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Identifying the characteristics, constraints, and enablers to creating value in applied performance analysis

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Abstract

While applied performance analysts (PAs) are a well-established applied sports science practitioner group, there is no clear definition of the purpose of an analyst, their key relationships, or the expertise required to execute the role successfully. This research sought to understand how PA practitioners and educators perceive their role as applied PA practitioners. Twenty-seven applied PAs and educators with applied PA experience participated in six online focus groups, completing an online survey in advance. Reflexive thematic analysis of transcripts and survey data generated an overarching theme: embedded applied PA practitioners have a value co-creation role within performance ecosystems which is inhibited by poor professional infrastructure and a lack conceptual clarity for the role. Five sub-themes are reported; the (a) why, (b) what, and (c) how of professional practice; d) the impact of stakeholder misunderstanding on PA practitioners; and (e) issues with professional recognition, development, and renumeration opportunities. This study demonstrates applied PAs' role as curators, translators, influencers, and educators aiming to add value to the decision-making of a wide range of stakeholders. It highlights a potential deficit in applied practice in 'value capture' which may be perpetuating the problems practitioners reported with stakeholder misconceptions and undervaluing of their role. It is hoped this paper will inspire those invested in applied PA practice to create a shared understanding of how they can add value within the performance ecosystem so the profession can evolve and thrive.

Keywords

Multidisciplinary sports science team, professional practice, technology

Introduction

Applied performance analysts (PAs) are a well-established applied sports science practitioner group, having operated within performance sport ecosystems for over 20 years.[1] Until recently, this group of practitioners and their perspectives on practice have been largely absent from the body of performance analysis (PA) literature,[2–4] reflecting a lack of emphasis on the study of applied practice in PA. Investigations which have captured the lived experiences of applied PAs reveal a group of dedicated and passionate practitioners who face several challenges including general role ambiguity,[5,6] ad-hoc recruitment and job insecurity,[7,8] poor working conditions,[9–11] widespread use of unpaid internships and poor salaries,[1,12] continually having to 'prove their worth' in an often volatile micro-political climate,[7,8,13] and a general uncertainty about what skill set is required as the profession and technology rapidly evolve.[14]

In response to media coverage of poor conditions for analysts,[15] O'Donoghue's 2013 editorial[12] (p. iii) made the case that '*sports performance analysis is a skilled profession requiring knowledge of sports performance, intellectual ability, practical skill and the ability to work professionally with a squad. The profession should not be undersold*'. Ten years later, it is timely to explore if the lived experience of applied PAs' is indeed one of esteemed

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professionals and examine if the concept of applied PA as a profession has developed. This is particularly pertinent in the broader sports science sphere given the human redundancy which will impact roles as task automation becomes more prevalent through technology and computer developments.[16] As more and more students graduate with aspirations of becoming applied PAs, there is a duty of care on established practitioners and representative organisations to consider how we can better understand the evolving role in order to provide PA practitioners with guidance, regulation, and clear pathways in which to practice and thrive as professionals.

The key characteristic of any profession is being able to define who they are—and who they are not—as a group of practitioners.[17] A profession can be said to have a distinct body of knowledge, a specialised and unique set of skills, practitioners with the ability to make judgements with integrity in uncertain environments, and a community who perform oversight and monitoring of professional practice.[18,19] Martin,[20] considering the discipline of sports psychology, adds the additional criteria that professionals should be able to make a living in the role. Many applied PAs are making a living within the performance sport industry, and they are increasingly being described in the literature as professionals,[1,7,21] with their activities termed 'professional practice'.[22–24] The capacity to harness technology to capture ever increasing volumes of performance data, coupled with the time demands on modern coaches, ensures the continued demand for the services of applied PAs in sport. Despite this, the 'trappings' of professional practice such as demonstrable theoretical and practical expertise, guides for practice, codes of practice, organisation, and regulation,[18] are largely absent in a role which deals with increasing volumes of athlete data.[25] A series of editorials[26,27] track the evolution of PA as a discipline from a working group of the British Olympic Association[28] to the formation of the International Society of Performance Analysis in Sport (ISPAS), as it became '*apparent that Performance Analysts need some sort of support body*'[29]*(p. i).* ISPAS began the process of accrediting PAs in 2006.[30] It does not currently provide structured professional development programmes or a guide for practice for applied practitioners.

Martin et al.'s[2] framework for professional practice in applied PA provided a comprehensive overview of the mechanics of practice—i.e. the components and processes which contribute to the understanding of what applied PAs do. However, this approach does not fully capture the behaviours and actions which determine the successful delivery of these processes. The ever-evolving nature and volume of data now available to inform decision-making in sports organisations and the critical mass of people employed in applied PA in such a variety of roles demand a deeper assessment of practitioners' function and purpose. Without this clarity, it is very difficult to educate consumers about what they can and should expect from applied PA or indeed appropriately prepare applied PAs for the realities of their role. This research sought to understand how a large and varied group of leading PA practitioners and academics perceived the role of an applied PA practitioner.

Methods

Following ethical approval, six independent online focus groups comprising elite applied PAs and leading academics in the field (Table 1) were convened with the dual purpose of validating a proposed framework for professional practice[2] and capturing the lived experiences of applied PAs. A deductive analysis was conducted to determine the validity of the proposed framework and is reported in Martin et al.,[2] while an inductive analysis was implemented to consider the participants' perspectives of their lived experience as analysts and educators/researchers in the field. Capturing the complexity of professional practice requires a philosophical position such as critical realism as it conceptualises industrial relationships, processes, and networks as continuously changing based on human agency.[31] A critical realist position recognises that all of the perspectives expressed are the individual's interpretation of their experience; however, it also provides scope to notice how the collective experiences might be observed as a phenomenon which impacts a group, such as applied PA practitioners.[32] All analysis and interpretation draw on existing knowledge and life experience within the research team, and we acknowledge our biases relative to this study acquired though our collective experience of professional practice, research, lecturing, accreditation processes, and consultancy.

Participant sample

The professional networking site LinkedIn was used to recruit participants. The duration (maximum 2 years' experience for Early career analysts and minimum 5 years' experience in elite sport as lead applied PA for all others) and nature of participant experience were a key consideration for inclusion. The aim was to recruit a diverse range of experiences in different sports and environments through purposive sampling. Academic participants were involved in the development of applied PAs practitioners, and most were still practicing elite applied PAs (Table 1). Participants were currently working in a variety of countries/continents: Africa (1), Europe (1), North America (1), and Oceania (2), but were predominantly British or Irish (22) due to constraints with logistics and contacts. A quarter of the sample were female participants (7/27).

Procedure and analysis

Six focus groups and three follow-up interviews were conducted (Table 1), via Zoom (Zoom Video Communications Inc., 2016). These were recorded and transcribed verbatim. Participants were asked to complete a survey prior to

Table 1. Details of focus group structure and participants.

Group	Theme	Typical role descriptions	Ave. years' experience	Total no. of participants	Duration (hr:mins)	Participant IDs
Pilot	Test group	PA Course Director/Head of PA at Professional Club or National Federations or PA Company or Institute of Sport	20	4	1:33	N/A
1	Elite Gaelic games applied PAs	Head of PA at elite Gaelic games teams	9	6	1:06	P1-6
2	Elite multi-sport applied PAs	Head of PA at National Institutes of Sport or Professional Clubs	16	4	1:54	P7-10
3	Elite soccer	Head of PA/Director at Professional Clubs or National Federations or PA Company	18	5‡	1:38	P11-15
4	Academics I	PA Course Director/Senior Lecturer/ Researcher	20	3 + 1*	1:20	P16-19
5	Academics II	PA Course Director/Senior Lecturer/ Head of PA at Professional Club or National Federations	11	3	1:15	P20-22
6	Early Career Analysts≠	Applied PAs at Professional Clubs or National Federations or Institute of Sport or Elite Gaelic Games Teams	2	4 + 1*	1:20	P23-27

*One participant withdrew at the last minute due to unforeseen circumstances having completed the survey and they offered to be interviewed individually. These interviews lasted 56 min and 1 h 5 min, respectively.
‡One participant had to leave early and offered to do an individual follow up interview which lasted 34 min.
≠Early Career Analysts were defined as those with a maximum of two years' experience delivering PA, and currently working at the elite level.

attending the focus group where they were invited to comment on the components of the proposed framework for practice and 25/27 participants did so. Braun and Clarke's[33] six-step reflexive thematic analysis process was used to analyse the focus group and qualitative survey data as this was flexible enough for different concepts to come to the fore at different stages as decisions were made about how best to interpret data and code to higher order themes. We did not seek to arrive at consensus among the coders, but rather to deepen the interpretation of the data and allow voices to be heard and themes to develop in a collaborative and nuanced approach.[34] A total of 128 codes were generated in phase 2 of the initial inductive analysis. In this phase, transcripts were coded by the first author and then reviewed by the final author, allowing codes to be refined and agreed. Data trustworthiness and richness were achieved through the triangulation of survey data with focus group transcripts, and the use of QSR NVivo (Version 12, www.qsrinternational.com) ensured a transparent audit trail for decision-making.[35] Potential themes were identified and discussed in phase 3, and several iterations of the themes were mapped and reviewed by the first and final authors. Authors 2, 3, and 4 challenged the assumptions underpinning themes as the final mapping took place adding to the credibility and confirmability of findings.[35] Participant comments are presented as quotations to support the credibility of the interpretations and the explanations put forward[36] and are referenced by the participant number. Quotations were reported verbatim; however, words or phrases such as 'like', 'so', 'kind of', and 'you know' were removed where that did not impact the meaning of the comment.

Results

Inductive analysis of qualitative survey data and focus group conversations generated five sub-themes (Figure 1), three regarding the characteristics of professional practice: the why, what, and how, and two concerning how the broader issues and constraints which impact professional practice. The 'Why' was the aspiration to add value to decision-making processes such as recruitment, training, selection, and tactics. Considering 'What' applied PAs do, participants discussed processes that applied PAs undertake in generating, translating, and designing learning opportunities to co-create valuable knowledge. In terms of 'How' valuable knowledge was co-created, a strong theme of 'embeddedness' within the performers' organisation was evident, which allows applied PAs to build the necessary relationships, credibility, and contextual intelligence to deliver optimally on their role. The impact of broader issues within the profession on practice was captured in two final sub-themes: how the lack of definition and conceptual clarity for the applied PA role leads to stakeholder misunderstanding and undervaluing of practitioners and their work and how the lack of professional infrastructure for practitioners inhibits professional recognition, development, and renumeration

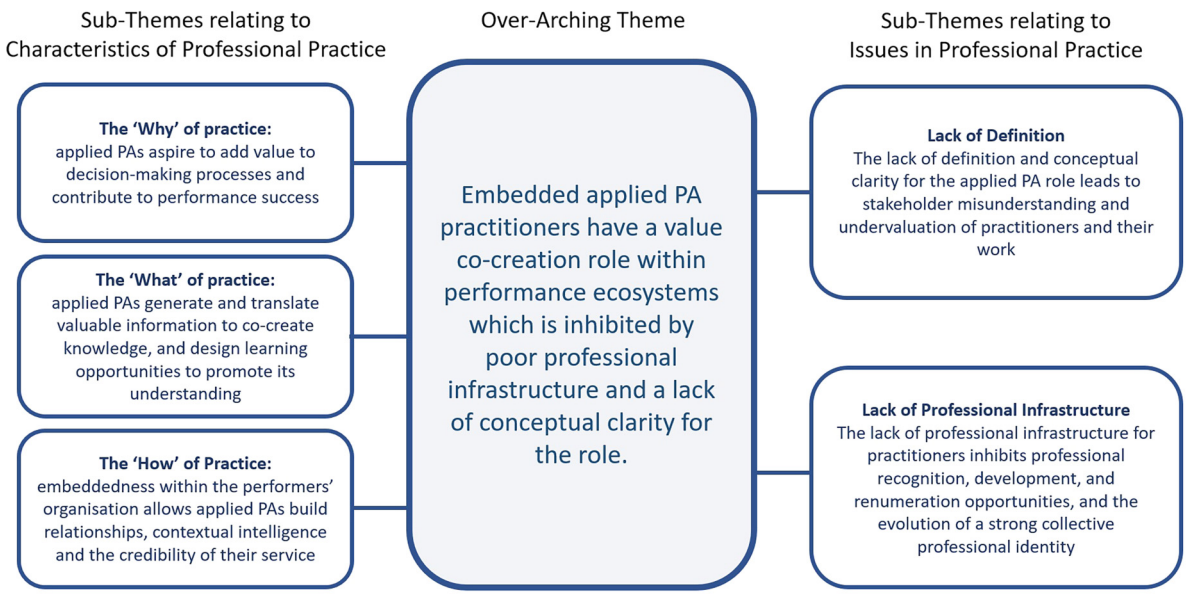

Figure 1. A summary of the themes which were generated from a survey and focus group conversations with 27 elite applied PAs and academic experts about their perceptions of the role of an applied PA.

opportunities. The overarching theme was that embedded applied PA practitioners have a value co-creation role within performance ecosystems which is inhibited by poor professional infrastructure and a lack of conceptual clarity for the role. This value co-creation role involves working with stakeholders to generate, curate, and translate data which leads to better decision-making. This section explains the term performance ecosystem and presents the five sub-themes and the lower order themes which they are built upon with quotes to illustrate their meaning.

A performance ecosystem

The term 'performance ecosystem' is used to reflect the work environments described by applied PAs. The diverse range of internal and external stakeholders that applied PAs reported dealing with are captured in a network diagram (Figure 2), illustrating the importance of a contextual intelligence and relationship management skillset for applied PAs. Several participants referred to how their presence within these performance ecosystems afforded them the opportunity to observe the environment, the culture, and dynamics which contextualise their practice. This embeddedness within the performance ecosystem is interpreted as a key distinguisher between 'applied PAs', as defined later, and others who work in the PA industry (Figure 4). Participants felt that presence was key to sustaining relationships and building sufficient contextual intelligence to function and have influence within the complexity of the performance ecosystem:

> *So when you're going into these cultures and environments, go and smell it, go and really, actually, purposefully go into that environment, not just with your technical hat on, but with all the other things that are really important. … looking at the environment and working out how you're going to work in this environment, and deliver in this environment, and connect with people in this environment. Also, you need to be looking at the organisation, what is the culture, what the behaviour is, what's accepted, not accepted…* P10

The 'why' of practice: applied PAs aspire to add value to decision-making processes

> *The whole point of the work we do is to inform future decision-making and learning.* P16

As articulated in the quote above, participants felt their purpose was to add value to decision-making processes which may in some way contribute to successful sporting performance. The potential to impact sporting performance is understood as another distinguishing factor between applied PAs embedded within a performance ecosystem and others who work in the PA industry (Figure 4). Participants connected the purpose of their practice to having a voice and agency to influence or add value to decision-making, although this was not always a given:

> *[You] can only attempt to influence so much. Again, credibility through consistency with your coaches is a crucial barometer of how hard to push some things. Subtle influencing [is] often the way.* P8

Figure 2. A network diagram of the stakeholders applied PAs engage within and externally to their organisation identified by focus group participants. The dashed lines represent assumed relationships within a performance ecosystem.

> *I think it [the level of advocacy] comes down to those things, analyst experience and… analyst knowledge within the sport, …therefore, does the coach trust what you're going to say?* P21

In the dataset overall, the positive aspects of the applied PA role did not receive as much airtime as the challenges. When participants did express high motivation and enjoyment of the role, it was commonly in the context of feeling that they had contributed in a meaningful way:

> *Sometimes, and my preference, where I felt I was getting more job satisfaction when it was more interactive, and you had more input and there was more discussion back and forth. And I think… you felt like… you're on a level with the head coach or the manager and you were actively involved…* P12

> *I was massively valued in terms of being able to give an opinion, being heard, not always following through, but that's their job. The staff we had …that was one of their biggest strengths. They would absorb multiple bits of information …and decide what went to the players. And it might be, 10% of what we gave them. But at the end of the day, if they felt like that was enough, then that's what they felt was the right way to do it. And… for us, we felt we'd done… [our job]* P13

The 'what' of practice: applied PAs generate and translate valuable information to co-create knowledge and design learning opportunities to promote its understanding

Study participants identified knowledge co-creation and dissemination within an organisation as the 'What' of practice. Analysis of the data generated three lower order themes which could be said to be phases to this process: (a) to generate bespoke, integrated, reliable, and valuable

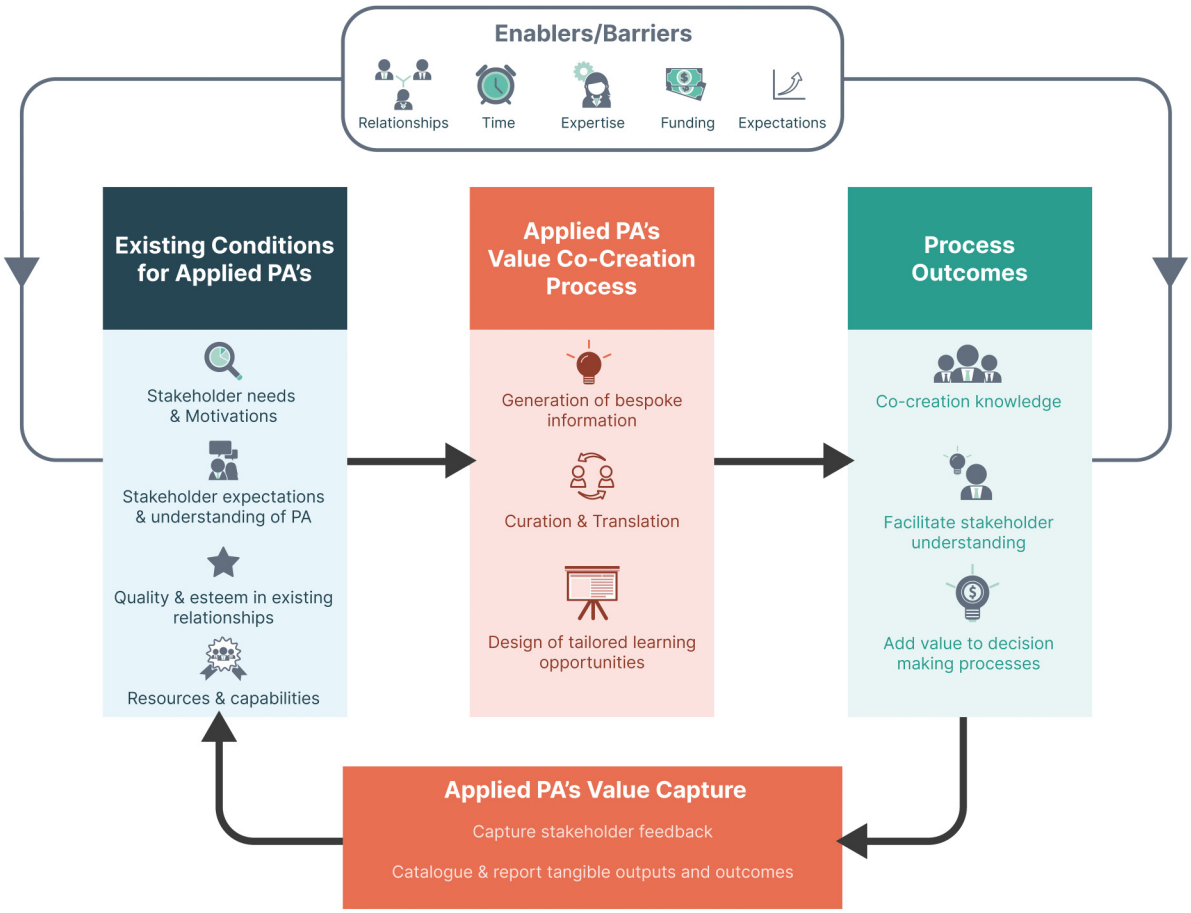

Figure 3. A conceptual model for the value co-creation process in applied PA practice adapted from de Oliveira and Cortimiglia.[38]

information; (b) to translate information directly with stakeholders to co-create knowledge; and (c) to play a role as educators, investing significant time and consideration into designing and supporting learning opportunities for a range of stakeholders (Table 2).

The 'how' of practice: embeddedness within the performers' organisation allows applied PAs to build relationships, contextual intelligence, and the credibility of their service

> *For me, the actual doing is …being immersed in the environment and actually undertaking it.* P22

The quote above is reflective of this sub-theme identifying the embedded nature of the role of an applied PA within the performers' organisation, a sense of belonging and contributing to something bigger. Participants connected embeddedness to their ability to build and foster strong relationships, to build their credibility as practitioners and the credibility of applied PA as a service, and to gain the contextual intelligence which drives their professional decision-making. The identification of embeddedness as fundamental to enabling effective practice led to its interpretation as the 'How' of applied PA practice. The lower order theme participants described were grouped into three aspects of professional practice which underpin embeddedness: (a) relationship management with diverse stakeholders in a highly political context; (b) self-management within the demands and expectations of the organisation; and (c) service management in an embedded context (Table 3).

The lack of definition and conceptual clarity for the applied PA role leads to stakeholder misunderstanding and undervaluation of practitioners and their work

Whether applied PA is actually a profession arose in several focus groups, with opinions expressed that it is a profession to those who understand and value it. Many participants felt that PA was poorly understood by stakeholders, and this was linked to a perceived lack of value placed on the service and on practitioners (Table 4). Some focus groups highlighted that the purpose of embedded applied PA practitioners is to contribute to sporting success in some way,

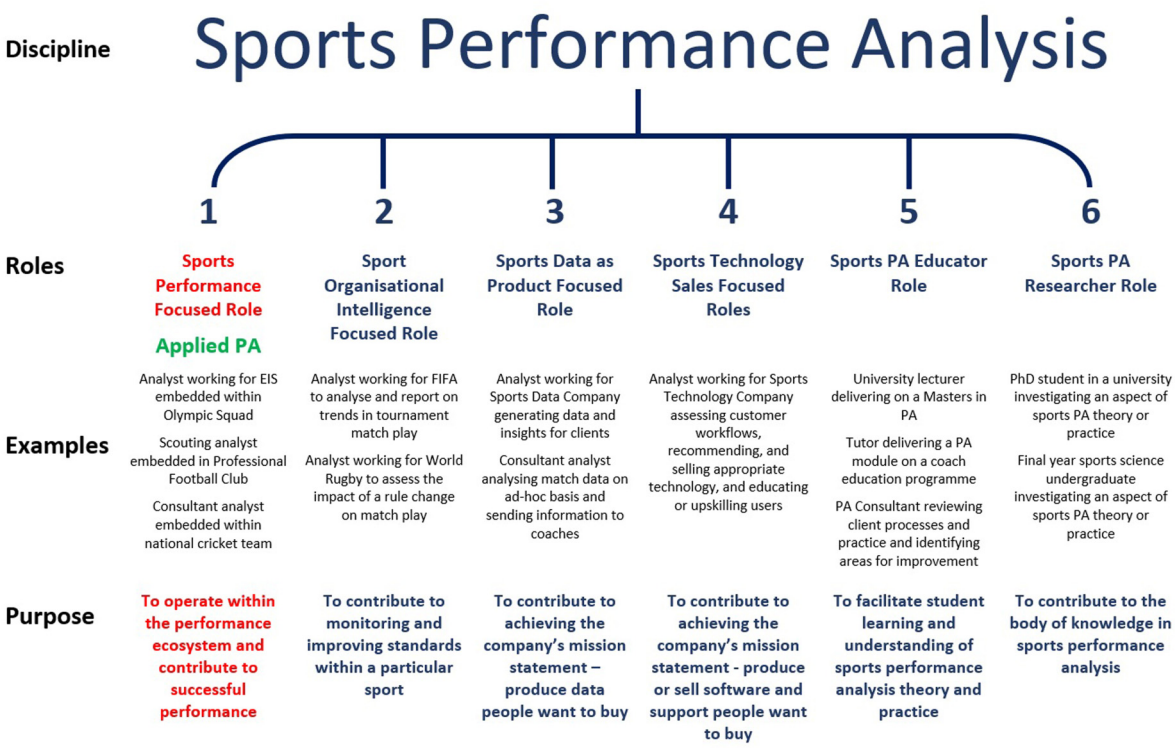

Figure 4. Mapping the diverse roles practitioners may carry out within the Sports Performance Analysis discipline, differentiated by their purpose and expertise. Many practitioners operate in multiple roles simultaneously.

Table 2. Lower order themes and quotes of applied PAs' perspectives on the 'what' of practice: applied PAs generate and translate valuable information to co-create knowledge and design learning opportunities to promote its understanding.

Lower order themes	Quotes
Phase 1: Applied PAs generate bespoke, integrated, reliable, and valuable information	*'For me one of the fundamentals in terms of making sure that… are we actually collecting what we're wanting to collect and with the emergence of all these wonderful secondary data companies, which is fantastic for creating some interesting visualisations, which are general, but is it actually club specific or team specific and philosophy based'?* P20
	'An important aspect of designing the system is then explaining it to the relevant stakeholders in a way that makes sense to them and connects them to the project. They won't care about how hard it is to design, just the output'. P14
Phase 2: Applied PAs translate information directly with stakeholders to co-create knowledge	*'We call [it] …translating …a lot of technical leads will really focus on the translation and making sense of it …you got to land it with a with a PD, you know, all the way down to the athlete in the action'.* P10
	'…you can interpret what you've seen… whether it is video, whether it's data or visualisations, and actually try and tell a story… in coaches' terminology; because it's for the end user, it's not for us, we're there to help the coach or the player or the athlete. So, you should talk in a language or use words that they understand'. P12
Phase 3: Applied PAs as educators investing significant time and consideration into designing and supporting learning opportunities to disseminate knowledge to a range of stakeholders	*'Context again is most important - we do not have rigid models of feedback. We do what is right at the time given the game or training session at hand, taking into consideration their needs. Carefully plan break out groups so that individuals can each contribute and not be overwhelmed by others'.* P22
	'The softer skills of an analyst's role are incredibly important, and whilst there often isn't a perfect time, you can quite easily find the wrong time for players or coaches to be in the right moment to be receptive…' P13

Table 3. Lower order themes and quotes of applied PAs' perspectives on the 'how' of practice: embeddedness within the performers' organisation allows applied PAs build relationships, contextual intelligence, and the credibility of their service.

Lower order themes	Quotes
Embeddedness within the performers' organisation allows applied PAs to build relationships, contextual intelligence, and the credibility of their service	*'Relationship building, and more importantly, relationship management is a huge part of day-to-day practice. Sport is a people business'.* P8 *'Just find out kind of how the environment works, what the culture and people are, how the coaches like to work as in their culture of the environment? And who was who within the organisation, who do you have to liaise with, engaged with and influence…'* P21
Embedded service management builds credibility by effectively managing resources and the system but lacks formal planning or evaluation	*'Are you a product like a transaction? Or are you a service? …we want to be a service. We want to have a seat around the table'.* P10 *'Many of these things are iterative and are a constant cycle of improvement. …system design never stops, because… you're always trying to adapt to changes in technology, changes in software, changes in hardware… "Is it worth us moving on to this new bit of kit"?, or "Does it… give us anything for the extra cost, and does it fit into our legacy systems?"'* P14 *'Most of this process [evaluation] is informal and not too often coaches will value the need for a formal meeting. Evaluation an area that is often overlooked, largely due to time constraints but also due to the ever-changing environment'.* P13
Self-management is critical to embeddedness, practitioners must have the characteristics and behaviours to fit in and deliver within the performance ecosystem	*'Some of the clubs …they don't always go for the best students, or the best on paper, or the best person with experience. A lot of it is about the rapport… Do they see them fitting in? Do they see them communicating? Do they think that they'll be easy to line manage'?* P19 *'I think I think all of us would probably say we're competitors as well. … people don't get out of bed at whatever time or stay up until three o'clock in the morning if they didn't want to achieve something or they didn't want to be a part of, a high-performance environment or a successful [team]'.* P8 *'We've set the expectations, haven't we, we've over delivered … at a detriment of our own health and wellbeing, and actually sometimes over delivered at the detriment of actually collecting too much data … you know, that we're not even using'. P10*

which differentiated them from others in the discipline. In considering the interface with data science, participants expressed a view that there was a delineation of the roles where the embedded applied PAs were more likely to be the data translators who commissioned and managed data models and systems, rather than build them. This difference in skill set and purpose was the first of two lower order themes. The second captured the lack of value placed on practitioners as reflected in poor pay and conditions (Table 4).

The lack of professional infrastructure for practitioners inhibits professional recognition, development, and renumeration opportunities and the evolution of a strong collective professional identity

Participants in general demonstrated a strong sense of 'kaizen' or philosophy of continuous improvement and the need for effective professional infrastructure to support this was a prevalent theme, with lower order themes around the lack of professional development opportunities and industry regulation (Table 5). While several participants were accredited to different bodies including the ISPAS, it was clear that this was a voluntary exercise, generally not sought by employers nor viewed as essential to career progression. The perceived lack of value and recognition of the profession was linked by many to the absence of mandatory professional standards and a regulatory framework. The introduction of regulation through robust accreditation would potentially be welcomed by practitioners and would assist in filling the gap in professional validation which was identified.

Discussion

This study set out to understand how applied PAs perceived their role within the performance ecosystem as part of a larger study to understand the practical components of the role itself.[2] Inductive analysis of the findings identified that applied PAs provide a value co-creation

Table 4. Lower order themes and quotes of applied PAs' perspectives on how the lack of definition and conceptual clarity for the applied PA role leads to stakeholder misunderstanding and undervaluing of practitioners and their work.

Lower order themes	Quotes
The applied PA role is frequently misunderstood, needs conceptual clarity, and may be distinguished from other PA roles by its purpose and skillset	*'There's also an awful lot of misconceptions and misunderstanding of the role of PA that exist out there, a lot of people who don't maybe have access or don't have the understanding of it all still think it's: somebody filmed it, and codes it, and hands it over to the coach'.* P22
	'This is perhaps my biggest question relating to the entire project - what is a performance analyst? It seems that culturally it varies substantially across sports and indeed continents. For example, some of the above is 'traditional' video analysis, whereas in Australia some would actually be done by Sport Scientists. In the US, it might be done by analysts/data scientists. Do we consider PA as an umbrella term to cover all of these roles'? P16
	'I engage with a data engineer at [National Governing Body], we've got a data scientist and then I sit on the PA front. [The] data scientist is more like getting hold of that data, pulling it into places doing … very mathematically type things, we use …that information to translate it to the coach almost being like the right hand of the coach type thing. The data engineer, …he's more concerned with the structure, the data, the flow of how that data is collated, stored, and managed to enable the analyst to then pull it out in an effective manner'. P21
	'Why am I doing this? was more important to me at the time than… What am I doing? … you can have "coding monkeys" …and that's the people who work at [Data Company] …who don't necessarily have the experience of working with actual people at the end of that data side, or the video side of it, so they can just go bang, bang, a load of buttons …they're none the wiser if it's being used in a good way, a bad way, or anything else'. P13
Applied PAs are professionals operating in demanding environments but are generally not highly valued and lack validation opportunities	*'Because we've worked under stress every day, all day, you just need to have a kind of calmness and a logic to your work. Get on with something and maximise the time'.* P12
	'I think there's also a long way to go for it to be widely recognised as a profession, I think those that work within it and know it inside out, and those who recognise the value in it will absolutely see it that way'. P22
	'Every single one of us has said, we all worked for free to start with. Which, okay, it's part and parcel of it, but shouldn't be. I… I missed out on one job, because someone lived two minutes from the training ground and would do it for free. So that's the nature of it'. P13
	'You speak to people in Australia and New Zealand, South Africa, North America as well. They're so isolated at times and they don't know whether they're doing a good job or not, or what they should be doing, or what other people are doing. Just creating that community independently, I think is so important, and peers to bring through the next generation'. P14

role within performance ecosystems, achieved through embedded practice, in order to contribute to performance success. This discussion is structured in two sections, framing the findings of this study through the lens of existing literature in PA, professional practice in sport, and value co-creation. The first section examines the idea of applied PA as value co-creation considering the lessons of value co-creation in other service ecosystems.[37,38] Section 4.2 discusses the importance of role definition and conceptual clarity to participants in their day-to-day practice and explores the opportunity to reimagine applied PA as a credible, dynamic profession, essential to the translation, integration, and optimisation of data within performance ecosystems.

Applied PA as value co-creation

Applied PA practice has not previously been considered through the lens of knowledge co-creation or the broader body of literature regarding value co-creation in the

Table 5. Lower order themes and quotes of applied PAs' perspectives on how the lack of professional infrastructure for practitioners inhibits professional recognition, development, and renumeration opportunities and the evolution of a strong collective professional identity.

Lower order theme	Quotes
Professional development opportunities can be haphazard in applied PA, and there are limited career progression supports or pathways	*'In my Head of Analysis [role]… we could also ask for CPD support for education, training, conferences etc. I think CPD should be a big focus of a profession and a professional'*. P17
	'Time's your enemy… as an analyst, time is your biggest enemy. I think for a lot of people, they don't really have a lot of time to think about things too far down the line, because they are under so much pressure to get results or over emphasise preparation for each individual match. That constant pressure creates instability, it doesn't allow you to really develop yourself or other people as much. I don't think it's as conducive to that'. P12
	'I think having a mentor that's been there and done it is so important… you can always bounce ideas off, you know you're going down the right path a little bit. If there was some mentor scheme, or some… contacts, that… have been there and done it and will help you out along the way. I think they're so important'. P25
	'It's [management] my role now. And I didn't have experience in some of it. Some of it I do, some of it I was trained to do, some not. Some developed, or [I was] thrown in the deep end'. P14
	'Setting up that overarching governing body to then provide the framework by which people can be assessed, accredited, but then improve it and see a pathway and see where they are in the global landscape'. P14
Applied PA needs regulation and industry standards for practice and practitioners	*'If we then raise the standards through that method [accreditation and regulation], seeing what else goes around elsewhere, you're almost being externally validated, then that's no reason… why the wages can't then match to the jobs and then you can use that to try and get better people in and then it just goes nicely full circle and then eventually the whole level of PA just goes up throughout the entire world hopefully'*. P21
	'Probably the point I'll take out of this exchange is the… the lack of accreditation. I think it's true, it's something we really need to… improve really… it's a bit of the …wild west at times'. P15
	'Something that's not really been defined in the football industry is actually about the value of staff. But there's always this hidden sort of society about how much they're going to pay people. You know, if we're talking about layers of competency or your idea of expertise, I think aligning that to something of value is a little bit more transparent for people to see where the industry takes them'. P13

service and consultancy industry.[38] The first phase of knowledge co-creation is to design a system which will collect valuable, reliable information. Practitioners, and their stakeholders, placed considerable value on collecting, curating, and integrating bespoke information, tailored specifically to the needs and demands of the context. Many authors in the sports domain have linked contextual intelligence—a thorough understanding of the needs and motivations of stakeholders—and the capacity to design a system which uses stakeholder terminology and language, to the success of subsequent knowledge translation, user understanding, and acceptance.[1,39–43] It is increasingly acknowledged that the second phase of knowledge co-creation, translation, is a key function of applied PAs;[1,6,14,44] however, there has been limited exploration within academic literature of how knowledge translation occurs effectively in applied PA contexts.[2] Rothwell and colleagues[40] posit that knowledge translation and integration are so important that practitioners should consider themselves as '*learning designers*'[40] *(p.60)*, a perspective with which study participants strongly identified. It is clear from the current data that applied PAs invest significant time and consideration into designing and supporting learning opportunities for a range of stakeholders, through formal and informal meetings and the use of technology platforms to communicate video or data in particular

ways. Data visualisation aside, there is little guidance specifically for applied PAs in the academic literature as to how to design and deliver context-appropriate learning opportunities for stakeholders, which is challenging given the rapidly evolving technological landscape.[41,45]

The '*How*' of successful practice is the extent to which applied PAs develop relationships, credibility, and contextual intelligence through their self- and service management while embedded in the performance ecosystem. The concept of embeddedness has not previously been named in research relating to applied PA practice but is clearly evident in many accounts of practice spanning the past 20 years.[46–48] The findings tally with the increasing body of literature acknowledging that applied PA practitioners operate in a highly political environment,[49–51] and the strategies applied PAs use to function effectively which were previously reported[7,8] were echoed in the current study. Given the wide range of internal and external stakeholders applied PAs manage (Figure 1), participants consistently identified the importance of developing the contextual intelligence to enable them to have a meaningful presence within the performance ecosystem. Others in sport science called this 'putting in face-time',[52] creating 'touchpoints'[53] or 'visibility', and 'getting a day-to-day feel' for organisational dynamics.[1] Performance sport is widely acknowledged as an emotional business,[54] with significant pressure and emotional stresses on athletes,[55] coaches[6] and managers/performance directors,[57] and sports scientists.[58] Appreciating the pressure points for individuals allows for the development of contextual intelligence which can be described as an understanding of the organisational culture and stakeholder motivations, philosophy, needs, and decision-making processes.[59]

A philosophical debate as to the nature of applied PA practice has not taken place in the literature; however, the word 'service' to describe applied PA activity is seen sporadically.[1,8,9,44,60–62] In a service ecosystem, the term 'service' can be defined as '*the application of one's resources for the benefit of another actor*'.[63] Applied PAs working within PA departments in performance ecosystems can be seen as service providers to the coaching or commercial departments, similar in function to the human resources or marketing functions. Many of the applied PA service management activities described by participants focused on system oversight and resource management. The lack of evaluation of practice in PA was highlighted recently by Robertson,[64] and the difficulty in measuring the impact of applied PA is frequently cited.[65,66] Thus, there has been little exploration as to how to measure the effectiveness of the practitioner or the value they bring to organisational processes. de Oliveira and Cortimiglia[38] propose a generic conceptual framework which can be applied to service ecosystems to examine how value is co-created and measured. Applying our participant perspectives to adapt de Oliveira and Cortimiglia's framework,[38] value co-creation in applied PA practice is illustrated (Figure 3). The '*existing conditions*' comprise stakeholder needs and motivations, expectations and understanding of PA, the quality of existing relationships, and the resources and capabilities of stakeholders to create value. The phases of the applied PA's '*value co-creation process*' identified by participants form the central element of the graphic, while the '*outcomes*' are co-created knowledge, stakeholder understanding, and the potential to add value to decision-making processes. The five '*enablers/barriers*' listed: relationships, time, expertise, funding, and expectations, are well evidenced in this study and previous work.[1,7,48] This cannot be said of the applied PA's '*value capture*' component of the model as there is limited evidence of how this occurs, or if it happens at all, within the current data or in the body of PA literature. Considering applied PA practice in this way highlights that value capture is potentially the missing link in the value co-creation process. The failure to capture and report how practitioners add value to the organisations in which they function perpetuates the lack of understanding of what applied PAs do and how they can add value, thus existing conditions do not change. This can be said of practice within individual organisations, but also of the profession as a whole.

The framing of applied PA practice as value co-creation presents an opportunity to rethink the role in a future-focused manner, beyond the inertia of the status quo. There is potential for applied PAs to be central to the optimisation of resources within a performance ecosystem where the quality of decision-making is increasingly seen as a key frontier in competitiveness.[67] This would be done by providing evaluation data on how efficiently organisations are using time, technology, or data in a given setting. Through a systematic approach to identifying inefficiencies within sports organisations, applied PAs can be key to loss aversion, providing significant value for decision makers.

Defining and reimagining the role of applied PA professionals

There is no clear definition of the purpose of an applied PA, their key relationships, and the expertise required to execute the role successfully. It seems that in the infancy of the discipline, the lack of definition of PA was a deliberate strategy to avoid limiting the potential horizons of its development.[68] This led to the transdisciplinary evolution of PA, epitomised by early practitioners such as Professor Mike Hughes who applied an engineering and elite coaching background to sports PA. While this may have been optimal in the early evolution of the profession, the lack of a defined conceptual framework seems now to be a limiting factor in the development of practitioners, their practice, and their aspirations to be perceived by stakeholders as valued professionals.[7,10]

In consultancy work, the perceived value of the service is often inextricably linked to the competence of the individual delivering it.[69] Without a clear conceptual understanding of applied PA practice, it is difficult to determine what skills and competences aspiring applied practitioners actually need to thrive. Our data reveal a two-dimensional challenge in conceptualising the role. The first is to consider what differentiates applied PAs from other practitioners operating under a sports PA umbrella, and the second is to conceptualise a definition which embraces the diversity of practice and roles for applied PAs. While there is huge overlap between the functionality of roles under a sport PA umbrella, their delineation allows for a more purposeful examination of the applied PA role, its characteristics, and particular functions. The recognition of an 'other' group is an important step in creating boundaries for a profession and building a collective professional identity.[70] In order to support the discussion, an attempt has been made to illustrate possible delineation of the various roles which fall under the broad discipline of Sports PA (Figure 4), while acknowledging that many in the industry will deliver multiple roles simultaneously. This mapping differentiates the applied PA (Role 1) from practitioners collecting and analysing data in Roles 2, 3, and 6—where the analyst has no agency in how the data may be applied within a performance ecosystem to contribute to successful performance. This is not unproblematic given the definition of the word 'applied' as '*something put to practical use*, *rather than being theoretical*'.[71] Some aspects of all the roles could be considered the application of PA knowledge, particularly Roles 2, 3, and 6, highlighting a significant issue with terminology. Rather than creating new terminology, a pragmatic approach was adopted to refine the existing vernacular with the addition of the word 'applied' to 'performance analyst'. This role is differentiated from those PA practitioners not embedded in a performance ecosystem by its purpose: to operate within the performance ecosystem and contribute to successful sporting performance, in a similar fashion to the description of 'applied sports psychologists'.[72]

The second challenge to a conceptualisation of the applied PA roles is the diversity of practitioners and roles within Role 1. A conceptual model of the profession must accommodate this range of practitioners, from novices doing basic coding tasks, to Heads of PA who manage PA systems serving multiple arms of the performance ecosystem. A profession should have a unique body of knowledge which is 'applied' by practitioners,[18] forming the basis of curricula delineated for the profession, and validated by standardised professional regulation designed to certify the knowledge and skills of practitioners.[72] It is critically important to the development of the profession to achieve a clear understanding of the balance of technical and analytics skills, versus the sport knowledge, and pedagogical and professional skills required for practice. This would bring much greater clarity and direction to educational programmes, particularly given the significant time investment required to acquire technical proficiency. It would provide a strong foundation to regulate and validate practice via accreditation and also be helpful in isolating the 'distinct knowledge base' which applied PAs claim to 'profess' and 'apply'.[18,72,73] This is important as it appears many applied PAs are practicing without a code of conduct, practice guidelines, occupational health guidance, and potentially professional indemnity insurance. In general, the applied PAs in this study did not see themselves as data scientists, despite the overlap in skill set which is evident. This is a similar delineation to the one made between a business analyst (analogous to applied PA) and data scientist in a recent classification of job roles and required skill sets in Big Data professions.[74] On the basis of the new insights on applied practice revealed in this study, the definition of the role of applied PA previously submitted by Martin and colleagues[2] was amended as follows:

An applied PA is an embedded practitioner who applies PA principles to generate valuable information, translates this information to co-create knowledge, and designs learning opportunities so that knowledge can be understood and can add value to stakeholder decision-making and performance outcomes.

A value proposition[75]-type strapline for this value co-creation role would be

Applied PAs generate, curate, and translate data which leads to better decision-making,

where data includes video and curate means to support the selection of the right data for the right people at the right time. It is important to note that this definition is likely to be sensitive to geography and cultural understandings of the role as discussed in our previous work.[2]

A similar discussion about role definition is taking place among academics concerned with the Sporting Director role in professional football with Parnell and colleagues[73] identifying how the lack of clarity was causing problems in how these professionals were perceived and the negative impact this had on their practice. They made six recommendations to remedy this. Considering these recommendations to re-imagine applied PA, they are presented as follows:

(a) Conceptual clarity—clearly defined remit and role descriptors for the applied PA role for employers and for employees;
(b) Education—the further development of continuing professional education to support the applied PA role;
(c) Recruitment and development pathways—the creation of clear career structures and pathways within sporting organisations for the recruitment and development of applied PA practitioners;
(d) Research on Applied Practice—a distinct body of context-specific knowledge to inform the practices of the applied PA;

(e) Regulation and support—an independent and inclusive professional membership body to support members;
(f) Ethics and code of conduct—a clearly defined set of values and ethical principles to guide professional practice.

These recommendations are similar to calls in other emerging professions (sports psychology, coaching, and clinical exercise physiology)[72,76,77] for conceptual clarity, regulation, and a shared, easily communicated understanding of the purpose of each role. Who in PA could or should lead this is a critical question to arise from this study. Is brand identity and professional regulation best developed through a single-discipline international organisation like ISPAS, or through the existing national sports science associations like BASES, who have recently established a Special Interest Group on PA? Is it perhaps through sport's governing bodies or the affiliation of analysts within a sport to form representative bodies such as the recently formed Association of Professional Football Analysis? It is hoped that the findings of this study can act as a stimulus to prompt debate and action from those in leadership positions in applied PA as to how we as a collective can address the issues presented here and help shape a thriving profession.

Conclusion

This study brings the applied PA practitioner as a person to the fore, a significant departure from previous conceptualisations of applied PA in literature, where the practitioner was largely invisible, and their role undefined. Applied PA practice has been conceptualised as value co-creation and practitioner embeddedness within a performance ecosystem. Embeddedness was identified as potentially the key factor in how applied PAs build the relationships, credibility, and contextual intelligence to enable value co-creation. The mapping of applied PA service provision to a generic framework for value co-creation in service ecosystems reveals a significant weakness in our understanding of how practitioners can capture and demonstrate the value which they aspire to add. This study brings to the fore a problem in how applied PA is understood and perceived as a profession which poses significant constraints for practitioners in their day-to-day practice but is also a potential threat to the development of applied PA as a viable and thriving profession. These misunderstandings reinforce the need to define and conceptualise the role, and this study begins this process, bringing a new understanding of applied PAs as translators and educators influencing decision-making, in addition to their well accepted role as information generators and curators.

This research offers a conceptualisation of applied PA practice which is a first step in developing a much more nuanced understanding of this role, providing a platform to generate debate, collaboration, and action among the applied PAs community. As technology and data become ever more embedded in decision-making in sport, there is a significant opportunity for applied PAs to position themselves and brand the profession as essential to the translation, integration, and optimisation of data and decision-making within performance ecosystems. The creation of this brand requires clarity of identity and purpose. It is hoped that this paper can provide a catalyst for those invested in applied PA practice to come together to create a shared understanding of how they fit and add value within the performance ecosystem now, so that in this era of digital transformation, the profession can evolve with technology and find new ways to co-create value.

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References

1. Carling C. Performance analysis: working in football. In: *Routledge handbook of elite sport performance*. Oxon: Routledge, 2019, pp.99–113.
2. Martin D, O Donoghue PG, Bradley J, et al. Developing a framework for professional practice in applied performance analysis. *Int J Perform Anal Sport* 2021: 21: 845–888.
3. Kojman Y, Beeching K, Gomez M-A, et al. The role of debriefing in enhancing learning and development in professional boxing. *Int J Perform Anal Sport* 2022: 22: 250–260.
4. Nicholls SB, James N, Wells J, et al. Performance analysis practice within Olympic and Paralympic sports: a comparison of coach and analyst experiences. *Int J Perform Anal Sport* 2022: 22: 343–351.
5. Wright C, Atkins S, Jones B, et al. The role of performance analysts within the coaching process: performance analysts survey 'the role of performance analysts in elite football club settings.'. *Int J Perform Anal Sport* 2014; 13: 240–261.
6. Hammond V. The power of a pause - a chance to reflect review and refine. *World Congr Perform Anal Sport* 2018: 26.
7. Huggan R, Nelson L and Potrac P. Developing micropolitical literacy in professional soccer: a performance analyst's tale. *Qual Res Sport, Exer Health* 2015; 7: 504–520.
8. Bateman M and Jones G. Strategies for maintaining the coach-analyst relationship within professional football

utilizing the COMPASS model: the performance analyst's perspective. *Front Psychol* 2019; 10: 2064.
9. O Donoghue PG. Health and safety issues in match analysis. In: G Sporiš, Z Milanović, M Hughes and D Škegro (eds) *World Congress of Perform Analysis of Sport X*. Opatija, Croatia: Faculty of Kinesiology, University of Zagreb, Croatia, 2014; 10.
10. Fairbairn C. *Juggling multiple identities in elite level rugby league: a neophyte performance analyst's perspective*. PhD Thesis, University of Hull, 2017.
11. Dickey L, Ramsey C, Humphrey R, et al. The working conditions of performance analysts in oceania. *Int J Sports Sci Coach* 2022; 18: 532–538.
12. O'Donoghue PG. Editorial. *Int J Perform Anal Sport* 2013; 13: i-iii.
13. Collins D, Carson HJ and Cruickshank A. Blaming Bill Gates AGAIN! Misuse, overuse and misunderstanding of performance data in sport. *Sport Educ Soc* 2015; 20: 1088–1099.
14. James N. Performance analysis perspectives. *World Congr Perform Anal Sport* 2018: 19.
15. Taylor J. Unpaid, bad hours, and you have to watch Reading: is this the worst job in football? Premier League club advertise year-long full-time internship. In: *Independent*. London: Independent Print Limited, 2013.
16. Robertson S. Will your job exist in the future? In: P Ward (eds) *One Track Mind Podcast*. Australia: Victoria University, 2020.
17. Winter S and Collins DJ. Applied sport psychology: a profession? *Sport Psychol* 2016; 30: 89–96.
18. Carr D. Professional education and professional ethics right to die or duty to live? *J App Phil* 1999; 16: 33–46.
19. Gardner H and Shulman LS. The professions in America today: crucial but fragile. *Daedalus* 2005; 134: 13–18.
20. Martin J. Is the profession of sport psychology an illusion? *Kinesiology Rev* 2019; 9: 92–103.
21. Lames M. Coach and computer science. *Comput Sport* 2008: 99–119.
22. McKenna M, Cowan DT, Stevenson D, et al. Neophyte experiences of football (soccer) match analysis: a multiple case study approach. *Res Sports Med* 2018; 26: 306–322.
23. Butterworth AD and Turner DJ. Becoming a performance analyst: autoethnographic reflections on agency, and facilitated transformational growth. *Reflective Pract* 2014; 15: 552–562.
24. Mackenzie R and Cushion C. Performance analysis in professional soccer: player and coach perspectives. *Perform Anal Sport IX* 2013: 10–16.
25. Australian Academy of Science. *Getting ahead of the game: athlete data in professional sport*. Australia: Australian Academy of Science, 2022.
26. Hughes M. Editorial. *Int J Perform Anal Sport* 2005; 5: 1–2.
27. Hughes M. General editorial. *Int J Perform Anal Sport* 2005; 5: -i.
28. Hughes M and Bartlett R. JSS - editorial of the special edition on performance analysis. *Int J Perform Anal Sport* 2002; 2: 104–106.
29. Hughes M. Editorial. *Int J Perform Anal Sport* 2005; 5: i-ii.
30. O'Donoghue P. Editorial. *Int J Perform Anal Sport* 2006; 6: i-ii.
31. Bhaskar R. *A realist theory of science*. London: Routledge, 2013.
32. Ryan A, Tähtinen J, Vanharanta M, et al. Putting critical realism to work in the study of business relationship processes. *Ind Mark Manage* 2012; 41: 300–311.
33. Braun V and Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006; 3: 77–101.
34. Braun V and Clarke V. Reflecting on reflexive thematic analysis. *Qual Res Sport Exercise Health* 2019; 11: 589–597.
35. Shenton AK. Strategies for ensuring trustworthiness in qualitative research projects. *Educ Inf* 2004; 22: 63–75.
36. Nyumba T, Wilson K, Derrick CJ, et al. The use of focus group discussion methodology: insights from two decades of application in conservation. *Methods Ecol Evol* 2017; 9: 20–32.
37. Breidbach CF and Maglio PP. Technology-enabled value co-creation: an empirical analysis of actors, resources, and practices. *Ind Mark Manage* 2016; 56: 73–85.
38. de Oliveira DT and Cortimiglia MN. Value co-creation in web-based multisided platforms: a conceptual framework and implications for business model design. *Bus Horiz* 2017; 60: 747–758.
39. Bartlett JD and Drust B. A framework for effective knowledge translation and performance delivery of sport scientists in professional sport. *Eur J Sport Sci* 2021; 21: 1579–1587.
40. Rothwell M, Davids K, Stone J, et al. A department of methodology can coordinate transdisciplinary sport science support. *J Expertise* 2020; 3: 55–65.
41. Barker-Ruchti N, Svensson R, Svensson D, et al. Don't buy a pig in a poke: considering challenges of and problems with performance analysis technologies in Swedish men's elite football. *Perform Enhanc Health* 2021; 9: 100191. doi:10.1016/j.peh.2021.100191
42. Robertson S, Bartlett JD and Gastin PB. Red, amber, or green? Athlete monitoring in team sport: the need for decision-support systems. *Int J Sports Physiol Perform* 2017; 12: S2-73–SS2-9.
43. Schelling X and Robertson S. A development framework for decision support systems in high-performance sport. *Int J of Comput Sci Sport* 2020; 19: 1–23.
44. Nicholls SB, James N, Bryant E, et al. Elite coaches' use and engagement with performance analysis within Olympic and Paralympic sport. *Int J Perform Anal Sport* 2018; 18: 764–779.
45. McCosker C, Otte F, Rothwell M, et al. Principles for technology use in athlete support across the skill level continuum. *Int J Sports Sci Coach* 2021: 17: 437–444.
46. Macquet A-C, Ferrand C and Stanton N. Divide and rule: a qualitative analysis of the debriefing process in elite team sports. *Appl Ergon* 2015; 51: 30–38.
47. Murray S and Hughes M. Tactical performance profiling in elite level senior squash. In: M Hughes and F Tavares (eds) *Notational analysis of sport IV*. Porto, Portugal: Faculty of Sports Sciences and Education, pp.185–194.
48. Nicholls SB, James N, Bryant E, et al. The implementation of performance analysis and feedback within Olympic sport: the performance analyst's perspective. *Int J of Sports Sci Coach* 2019; 14: 63–71.
49. Booroff M, Nelson L and Potrac P. A coach's political use of video-based feedback: a case study in elite-level academy soccer. *J Sports Sci* 2016; 34: 116–124.
50. Reeves MJ and Roberts SJ. Perceptions of performance analysis in elite youth football. *Int J Perform Anal Sport* 2013; 13: 200–211.

51. Jenkins S. Sport psychology, hypnosis and golf. *Int J Sports Sci Coach* 2009; 4: 149–221.
52. Thompson KG. Being an elite sports scientist: a balancing act? *Int J Sports Physiol Perform* 2010; 5: 1–2.
53. Bartlett JD and Drust B. A framework for effective knowledge translation and performance delivery of sport scientists in professional sport. *Eur J Sport Sci* 2020: 1–9.
54. Wagstaff CR, Fletcher D and Hanton S. Exploring emotion abilities and regulation strategies in sport organizations. *Sport Exercise Perform Psychol* 2012; 1: 268–282.
55. Jones MV. Controlling emotions in sport. *Sport Psychol* 2003; 17: 471–486.
56. Potrac P, Smith A and Nelson L. *Emotions in sport coaching: an introductory essay*. Taylor & Francis, 2017.
57. Molan C, Arnold R, Kelly S, et al. An exploration of performance management processes used within Olympic sport programmes. *J Appl Sport Psychol* 2021; 34: 713–733.
58. Malone JJ, Harper LD, Jones B, et al. Perspectives of applied collaborative sport science research within professional team sports. *Eur J Sport Sci* 2019; 19: 147–155.
59. Mellalieu SD. Sport psychology consulting in professional rugby union in the United Kingdom. *J Sport Psychol Action* 2017; 8: 109–120.
60. Francis J and Jones G. Elite rugby union players perceptions of performance analysis. *Int J Perform Anal Sport* 2014; 14: 188–207.
61. Martin D, Swanton A, Bradley J, et al. The use, integration and perceived value of performance analysis to professional and amateur Irish coaches. *Int J Sports Sci Coach* 2018; 13: 520–532.
62. Kraak W, Magwa Z and Terblanche E. Analysis of South African semi-elite rugby head coaches' engagement with performance analysis. *Int J Perform Anal Sport* 2018; 18: 350–366.
63. Vargo SL, Akaka MA and Vaughan CM. Conceptualizing value: a service-ecosystem view. *J Creating Value* 2017; 3: 117–124.
64. Robertson PS. Man & machine: adaptive tools for the contemporary performance analyst. *J Sports Sci* 2020: 1–9.
65. Gasston V. Performance analysis during elite netball tournaments - experiences and recommendations. In: World Congress of Perform Analysis in Sport, Belfast, UK 2004, pp.8–14.
66. Mayes A, O'Donoghue PG, Garland J, et al. The use of performance analysis and internet video streaming during elite netball preparation. In: ISPAS 3rd Int Workshop, Worcester, UK 2009, pp.435.
67. De Smet A, Weiss L and London S. Decision making in your organization: cutting through the clutter. *McKinsey Q* 2018.
68. Hughes M. Performance analysis–a 2004 perspective. *Int J Perform Anal Sport* 2004; 4: 103–109.
69. Castillo EA. Developing a professional philosophy for applied exercise psychology: integrating theory and practice. *J Sport Psych Action* 2020; 11: 183–195.
70. Cardoso I, Batista P and Graça A. Professional identity in analysis: a systematic review of the literature. *Open Sports Sci J* 2014; 7: 83–97.
71. Oxford English Dictionary Online. *Oxford English Dictionary* n.d.
72. Portenga ST, Aoyagi MW and Cohen AB. Helping to build a profession: a working definition of sport and performance psychology. *J Sport Psychol Action* 2017; 8: 47–59.
73. Parnell D, Groom R, Widdop P, et al. Exploring current practice and challenges within elite football. In: *Routledge Handbook of football business and management* 2018: 155–170.
74. De Mauro A, Greco M, Grimaldi M, et al. Beyond data scientists: a review of big data skills and job families. *Proc IFKAD* 2016: 1844–1857.
75. Osterwalder A, Pigneur Y, Bernarda G, et al. *Value proposition design: How to create products and services customers want*. John Wiley & Sons, 2014.
76. Jones H, George KP, Scott A, et al. Charter to establish clinical exercise physiology as a recognised allied health profession in the UK: a call to action. *BMJ Open Sport Exercise Med* 2021; 7: e001158.
77. Carson F and Walsh J. Are we there yet? A signature pedagogy for sports coaching. *Ann Leisure Res* 2021; 24: 255–261.