Software Development as a Sport: What Software Development can Learn from Team Sports.

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ABSTRACT

The discipline of software development is a dynamic, continuously changing and increasingly competitive field. With a growing demand for speed, flexibility and quality, it is more important than ever for practitioners to innovate and seek methods of performance improvement in order to be successful. These characteristics are mirrored in the field of team sports, where effective team dynamics, innovation and performance evaluation have proven to be central to success. The similarities in the challenges faced by the two disciplines present an potentially interesting opportunity for study and research of how one field might serve to inform progress in the other. This paper aims to perform a review of the existing literature on factors that have been found to positively and negatively influence performance in both software development and team sports domains, and to draw conclusions on the facets of team sports psychology, organisation and analysis that may potentially be of interest and value to those looking to increase success in the context of software development.

KEYWORDS
Software development, team sports, team psychology, organisation, performance analysis

1|INTRODUCTION

The topics of software development and team sport are distinctly different fields, each with their own respective challenges and dynamics. Despite this, numerous conceptual similarities can be drawn between the two domains which potentially yield opportunity for different techniques, strategies and tools typical to one area to be applied successfully to the other. The dynamic nature of the environment, orientation towards goals and importance of teamwork and structure is prevalent in both disciplines and leads to a perceived transferability of several solutions to common or related issues that may arise in either field. In fact, such similarities have already given rise to examples of sporting terminology and approaches being adopted in software development; most notably with the analogous "scrum" framework as is commonly applied in agile software development, "*Similar to the agile scrum methodology used in product development, in order to be successful, a strong rugby team with self-managed roles works together for a common goal.*"[1].
Similarly, this study endeavours to identify other facets of the approach to performance improvement in team sports that could potentially be effectively applied to software development. A primary subject under consideration for this study is the utility of techniques and frameworks for the analysis and improvement of various shared psychological aspects between the two fields. Examples of such aspects include communication, cohesiveness, motivation, vision and focus where increased attention to their improvement has been shown to correlate with success in both domains. Comparably, organisational approaches applied in sports management, such as structure, effective decision making and human resource management, will be examined and judged for their potential effectiveness if applied in the context of software development. Finally, this

study will seek to classify the respective applicability of several sports performance analysis and improvement techniques and tools to the area of software development to gauge the value of qualitative and quantitative reflection and corresponding reactionary measures.

The remainder of this paper is laid out as follows. Section 2 provides relevant background information and related work in relation to the characteristics of software development and team sports. Section 3 clearly outlines the research methodology applied throughout this study; detailing research questions, the searching and selection processes and how relevant data was subsequently extracted from selected primary sources. Section 4 documents the findings of the study by analysing how each of the research questions are addressed and resolved in the primary source. Section 5 applies these findings to discuss the key aspects of"Software Development as a Sport", addressing what this study has determined to be useful solutions in team sports that can be executed in a software development team context. The final section, section 6, concludes this study with a summary of the approaches, discoveries and main points made in the study as a whole; as well as a list of references and primary sources.

2| BACKGROUND AND RELATED WORK

2.1 | Software Development

Software development refers to a set of computer science activities dedicated to the process of creating, designing, deploying and supporting software[2] It is an ever growing industry in today's world, with many advancements being made in recent years.

As with many processes there has to be a team behind it. This means each Software Development project will have a team behind it. This means there are multiple aspects of the team dynamic that will have a major impact on the software. The impacts they have can be both positive/negative.

The first factor is the Organisation of the team developing the software. You must first decide what way you want to type the team you want to build, *"one of the challenges that appears is whether to build a team of generalists, specialists or a hybrid team".*[3]. The size of the team is a key factor in how well it will perform. The size of the team should be relative to the size of the business and mainly to the size of the project in order to be as efficient as possible. *"4-7 members is as close to perfect as it gets."*[3]. Clear Roles for each member should be defined from the start in order to avoid ambiguity later on in the development and to allow each member to perform adequately. If the team is too big the team won't be able to complete the tasks assigned to it and then the project will suffer.

The psychology of software development teams also plays a vital role in the efficiency in said teams. As with anything if the team is unhappy to be working then the workrate and results will suffer as well. *"Developers declared that unhappiness caused them to have decreased process adherence"*[4]. This means the code the developer is writing will suffer and not be as high of quality that that developer can produce. This will then lead to the software being less useful and thus the business being less profitable. This means that it is in the interest of the business and the team to have a positive mindset and share the same psychology towards the work which they are doing. Team building exercises and events to help boost morale of team members are being introduced into more and more workplaces. These allow team members to have to build a relationship and therefore able to work together better.

Analytics are also a major part of the Software Development lifecycle. While the method of analytics may differ from project to project they monitor the same things. They monitor how far the project has progressed, how the team is getting along with one another and how close the project is to being complete. These analytics can be used then to make changes to improve productivity. There are many techniques which can be used to monitor and these should be decided on by the team and line up with the goal of the project. There are metrics for code performance as well as metrics for team performance. A mix of both is usually adopted by teams nowadays. A metric for monitoring production and reliability is *"Mean time to repair - How quickly a security breach is identified and repair".*[5]

Team meetings commonly referred to as stand ups can be used as another method of measuring team performance by communicating what tasks have been completed and what tasks are left to be completed. This also allows team members to communicate any issues or problems they may be encountering to the other members of the team. *"We may be tempted to hide our mistakes, but sharing them can lead to big future gains."*[5]. These meetings will boost the confidence of team members by praising the successes of members and providing constructive criticism in a positive way to help solve problems.

2.2 | Team Sport

A team sport includes any sport where individuals are organized into opposing teams which compete to win. Team members act together towards a shared objective.[6] In team sports, all members of the team must bond, communicate with each other and all work together to reach the goals they have set out to achieve regardless of the calibre of player. "High-performing teams are high in cohesiveness, shared understanding, and a sense of team confidence or collective efficacy."[7]

Psychology has a major impact on team sports. All sports teams discuss and decide on their overall goals for them to achieve. They also decide on smaller short term goals to help achieve these goals. The short term goals must be simple and straightforward, this will help the team to experience success quicker and as proved in [8] "Early events shape the path a team will follow", this means if a team is successful at the start they more than likely will be successful at the end.

Many teams hold weekly meetings to discuss their progress by getting different types of players eg. goalkeeper and defenders, opinions and if the current approach is not advantageous to the teams success they will then discuss methods to get back on track or decide on new more realistic objectives.

The team can also use this meeting to boost the confidence of the players by complimenting them on the goals which they succeed in achieving and on any great individual performances during their teams sports event.

Motivating all the players in a team is a complex process as the coaches need to understand each individual player and what drives them. There are many other styles coaches can choose to motivate their players such as fear and money. In a study by Stephanie J.Hanrahan and Ester Cerin, they prove that men are more ego-oriented and females are more task-oriented.[9]

Coaches need to encourage healthy competition within the team. Healthy competition can drive the players to keep improving and perform better in training and matches. It also decreases the chances of players trying to outperform their teammates and jeopardising the performance of the team. "When openly acknowledged and treated positively, the competitive drive is more likely to take a healthy form-wanting to outperform teammates without undermining their performance".[8]

The organisation of the team is another important factor to the success of the team. Every team needs to have a coach to run the team who is incharge of organising training and motivating the team. It is also beneficial to have a captain of the team who can fill the coaches role when he is unavailable. The captain is usually a well respected member of the team who is proven to help get the most out of the other players. The coach of the team must always always find time for their team to train. This is easy in team sports as all details for the teams matches are usually decided before the start of the season. The team is then free to hold training sessions during their time off. "During games, a team is in performance mode. Games are a do-or-die setting", "During practice, a team is in learning mode."[8] This means that while the team is training they can experiment with new players and tactics to have the best chance of beating their opposition. Only when they have perfected a tactic they perform it in a match.

By practicing as a team often they get more comfortable with each other. The players need time at the start to figure out how to play together and what the rest of the team likes and doesn't like. "The more stable a team's membership was, the more likely the team would win"[8] It is also believed that the more success a team has the more likely the members will stick together and keep improving.

Analytics is becoming more and more popular in the world of sport. "It is standard operating procedure in the days following a game to study the game video"[8] Teams are having video analysis sessions where they look over highlights of their own matches and training sessions to see what they are doing right and wrong but more importantly to spot any weaknesses in the team and rectify these problems immediately. They also look at videos from other teams in both their sport and sports to try identify different approaches to improve their own team.

3|METHODOLOGY

3.1|Research Questions

Table 1 below outlines the finalised research questions as established for and applied in this study. The aim of these questions is to classify and address the analysis of the factors of both team sports and software development that are explored within each source.

TABLE 1 Research Questions

ID	Question
RQ1	What is the overarching topic of the source?
	RQ1.1 What is the subject that is under examination?
RQ2	What problems/issues are being addressed?
RQ3	What solutions to these problems are outlined in the source?
	RQ3.1 What techniques, if any, are employed as part of the solutions?
	RQ3.2 What strategies, if any, are suggested?
	RQ3.3 Which tools, if any, are used to support the solutions?

Potentially useful sources to this study may fall in the domain of team sports or software development, and in presumably rare cases, both. As such, RQ1 looks to classify each source into their respective domain with the goal of providing context to future research question answers. Similarly, RQ1.1 aims to identify the underlying subject matter that is being examined in a given source, classifying the subject to, again, provide contextual information to support further questions.

Following this initial classification, it is important for this study to identify the challenges and corresponding solutions, complete with any helpful components, that are raised in each source and may prove to be useful in later analysis. RQ2 is designed to encapsulate any issues or problems that are addressed in a given source, with RQ3 subsequently capturing any proposed solutions to these issues. In support of representing these solutions, RQ3.1-3.3 were derived to record any techniques, tools or strategies that were documented as aiding in the execution of said solutions. These questions, therefore, serve to provide this study with the necessary context and data to make decisions on the validity, impact and transferability of aspects of team sports with respect to the field of software development.

3.2|Search Process and Study Selection

The approach to searching for sources that was applied throughout this study was designed to deliver a comprehensive coverage of available, relevant sources. Initial search strings were derived from carefully selected keywords that are representative of the MLR goal and finalised research questions. These search strings were used to compile an initial pool of both white and grey literature sources, by submitting them to various broad and limited, academic and general search engines including Google, Google Scholar and IEEE Xplore. It was vital that these strings remained general enough as to maximise coverage while still providing sufficient relevance to the research goal.

It was also deemed important to attempt to find sources that analyse the areas of software development and team sport both in isolation and comparatively. For example, to achieve coverage of sources analysing both topics, the search string "software development team sport" was chosen. Such documents were determined to hold inherently greater significance to this study and, as such, were used as seed documents for the implementation of a forward snowballing technique in order to include as many relevant sources as possible. Conversely, to obtain sources that look at the certain subjects within each topic

in isolation, search strings including both the topic and keywords relating to the subject were used. For example, to search for sources related to the psychological aspects of team sports, the phrase "team sports psychology" would be employed. Subsequently, source selection and a quality assessment were carried out in parallel through the execution of a screening analysis on the initially compiled pool to exclude any sources that were likely to be unusable or unhelpful. Sources were included if they provided a sufficient, direct comparison between software development and team sports, or if they covered one or more of the agreed upon core subjects for this study (team psychology, organisation or performance) in adequate detail and in a manner that could be transferable between the two topics. Similarly, sources were excluded based on several exclusion criteria such as inaccessibility or illegibility of the full text, presence of outdated or biased information, or disreputability of the source's producer. The assessment of these inclusion and exclusion criteria was performed by each of the authors of this study individually and the final source selection was accomplished by way of voting. The output of this voting process was a set of core, primary sources that form the basis of evidence for the content of this study, and are listed in the appendix.

3.3|Data extraction and analysis

The design of a data extraction form was paramount in facilitating the capture of answers to each of the research questions from each respective primary source. The notable fields of this form, as depicted in Table 2, are described as follows:

- Type of publication: The classifications of these fields aid in informing about validity and reputability of the source.
- The overarching topic and underlying subject matter provide context for subsequent data.
- Problems or issues.
- Solutions to the aforementioned problems or issues.
- Techniques, tools and strategies that serve to support the implementation of the aforementioned solutions.

TABLE 2 Data extraction form

Data Item	Description	RQ Mapping
Study ID	*<First author's surname><Publication year>*	
Title	*Title of the literature*	
Author Name(s)	*Name(s) of the author(s)*	
Publication Year	*Calendar year of first publication*	
Publication Type	*Journal Article, Book, Web Page, etc.*	
TOPIC	*What is the overarching topic of the source?*	RQ1
SUBJECT	*What is the subject that is under examination?*	RQ1.1
ISSUES	*What problems/issues are being addressed?*	RQ2
SOLUTIONS	*What solutions to these problems are outlined in the source?*	RQ3
TECHNIQUES	*What techniques, if any, are employed as part of the solutions?*	RQ3.1
TOOLS	*Which tools, if any, are used to support the solutions?*	RQ3.2
STRATEGIES	*What strategies, if any, are suggested?*	RQ3.3
NOTES	*Any notes that may need to be recorded*	

The extraction process was performed in equal parts by each of the authors of this study, with the verification of the validity of the extracted data being conducted by at least one other author. This extraction involved capturing and documenting fragments of text from each source that were considered to correspond to the research questions. Subsequently, an analysis of the captured data was carried out in which themes and patterns were derived from commonalities and differences across the primary sources, yielding a multitude of valuable insights and findings that are to be discussed in the sections that follow.

4|RESULTS

4.1|General results

Although the primary studies that aided in this research opportunity range from being from 1998 up until 2013, not a huge amount of research has been done into the topic of "What Software Development can learn from Team Sport". The years 2011 and 2013 both saw 2 of the primary papers used published. This vastly unexplored topic can lend itself to a very wide variety of research opportunities.

The primary papers go into aspects of Team Psychology and Team Organisation and how these skills can help teams in the field of sport perform better and achieve their goals. Each primary paper also goes in depth into the strategies and techniques used to improve the organisation in a team and to boost the morale and motivation of the members in said team. In [P1], [P2] and [P5] the authors delve into the usefulness of effective decision making in Sport and Software Development and how harnessing this skill and developing it further improves the effectiveness of the team dynamic. In [P7] aspects of effective goal setting and the process that can be used to enhance performance of team members. The primary papers used allowed for the answering of the research questions defined in the previous section.

4.2|RQ1 - What is the overarching topic of the source?

RQ1 aims to determine the overarching topic of each source. The two primary topics of software development and team sport were derived from the title of this study and were used to classify each of the respective primary sources. The division of the primary sources in this manner served the purpose of clearly categorising each of the texts to provide context to the answers of future questions, as well as providing a useful overview of the makeup of the sources. It was found that five of the sources pertain exclusively to the domain of team sport, with two relating purely to software development. Only P5 was found to fall into both categories as a comparative study between the two fields.

Similarly, RQ1.1 intends to identify the underlying subject matter of each respective primary source. It was decided that the predominant subject matter of each source could be categorised as being in relation to one or more of: team psychology, team organisation and structure, or team performance. When applied to the primary sources, it was found that, for each respective category, exactly two sources could be considered to be exclusively or predominantly related to said category; with the remaining two being judged to be comprehensive enough as to contain sufficient content pertaining to each category.

4.3|RQ2 - What problems/issues are being addressed?

The aim of RQ2 was to identify the issues faced by both software development and sports teams when trying to increase performance, in order to highlight the common and individual challenges of the respective fields. An analysis of the extracted issues showed a moderate overlap in the problems faced in software development and team sports alike; with general problems, such as lack of vision, communication or leadership, unproductive reinforcement, and poor team culture and climate, recurring across several sources of differing overarching topics and subject matters.

Conversely, some issues were found to be more pertinent to particular subjects. Examples of such issues include optimising operational structure in relation to the subject of team organisation, the need for effective performance analysis as expressed in sources regarding team performance, and motivational losses with respect to team psychology.

4.4|RQ3 - What solutions to these issues are outlined in the source?

RQ3 serves to extract proposed solutions present in the literature to the issues as documented by RQ2. Such solutions are classified as any method of potentially remedying or addressing one or more of the issues discussed in the primary source

literature for this study. An analysis of the compiled solutions revealed that many solutions serve a broad purpose, spanning numerous subject areas and are thus highlighted in several sources. Examples of such solutions include increasing team cohesion (P1, P2, P5, P6 and P7), improvements to team culture and communication (P2, P4, P6 and P8), and evaluating performance (P1, P3, P5 and P6). Long-form literature proved to be valuable for this research question as they generally provided a comprehensive view of desirable solutions and often alternatives to a multitude of issues, contrary to the focused nature of a paper or article. A prominent, recurring emphasis on the importance of increasing team cohesion, motivation, accountability and involvement as a general approach to resolving the majority of common issues was evident across multiple texts, alluding that a prevalent role is played by team psychology in determining a team's success.

In conjunction with the outlining of these solutions, the primary sources also proposed numerous supporting components that aid in the conceptualisation or implementation of said solutions. From an analysis of these components, it was determined that each could be categorised as either a technique, tool or strategy. The findings for each of these component categories are outlined as follows:

- Techniques: To support several of the proposed solutions, some accompanying techniques were described in the literature to facilitate and enhance the implementation of such solutions. To isolate such techniques, a specific research question was employed with the purpose of locating each of these techniques within the primary texts. The outlined techniques varied in complexity and detail across the sources, from simplistic ideals and instructions such as "using all of the team's talents" in P4, to comprehensively described processes and heuristics such as the "S.M.A.R.T" goal setting methodology as illustrated in P1. A particular emphasis on a number of shared techniques was observed across multiple sources, most notably in the descriptions of the importance and methods behind effective goal setting techniques (P1, P2, P5 and P7), methods for involving team members (P1, P2, P4, P5 and P8) and performance analysis methodologies (P1, P5 and P6) for optimising team performance. Helpful techniques are central to supporting the solutions put forward by P1, resulting in detailed descriptions of various techniques spanning goal development, decision making and human resource management. A similar emphasis and attention is employed by the authors of P5, who propose problem solutions in the form of lessons, complete with accompanying techniques for reinforcing and delivering said lessons. They too argue in favour of conscientious and effective goal setting and highlight the benefits of applying communication and feedback techniques to improve team involvement in decision making and policy, a desirable activity as outlined also in P8. It is clear therefore that the employment of suitable, verified techniques is paramount for effective problem solving in any team.

- Strategies: In order to efficiently and effectively achieve a desired solution, many primary sources advocate the application of various strategies. For the purpose of this study, strategies are defined as structured processes or conventions that may be employed to enhance solution implementation. Many of the strategies prescribed in the texts take the form of sequential processes that outline an approach to a given solution. P1 provides two key examples of such strategies in its descriptions of the 6-step decision making process and the 3-step process for initiating change respectively. Similarly, P6 proposes a cyclical "Plan, Act, Observe and Reflect" process for carrying out continuous performance analysis. Such strategies serve to provide a clear, concise and ordered series of steps for fulfilling a solution and are commonly emphasised as holding great significance. Strategies may also take the form of checklists or series of categories that describe the attributes of a successful solution. This format is perhaps best exemplified in P6 in which the authors describe the 4 A's of effective performance environments (agreement, alignment, accountability and adjustment), and the 4 areas of performance leadership and management (vision, operations, people and culture); the latter of which also forms the basis for discussion in P2. Other strategies applied in the literature included flexible organisational structures in P1, risk mitigation strategies in P4, and SWOT (strengths, weaknesses, opportunities and threats) analysis in P6.

- Tools: Components that were categorised as tools included various systems, models and frameworks that either serve to inform the user about a solution or directly enhance a solution's execution. Many intriguing and practical tools were proposed across the primary sources ranging from analysis systems such as the Computerised Coaching Analysis System portrayed in P6 to Thomas's model for the performance enhancement process in applied sport psychology as outlined in P7. The influence of tools as a support mechanism for solution deployment is made clear in each of the primary studies,

perhaps most prominently in P1 in which the authors regularly and prominently highlight the inherent value of adopting information technology and other tools in all facets of management, specifically acknowledging transaction-processing systems (TPS), management information systems (MIS) and decision support systems (DSS) as key aids in operations streamlining and analysis. Beyond physical systems, conceptual models such as Carron and Brawley's model of team cohesion and Jones's performance environment model, as described in P7 and P6 respectively, are consistently portrayed in the literature as useful sources of background information and as a framework for forming the basis of a solution to numerous issues that may arise.

5|SOFTWARE DEVELOPMENT AS A TEAM SPORT

The extracted data produced by the systematic mapping process undertaken in the previous section, although inherently inconclusive, facilitates an extensive summary of the available research on team performance determinants in the context of both sport and software development. Additionally, the study has elicited numerous interesting and valuable factors of team sports psychology, organisation and performance that may prove to be transferable and similarly beneficial to the field of software development. Such factors are discussed in the remainder of this study.

Software development in any meaningful, professional capacity is contemporarily a team activity.[10] To engineer adequate software requires a team of talented individuals, all working cohesively towards a common goal in an environment that is rapidly and continuously transforming.[11] From this description, the parallels that can be drawn between the fields of software development and team sport are obvious and undeniable. And, as the area of software development seeks to constantly and continuously improve, it is a reasonable assumption to make that such improvements may find roots in the field of team sport.[8]

5.1|Psychology

The psychological mechanics and characteristics of an effective team generally transcend the domain of the team.[12] As such, software development teams can relate to and learn from the behaviour of sports teams based on numerous pivotal factors. Perhaps the most prominent psychological lesson that is derived from team sports is the approach and emphasis given to team cohesion. According to Carron, team cohesion is a "dynamic process which is reflected in the tendency for a group to stick together and remain united in the pursuit of its goals"[11]. This concept can be further divided into two independent dimensions, namely social cohesion (often conceptualised as "team spirit") and task cohesion (similarly, "team work"). Social cohesion in this context can be extended as a consequence of the concept of team harmony or climate, which the authors of P7 hypothesise as being formed by interpersonal attraction, team attractiveness and closeness of identification with the team. Effective team building and bonding, focused on nurturing individuals relationships with other individuals and the team as a whole can be viewed as paramount to improving cohesiveness and, consequently, the performance of any team, sports and software development alike.

Also put forward in P7 and recounted in P1 are the differing dynamics of teams of different sizes and how an increase in team size will often result in decreases in individual performances. This is due to an effect conceived by Hardy called social loafing in which the identifiability of individual performances is lost in a team performance, leading to diffusion of responsibility and consequently a decrease in performance[13]. This effect is prominent for growing teams in both sports and software development and should be carefully monitored and defended against by means of increased accountability in individual performances. Motivational losses as a result of social loafing can similarly be prevented through conscious identification of individual contributions and the recognition, encouragement and reward of desired team work behaviours (P7).

Motivation loss as a whole is a leading factor in reduced performances of individuals and teams in both sport and software development, as is evident in P1. P4 and P7. Zander suggests that such losses can be overcome through the emphasis of a "pride-in-team" approach in which input from individuals on the team derives a unifying team goal with objectives for its achievement that represent the desire for group success.[14] Other factors include, again, the recognition of individual contributions, emphasis on good leadership and team cohesion, encouragement of unified commitment on behalf of team

members and the employment of effective communication and feedback techniques. Such an approach is universally transferable between teams of all nature and should be closely considered in software development teams to retain individual and team desire and effort.

5.2|Organisation

It is clear from the literature that software development and sports teams alike rely heavily on an effective structure and benefit from clearly defined team goals and roles.[15–17] The environments for both disciplines are inherently dynamic and are continuously and constantly changing at accelerating rates, placing a profound importance on the flexibility and the ability to both adapt to change as well as create it in the adapted structure of the team (P1 and P5). This point is further emphasised in P1 articulating that good managers effectively adapt to change, while excellent managers initiate change and promote innovation, using change to advance their team and the discipline; a concept that clearly transcends team sports and is deeply valuable to the highly competitive and rapidly evolving field of software development. Covell and Walker, the authors of P1, also propose a process for facilitating change that is general enough to be applied to multiple areas, including software development, involving three stages of "unfreezing", "changing" and "refreezing". Flexible team matrix and network structures are also proposed to enable such a process to take place and provide a more agile basis for involving team members and managing tasks and goals effectively in a flexible manner.

The values of careful, purposeful planning, decision making and strategy implementation are also highlighted in numerous texts with respect to both software development and team sports.[18–20] The authors of P1 examine and outline in outstanding detail the importance of effective decision making in particular, complete with a six-step decision making process based on goal definition, strength evaluation and alternative consideration. A similar or even identical process could be successfully deployed in a software development context to inform and structure the decision making process.

5.3|Performance

An aspect of ever-increasing value and prevalence in both domains is the application of progressively more complex and in-depth performance analysis for all members of the team.[21–23] Quantitative analysis in the form of metrics and measures is now at the forefront for informing sporting success, with the rapid growth in the capabilities of information technologies facilitating complex, multivariate analytics for both individual and team performance in sport. A similar approach can be taken in software development with intelligent use of information technology available to assess the quality of software being produced using numerous valuable metrics covering a wide range of topics.[24] Reflection on such analysis provides a deeper understanding of any underlying issues and may reveal solutions that would otherwise be too complex or hidden to derive otherwise. As such, P6 proposes a four step cyclical approach to performance analysis, namely "observe, reflect, plan and act", whereas P8 outlines a similar "plan, do, check and act" framework, processes that are universally applicable to a multitude of activities to learn from and improve upon previous performance.

P1 addresses the need to constantly upgrade talent, skills and knowledge, as well as the values of human resource management aspects such as effective recruiting and performance incentivisation. Such ideals are clearly transferable to a vast range of team professions and should be adopted in software development to ensure the highest possible quality of work is being produced by employees. The value of training and reinforcement is prevalent in several studies in both areas, with P4 outlining the benefits of controlled pressure and incentivisation in preserving developer motivation and upholding standards in production quality.

6|CONCLUSION

This literature review highlighted the extent to which software development can draw inspiration from team sports with respect to team performance and output quality improvement. The inherent similarities between the nature of the environments and thus the challenges faced by two disciplines allowed for a multitude of solutions, complete with

accompanying techniques, tools and strategies, employed in the field of team sports to be easily justifiable and applicable in the context of software development.

While we this study has formed connections and theorised about the applicability of such solutions, there is a need for increased empirical research on the matter, as well as a focus on directly comparing software development with team sports among other fields to fully assess the extent to which software development can learn and adapt based on the approaches to problem solving in other domains.

In summary, in numerous facets, software development likely serves to learn and adapt from the behaviours and methodologies in the field of team sport, and should endeavour to do so as to encourage the innovation and performance demanded by the industry.

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APPENDIX A: List of Primary Sources

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