use of common data models and asset identifiers.

Increasingly, traditional approaches will be supplemented with - and in some cases replaced by - open source software releases, published API specifications, and so on. Often the most practical way to explore a solution is by collaborating on practical implementation, such as building a proof of concept, the results of which can be shared.

The most practical way to explore a solution is often by building a proof of concept

The key is to find the right level of detail and formality for a given problem space. Traditional, formal standards should not be seen as the superior solution for every problem space, nor as completely outdated and useless. Rather, they are part of a range of valuable and useful tools to enable interoperability.

Traditional standards must be seen as part of a range of valuable and useful tools to enable interoperability

STANDARDS GROUPS

In recent years, there has been a rise in the number of industry specialist groups and consortia, formed to work on a specific problem space or define a specific standard.

In the best cases, such groups are more focused, business driven, and actively involved than traditional standards organisations. This allows them to deliver strong results quickly. In the worst case, they could be insular or exclusionary.

> **Subject matter experts and common interest groups are finding it easier and easier to form their own "standardisation" efforts with modern mechanisms of the internet and virtual work. However, they can become bubbles, and don't realise they often aren't reaching the wider community.**

Some of our contributors also felt that proliferation of standards groups creates confusion.

> **There are too many organisations publishing standards. It's hard to keep track.**

> **Currently there are too many trade associations. For users it is better to have a single accredited SDO.**

Ultimately, however, companies will choose the route they believe will be most effective in delivering their business goals. People will choose to work with SDOs if they perceive that the SDO provides the best way to solve a problem quickly and effectively.

It is therefore up to the standards community to ensure that it meets the needs of the industry.

It is up to the standards community to ensure that it meets the needs of the industry

Our research reveals some principles and guidelines that will help to ensure that users' needs are met. Many are especially applicable to the faster moving, more flexible type of standards development, but they offer good guidelines for the future of all interoperability.

MOVING FAST

The importance of a standards process that is quicker and more responsive can hardly be overstated.

> The challenge facing standardisation is how to maintain integrity and effectiveness at a much faster pace.

The importance of a quicker and more responsive standards process can hardly be overstated

The standards organisations of the future will need to keep an eagle eye on the pace of development. Given the resource constraints of contributing companies, this may mean that standards organisations need to be more active participants, rather than pure process facilitators.

> Standards bodies often do not drive their membership or have the staff to help push the creation of standards. They should view their standards as products.

SIMPLE BEATS PERFECT

In *The problem with standards*, a case was made that standards have historically often become bloated or over-engineered. Many contributors called for standards groups to keep things simple.

> **Standardisation prevents a lot of in-house work, but it is still a painful process on the way to "perfection". Remembering to "keep it simple" should have more focus.**

> **NDI grew up within a single vendor, and it's stupid simple. It's great.**

In order to avoid over-engineering, sometimes pragmatic decisions must be made.

> **There are problems when standards organisations concentrate too much on their idea of the 'best' way to do things, without pragmatism.**

Standards organisations should focus on keeping it simple

Although hardware related standards need to be fully defined at launch, in software it is often helpful to take a more iterative approach. Basic functionality can be defined in an initial release, with additional features and capabilities added later.

> **Usually the standardisation process is too slow, because standards bodies want to boil the oceans. Iterative standards which work towards the end goal are better.**

ACTIVE FACILITATION

In *The reality of implementation*, it became clear that the clarity of vision behind some de facto or small consortium standards was their strength. Such vision needs to be protected and nurtured in an active way.

> **Attempting to create a common approach to anything requires expert facilitation, taking care not to overreach on scope, and moving at the right time. Many standards we rely on today required sustained efforts to deliver in the first place.**

Maintaining focus, keeping business goals in sight, keeping it simple, and being pragmatic are all active processes.

The responses to our survey show that standardisation processes need clear and active facilitation. It is not enough for standards organisations to provide a space for work to be done; they must lead and nurture that work.

> Strong guidance is needed during the design process to ensure that standards are fulfilling their core requirements.

It is not enough to provide a space for work to be done; that work requires leadership and nurturing

This active involvement also means identifying the right stakeholders to be involved, and championing the work to get their engagement. It means creating a welcoming environment and culture that encourages both business users and engineers to take part.

> The people involved in standards organisations tend to be retired engineers, whereas the open source community tends to be engineers on the front line, building tools. There's a pace of development that's much faster. It's culturally very different.

VALIDATION AND TESTING

Another key lesson to be learned from the world of software is that testing should be embedded throughout development, not added at the end.

Testing should be embedded throughout development, not added at the end

The principles of Test Driven Development (TDD) dictate that test cases be written before implementation, and that tests are run at every opportunity as features are added. Similar thinking enables standards to be written in such a way that implementations can be easily tested. By considering test criteria up front, it is easier to avoid ambiguity in the standard.

> Capabilities need to be backed up with easy to perform validation criteria, to characterise and check compliance with a standard.

> Standards can sometimes be open to interpretation. Lack of examples and tests to validate them often make implementation difficult.

When test cases are well defined, it is possible to create testing and validation tools. A large number of survey respondents indicated that such tools are a significant help when implementing a standard. As a result, the existence of testing tools is a significant reason to choose one standard over another.

> Every standard should be accompanied by a validation tool for implementers.

> It doesn't matter whether DASH is easy or hard, complex or simple. What matters is that I can go to a DASH-IF website and get instant access to an open source stream validation tool and its related conformance tool suite. I don't worry about the breadth and depth of any standard; I simply need ways to confirm that my specific implementation is correct.

What matters most is that I can get access to validation tools to confirm that my implementation is correct

In addition to testing tools, other resources including sample content, reference implementations, and software development kits are all seen as extremely valuable.

> Reference models and samples make the largest difference in smooth implementation and adoption.

> The key to standards success is the availability of documentation without initial cost, and the availability of toolkits such as SDKs and open source code.

Such support is becoming increasingly common, as are measures such as 'plugfests', in which vendors test their implementations by connecting systems or exchanging content. But as more and more of the technical infrastructure of the media industry is created and maintained by software engineers, their needs must be considered throughout the development of standards.

The appeal of open source software partly comes from the ability to use, review, and contribute to the code as an engineer or company sees fit. But our contributors' comments also demonstrate that accessible tooling, examples, and testing are just as important.

Media industry standards must provide the same infrastructure for developers, or they will look elsewhere for solutions.

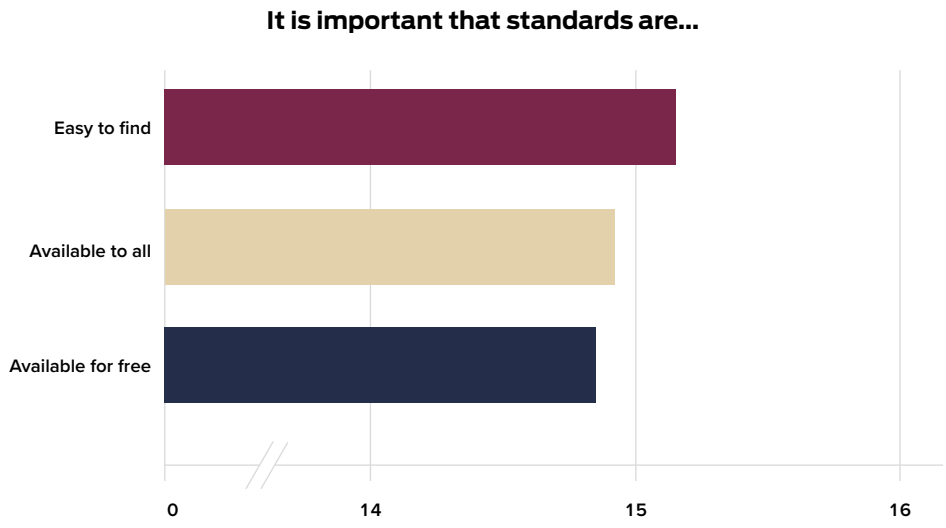
ACCESSIBILITY MATTERS

Even when a standard is approved, it is useless if companies cannot find it, access it, and implement it.

A standard is useless if companies cannot find it, access it, and implement it

We asked survey participants whether it is more important that a standard is:

- easy to find (e.g. via web search)
- available for everyone (not requiring membership of the standards group, signing of an NDA, or similar restrictions)
- available for free (i.e. no fee to access the documents)



The differences in priority were very small. But although users certainly prefer free standards, cost was once again the lowest priority.

It is clear that standards must be easy to find and access, in order to be successful.

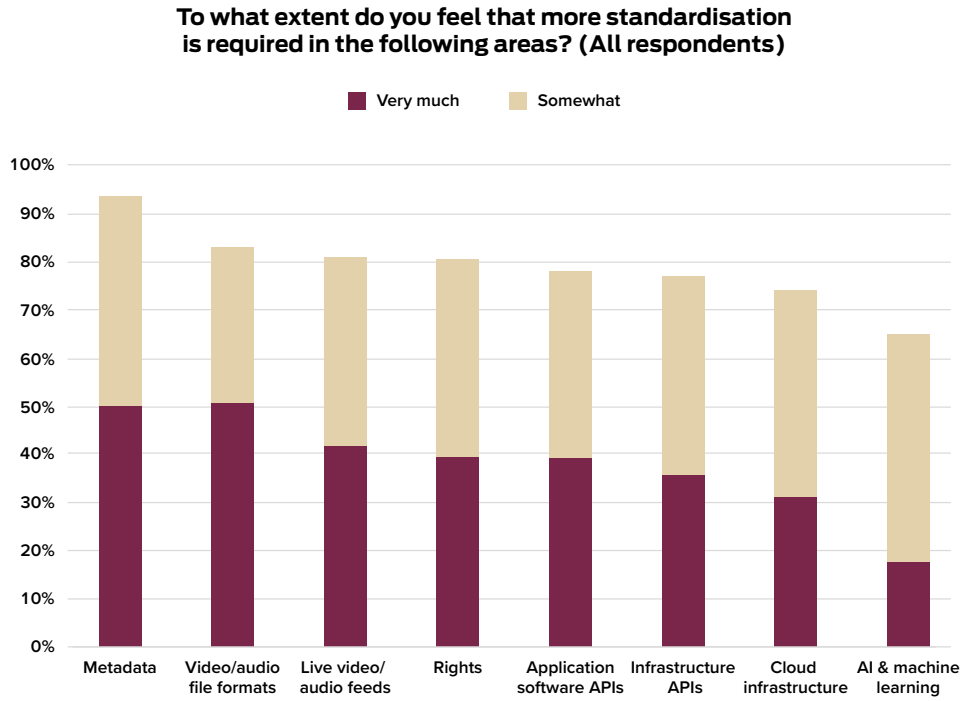
> Too many APIs, SDKs, standards, and documentation exist behind NDAs, private web pages, or charges for access.

The reality is that - as noted in a previous contributor comment - standards are products. And just like any product company, standards organisations of tomorrow will need to effectively market their products to gain market penetration.

Standards organisations need to be effective at marketing their products

AREAS OF NEED

We asked survey participants which areas of the media industry they felt needed more standardisation.



As noted in *The reality of implementation*, calls for increased metadata standardisation have been a common theme across a number of areas of DPP work. So seeing metadata top the list was not surprising.

It is unsurprising that metadata topped the list of areas needing more standardisation

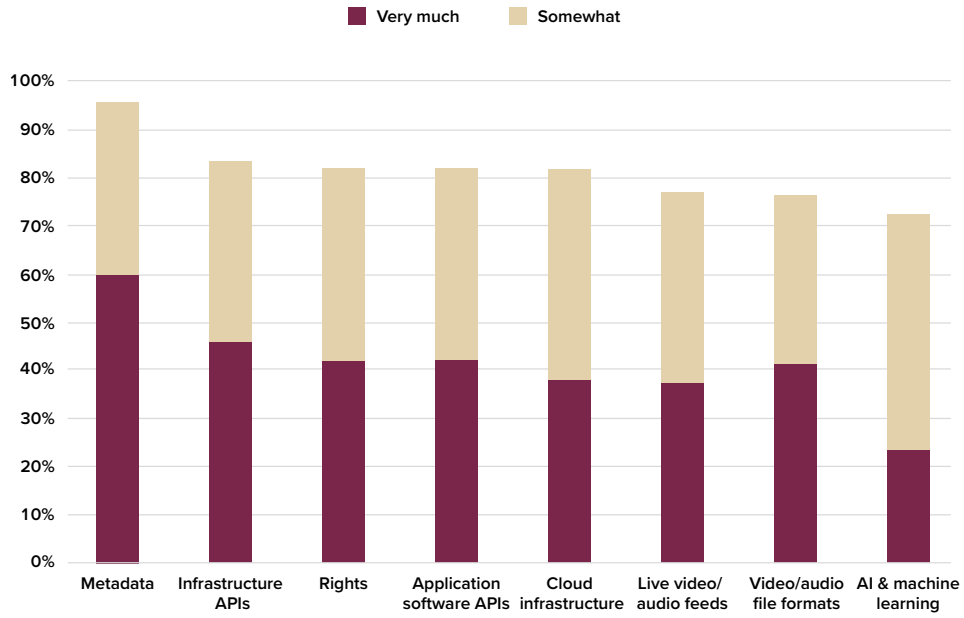
However, with the maturity of formats like MXF and increasingly IMF, as well as largely stable audio and video codec availability, it was a surprise to find video and audio file formats in second place.

It could be that confusion around next generation video codecs adds to the sense that more work is needed here. Or it could be that the variability of individual organisations' content delivery requirements drives frustration.

If these hypotheses are correct, then the need is perhaps not for more formal standards, but more common practice in the application of the standards that already exist.

However, the results change dramatically when reviewing only the answers from individuals who participate in at least one standards organisation. We could reasonably assume that this group has a higher than average understanding of the capabilities of current standards and the standardisation work that is already in progress.

To what extent do you feel that more standardisation is required in the following areas? (Standards participants)



These users still saw metadata as highly important. Indeed, 60% of them said there was “very much” more standardisation of metadata required, compared to 50% of the all respondents.

However, the standards participants placed APIs much higher up their priority list, with video and audio formats (both live and file based) much lower.

Standards participants felt a more acute need for standardisation of APIs

Artificial Intelligence and Machine Learning was consistently ranked the lowest. This may reflect a feeling that this technology is still nascent and undergoing too rapid change and innovation to be standardised; or it may be that companies see this as an internal capability which does not require structured interoperability.

Contributors were also asked to share any other areas which they felt warranted additional standardisation effort. Results were varied, with many responses in adjacent areas (such as language codes and content identifiers, which might be considered part of the broad topic of metadata).

Accessibility services, particularly subtitles, were also raised numerous times. The large number of subtitle formats and the persistence of legacy formats were cited as particular pain points.

Interestingly, however, the most comments were received about sustainability and security. This reflects the fact media companies are focusing not only on the specifics of media and data formats, but on the broader context of technology implementation.

A desire for standards in sustainability and security reflects a focus on the context of technology implementation

When it comes to technical standards, it is evident that metadata and APIs are worthy of further discussion.

METADATA

The need for additional metadata standardisation was reflected in a number of contributor comments.

> File and metadata exchange remain challenges, despite decades of standards activities in the industry.

> Exchanging metadata between systems and OTT platforms is a painful process, as each of them follow their own templates and norms.

Exchanging metadata between systems and platforms is a painful process

There certainly are metadata standards available, but adoption is not as widespread as many would like.

> Whilst standards exist (Cablelabs, Movielabs) a lack of broad adoption causes challenges when on-boarding new content partners.

> There are good metadata standards out there but I don't have the feeling that they are being adopted. Quite often they are only used as a starting point which later leads to some proprietary new schema.

However, almost as many comments warned against standardisation of metadata as called for it.

> I am a big fan of standards and they have proven very beneficial for audio and video formats, delivery packaging, etc. Less so for title, metadata, localisation data.

> A metadata standard terrifies me. It would be lots of work to create, and people will still augment it.

A metadata standard terrifies me

Many see metadata as too inherently flexible and individual to an organisation, to be able to fully standardise it. For this reason, flexible and extensible frameworks are more likely to succeed than all-encompassing formats or schemas.

> **Every workflow has a level of bespoke requirement. This is difficult where standards are concerned. The ability to add user defined metadata in a structured configurable way, within the limits of a standard, would be incredibly useful.**

Consistent with the theme of simple, tightly scoped, and iterative standards, it may be most helpful to divide the problem space into manageable pieces. Specific information domains may require defined vocabularies or ontologies, which can complement broader metadata structures.

Examples raised by contributors to our survey include the definition of different types of content distribution and monetisation, and the structure of a content order.

> **A lot of our core business logic depends on defined lists of media (e.g. SVOD, AVOD, Broadcast, etc.) to codify how content is being distributed. Each of our customers configures this for themselves, and everyone would greatly benefit from those media types having an accepted standard.**

> **Integrations with third parties - either content owners or suppliers - are painful due to the lack of a standardised lexicon for order data.**

It seems there is a genuine need for more commonality in the exchange of metadata between companies in the supply chain. However, a single unified metadata structure for the whole industry risks being the best example yet of an over-engineered, 'boil the ocean' solution.

The pragmatic approach would seem to be to build on existing work including MovieLabs MDDF, EBU Core, and various SMPTE dictionaries, to find well scoped solutions that solve highly specific business problems. It would not be wise to try to solve 'metadata' as a singular problem space.

Metadata may be the ideal application of tightly scoped, business focused, iterative standards

CONTROL AND APIS

The other area of technical standardisation which requires effort according to many of our survey respondents is API specifications.

In the first instance, as discussed in the DPP's ***Making Integration Work*** reports, it is increasingly important for systems in the media industry to offer APIs to control their functions. Concern was expressed by some survey participants that certain systems still require manufacturer-provided applications for control, without offering public APIs at all.

> Enterprise device control is overly dependent on custom software.

It is increasingly important for systems to offer APIs to control their functions

The extent to which APIs should be standardised is more controversial, however.

APIs are an area which has historically been dominated by de facto standards. A large number of object storage solutions, for example, implement Amazon's S3 API. This was created for Amazon's Simple Storage Service, not as a formal standard. But because it is published openly on the internet, and is very widely adopted, many others have implemented it too.

Few would deny that there should be some level of standardisation around APIs for a wide range of systems in the media industry. The contentious question is the scope of that standardisation.

The contentious question is the extent to which APIs should be standardised

At a foundational layer, it is uncontroversial to say that APIs should be based on fundamental web standards, communicating data over protocols such as TCP/IP (or in certain specific cases, UDP).

Building on this, there are multiple accepted patterns for the basic structure of an API. The most popular are the Simple Object Access Protocol (SOAP) and Representational State Transfer (REST). The latter is more common in modern web systems, and acts as the foundation for many popular web services and standards.

Nonetheless, our survey respondents expressed frustration with the fact that some systems in media still use bespoke interfaces for control.

> We feel pain when we find interconnection APIs that are not based on standards that are used in every industry (i.e. REST-based HTTP web service interfaces).

We feel pain when APIs are not based on basic standards like REST

Where different experts begin to disagree is the extent to which specific API endpoints (the functions that an API offers) and data structures should be standardised.

Many experts feel that the rapid pace of software development makes it difficult, and less valuable, to set standards for APIs.

> I do not see as much scope for standardisation of APIs or even metadata structures in most cases. At this level almost everything is fungible, change is relatively cheap, everything is software defined, business agility is key. Standards here will probably have a very short shelf life as the software frameworks, architecture, and engineering concerns are constantly evolving.

At this level change is relatively cheap and business agility is key

Some also feel that because APIs are closely tied to software product functionality, standardising them risks limiting innovation.

And many survey responses cited the failure of past attempts in this area, notably the Framework for Interoperable Media Systems (FIMS), to gain widespread adoption.

However, as more parts of the media supply chain are provided as software services in the cloud, the time may be right to make progress in this area. As with metadata, the key might be to take a more focused and iterative approach, and not to 'boil the ocean'.

The Open Services Alliance, for example, is working to build specific building blocks, such as a framework for status reporting and logging, and specific taxonomies to define key terms used in the exchange of information between systems.

A focus on the control, configuration, and automation of key parts of the media supply chain - while keeping the standards as simple and tightly scoped as possible - may yield more successful results than efforts of the past. This approach attempts to move faster, retain simplicity, and to enable extension of the standards and innovation on top of them.

If implemented correctly, simple standards can work alongside other interfaces and data structures

Such standards may then be used alongside proprietary interfaces and data structures. But if they all follow some common basic principles (such as providing published API documentation and data schemas, and building on common foundations such as REST and JSON or XML), this need not be a problem.

A PYRAMID OF STANDARDS

In this chapter, we have seen that different standards approaches are required to address different interoperability challenges.

This was eloquently outlined by some of the responses to our survey.

> **Standards lower in the technology stack need to be more formally specified and more broad based. I think of it like the testing pyramid. Focus most of your efforts on low level (e.g. Ethernet, TCP/IP), some of your efforts on mid level (e.g. HTTP, ST 2110), less of your efforts on high level (e.g. specific API endpoints).**

There is still a place for detailed, formal, standards processes. And significant effort is still required in the middle tier.

But we have also seen that two of the most pressing standardisation challenges exist towards the top of the pyramid. Any standardisation of metadata or APIs will benefit from a departure from historic methods of standards setting.

A rapid, inclusive, iterative approach is required, which owes as much to open source software development processes as it does to traditional standards development organisations.

A modern approach owes as much to open source software development as to traditional standards

Conclusion

The need for interoperability in the global media industry has never been greater.

But the methods by which that interoperability is achieved are dramatically changing.

The industry recognises the need for standards, and craves the confidence that can be inspired by well defined standards with broad backing.

The industry craves the confidence that can be inspired by well defined standards with broad backing

Yet it is frustrated by standards processes that are often seen as slow, bloated, and resource intensive. Companies struggle to justify investment in standardisation, because the payoff is too uncertain, and measured over too long a time frame. And they fear that the resulting standards are often over-engineered and difficult to adopt.

Nonetheless, engagement in standards processes remains relatively strong. In some cases however, that engagement is dominated by technologists and consultants, with too little involvement from business users.

GIVE THE PEOPLE WHAT THEY WANT

Users' demands are simple: standards that meet their business needs, and are as widely adopted across the industry as possible.

While they might ideally favour those published through a recognised standards body, real world implementation is ultimately more important.

They express positive sentiments about a mix of formal standards, open source protocols, and de facto standards. There is no simple rule that open standards are superior or that proprietary protocols are easier.

There is no rule that open standards are superior or that proprietary protocols are easier

Simply put, users prefer standards which are widely adopted, clear and focused, and easy to implement.

A MODERN MODEL FOR STANDARDS

Today's software defined content supply chains rely on a multi-layered stack of standards, and different approaches are necessary for different layers in the stack.

For hardware and low-level foundations, robust formal standards remain important. Yet for many software and data interfaces, the pace of business and technology change is much faster, and a different standards approach is needed.

That approach must be business focused, pragmatic, and fast. It needs active facilitation to reach its goals, and it requires the resulting standards to be supported with sample media, code, and testing tools.

Modern standards processes must be business focused, pragmatic, and fast

The standards community has an opportunity to evolve and become more relevant than ever. It must learn from the best practices of software development and open source, not blindly try to apply old processes to new domains.

It needs to accept a broader range of approaches, working with diverse companies and interest groups to support their goals. It must coexist with de facto standards and other open but informal formats and protocols.

Above all, it must remain focused on the business needs of companies across the industry. As those business needs have changed, so must standards.

The Truth About Standards was authored by **Rowan de Pomerai**, based on research by **Mark Pascoe** and **Rowan de Pomerai**. The report was designed by **Steph McGonigle**.

About Ross

High Impact, High Efficiency Production Solutions

Ross powers video productions for billions of global viewers daily with the industry's widest range of high impact, high efficiency production solutions. Ross makes it easy to create compelling news, weather and sports ***broadcasts***, engaging material for ***sports stadium screens and entertainment shows***, ***remote productions***, ***educational institutions***, ***legislative assemblies***, ***corporate applications*** and inspiring content for ***houses of worship***.

Ross solutions have impressed the audiences and marketing partners of NBC Sunday Night Football, Eurosport, BBC World, ***Google YouTube Space London*** and China's eSports powerhouse VSPN. Ross delivers an unrivalled range of products and services comprising ***virtual studios***, real-time motion graphics, cameras, robotic camera systems, production switchers, video servers, infrastructure and routers, social media management, newsroom systems and ***mobile live events***.