BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT: SPORTS SCIENCE

MASTER OF SCIENCE DEGREE IN SPORTS SCIENCE

SM 510 SUPPLY CHAIN MANAGEMENT IN SPORT

DURATION: 3 HOURS TOTAL MARKS: 100
(Plus 30 Minutes for Practical Preparation/Case Reading)

INSTRUCTIONS TO CANDIDATES

Section A is **compulsory.**

Answer **three** questions from Section B.

Section A: Case Study

An IOT/FOG-Based Framework for Sports Talent Identification in COVID-19-like Situations.

Introduction

All sections of human life have come to a halt recently due to the deadly ongoing pandemic – COVID-19. The virus has restricted and paralyzed all the units of society including government, education, economy, workplaces, religious practices, etc. (Haleem et al 2020). The harmful impacts of this pandemic are anticipated to be massive for mankind in the near future. According to a report by IMF, the world economy is going to suffer a loss of over $22 trillion for the period of 2020–2025. All the areas/systems that involve human interference and engagement at some level are put on a standstill mode. While enduring this trauma, we have to rebuild things in parallel to suit the current context. The domain of sports has also been a soft target of this pandemic. The much-awaited Tokyo Olympics 2020 was also postponed due to the Corona Virus Disease. Since the lockdown was implemented throughout the world to prevent this disease, the athletes suffered in many ways. They were unable to maintain the practice due to the mask-up and the social distancing instructions from authorities. The inability to conduct sports events affected player performance along with the sports economy sector badly. One specific department of sports that stands affected badly is the talent identification process. Since offline activities are constrained, the traditional coach-based systems become irrelevant in these testing pandemic times. The consequences of sports talent identification are comprehended after a gap of several years. It takes years to acknowledge if the talent was identified properly in the past or not. The

talent identified by a child at the age of 9 May show up when he/she is 14–16 years old. So, we can make an educated guess about how our sports talent pool is going to be affected in the coming years (most probably after 4– 6 years).

One hope lies in acknowledging the role of information and communications technology (ICT). ICT already worked out for us during COVID-19 and proved to be our dependable saviour (Soltane 2021). From our homes to the workplaces, all the respective activities that demanded physical presence in our normal routine life were shifted to the different ICT platforms. Researchers utilized state-of-the-art techniques to detect the disease (Mir et. Al. 2021). ICT has been playing a vital role in the sports domain since the 1960s. Many new areas have evolved in the sports domain since then, Baca (2006), provides an overview of the development of computer applications in sports. The research community has already worked on the role of ICT in the sub-field talent identification of Sports. However, the challenge of making the masses shift from traditional solutions to new solutions has always proved to be an impediment to its implementation. Now here we are faced with a time where we are left with no option but to embrace the role of ICT in sports talent identification and its other related activities. In this paper, we propose an ICT-based framework that can be implemented to deal with the challenges posed to the conventional sports talent Identification process by COVID-19. The Authors believe that the ICT-aided talent identification programs will work out great for the sports community. Such systems can help us to identify the potential talent among the players/athletes and this doesn't stop here, the system can be advanced to a degree where it can actually help us to select and develop the talent of athletes as well. If domain experts learn to decipher numeric facts, it is no wonder that such systems will perform much better than human judgments. If we are able to provide a heuristic environment to such ICT-based systems, in some years they will be developed into efficient and reliable Talent Identification Systems.

Effect of COVID-19 on sports

The sudden outbreak of coronavirus in December 2019 raised alarming bells among all the communities of mankind. The nanoscopic life-threatening virus is named SARS-CoV2 (Gorbalenya et al 2020). Within no time, the virus shook out the entire world. World health organization was bound to declare the disease as a pandemic on the 11th of March 2020. At the time of communicating this manuscript, 445,096,612 cases are confirmed and 5,998,301 deaths are reported (WHO 2021). Since COVID-19 came out of the box, there was no preparedness for this abrupt outbreak. The COVID-19 pandemic paralyzed all walks of life. Since humankind had no prior experience to deal with it, the preventive measures were implemented in form of forced lockdowns with the help of security forces. People were left with no option but to comply and stay at home. The sports industry is no exception to the causalities, it remains affected by COVID-19 as badly as other organizations are. Lockdowns crippled all physical

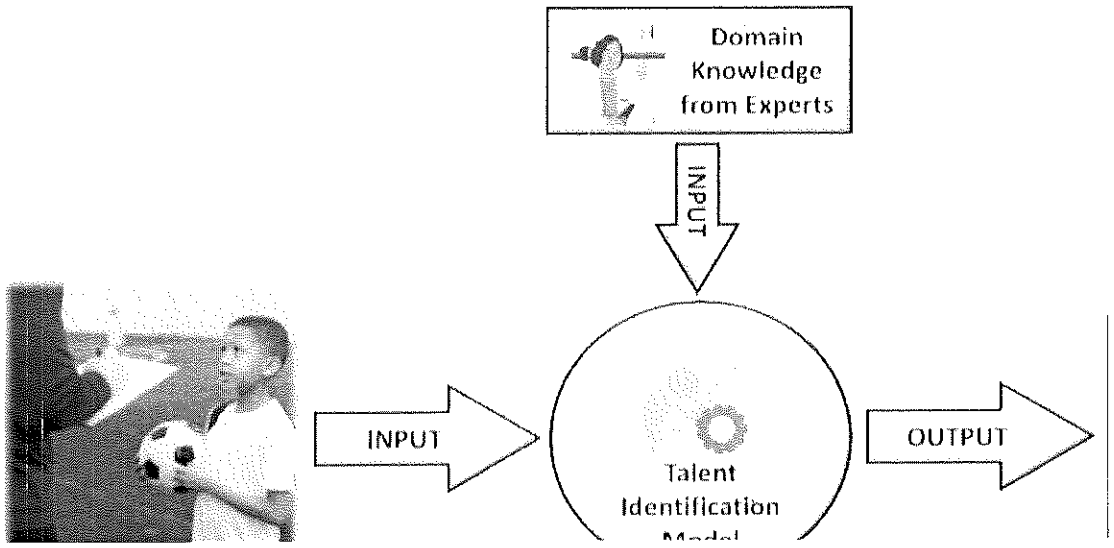
activities including sports activities. Hall et al. (2021), describe the physical inactivity and sedentary behaviour of masses during COVID-19 as a parallel pandemic of different natures. On 23 March 2020, the ESPN news services listed more than five hundred (500) sports events that were postponed due to the COVID-(ESPN 2021). Although after the recession in COVID-19 cases, some of the sports events were held in a desolate environment. Moreover, the transmission risks of COVID-19 vary from outdoor to indoor sports (Jones et. al. 2021), Sports economics is undoubtedly the backbone of Sports. The components of the sports market that remain affected are the fitness industry, sports tourism, sports goods manufacturing industries, etc. (Wang and Zeng 2020). Lindsay et al. (2020), show that from February 2020 to March 2020, the expenditure growth rate on sports services and physical activities decreased from 25% to –30%. In 2020, the sports market increased the compound annual growth rate (CAGR) by 3.4% from 2015 and touched a value close to $388.3 billion. The market deteriorated from $458.8 billion in 2019 to $388.3 billion in 2020 at a rate of –15.4% (Business Research Company 2021). Drewes et al. (2020), studies the economic impact of COVID-19 on professional soccer, the author analyses the economic dependency of soccer clubs on the cheering crowd and suggests possible solutions. The coronavirus is born to influence the physiology of the human body and health plays a vital role in the athletic career. Moreover, the prolonged stays in the same place, less physical activity during the lockdown period and the increased screen time on electronic gadgets only increased the negative effect of COVID-19 on human health. Pillay et al. (2020), conducted a study on South African athletes in which it is projected that during part-time the athletes prefer sedentary behaviour over an active lifestyle. Moreover, changes in sleep patterns, more consumption of carbohydrates and growing depression were recorded. In a longitudinal study, authors et (2021), conclude that with the development of sleep and eating disorders, the lockdown period negatively affected the physical activity schedules. Moreover, even if the athletes try to cope with this crisis, they will still be faced with the difficulty of reaching out to support teams or management organizations. Stambulova et al. (2020), refer to COVID-19 as "a powerful career development barrier producing changes in sport participants' athletic development". The resumption of sports and exercise provides hope to fight the mental stress that surfaced as a result of the COVID-19 restrictions. The process of sports talent identification among children is also going to be affected in the same way. The coaches/experts cannot reach out to the masses to assess the potential talent among children. This process usually starts in secondary schools, as pointed out by Kondric (1996), which remain closed due to COVID-19. This scenario demands efforts and research for strategies that may be helpful in dealing with this issue. A system is needed that should work well in coordination with all the stakeholders and deal with the challenges of pandemic-like situations in near future as well. Elavarasan et al. (2020), show the widespread and swift application of digital ICT-based solutions in various application domains, as a response to COVID-19. An ICT-based

system for sports talent identification also seems to be a promising solution for the halted talent identification programs that are dependent on the offline presence of stakeholders. The Scientific models already suggested in the literature can be implemented over an ICT-based architecture. However, such a system must be able to guarantee the authentication of the information or data gathered from the end users.

Talent identification and selection

According to Collins (2021), Talent is defined as the "natural ability to do something well" or ''an innate ability, aptitude, faculty or above-average ability''. In Sports, Talent Identification and development programs are of prime importance. Talent identification programs are employed to identify the potential talent among players at a young age. Prompt Recognition of talent saves many valuable resources including time. Moreover, the early orientation of a child into his/her feasible sports branch is beneficial for the candidate as well (Sporis et.al 2010). The talent examination is being performed since the 1928 Amsterdam Olympics. Many advanced countries including America, China, Russia, Germany, the UK, etc. are using talent identification and selection models to identify promising candidates at a young age for different sports departments (Ri et al. 2002). In sports literature, the two main methodologies used in the talent identification process are the natural and scientific selection. Natural Selection is the traditional coach or expert-based method in which the expert selects talent based on his judgment without using any scientific evaluation, tests, or processes. On the other hand, scientific selection follows a scientific approach. It identifies the key parameters that are determining factors in the elite athletes of the respective sports. Thereafter the data for the candidates are acquired by various testing mechanisms and a computational model is used to process the results which are later on used by the experts to assess and identify the potential talent in the candidates. Talent Identification models that use scientific techniques are gaining popularity (Zheng 2016). The process normally works like this, the candidates of a young age are made to go through a series of tests e.g. agility, strength, flexibility, power, coordination, etc. Each sport has its unique recommended test batteries. The Expert (coach or trainer) evaluates the inclination of the candidates towards different sports. The data for the parameters about the sport in which the candidate is found to be better inclined is recorded. This data is fed to the talent identification model and the talent is estimated based on the output results by the model. In this way, the superior potential talent is identified by a multi-stage process.

Figure 1: Scientific sports talent identification process



(a) Conventional Statistical Techniques

Popular methods of variance analysis like Analysis of Variance (ANOVA) and Multivariate analysis of variance (MANOVA) were found in the literature pertaining to sports talent identification. By these methods, the behaviour of variables is analysed. These are the classic statistical methods to determine the associative patterns between the different parameters of data. Analysis of variance (ANOVA) analyses only one dependent variable while multivariate analysis of variance (MANOVA) analyses multiple dependent variables at a time. The talent identification models study the effect of variables on each other. On analysing the parameters statistically, the importance of parameters is depicted which in turn is used to score the individuals for the nt identification. The regression methods have also been used to achieve the goal. Rozi et al (2019), have employed such techniques for a variety of sports.

(b) Multi-criteria Decision Making (MCDM)

Another set of computational procedures that are found in the literature for talent identification is multi-criteria decision-making procedures. These techniques are used to make a decision in a situation where we are faced with multiple alternatives and confusing techniques follow several steps during the process such as identification of objective, selection of contributing parameters, weight calculation, aggregation and final selection. There are many MCDM methods like Analytical Hierarchy Process (AHP), Technique for Order of Preference by Similarity to Ideal Solution, ELECTRE, Preference Ranking

Organization Method for Enrichment Evaluations (PROMETHEE), etc. were found to employ such techniques for different sports talent identification models.

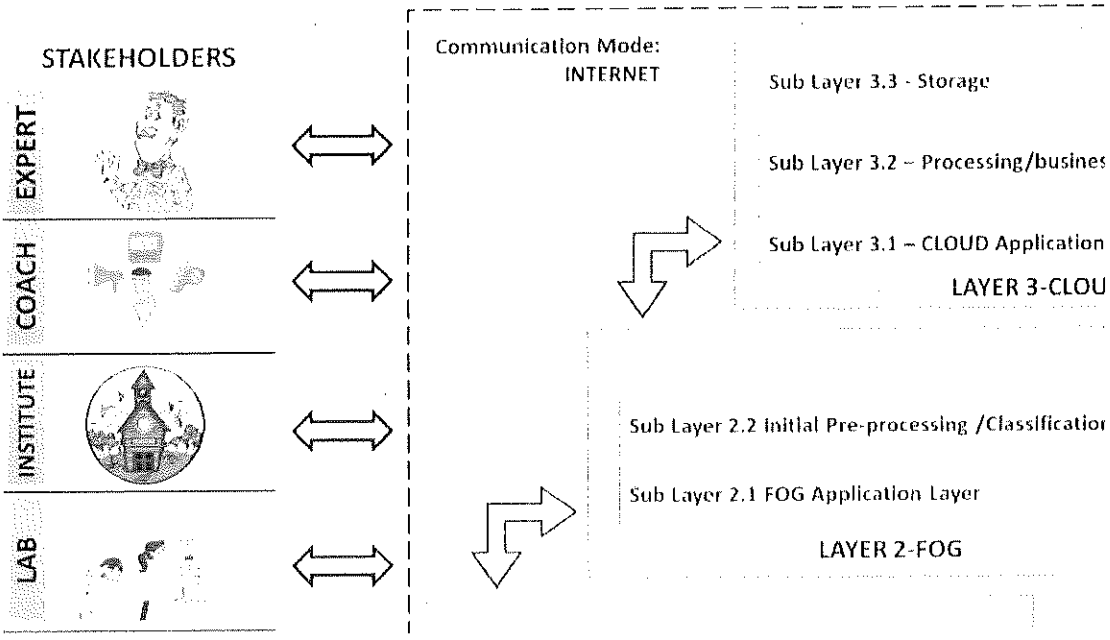
(c) Fuzzy Decision making

Fuzzy means uncertainty. The fuzzy set theory is used to describe vague situations and make decisions on basis of this uncertain data. In fuzzy theory, discrete values like true and false are depicted by absolute true and absolute false with help of the membership values and other values varying between 0 and 1 can also show up. The membership value is given by a specific membership function. Fuzzy Decision making tries to incorporate human thinking into decision-making. To deal with the issue of uncertainty in decision-making, various models have been proposed and implemented for sports identification.

Proposed framework for sports talent identification

We propose a six-layer conceptual framework as shown in Fig. 2 for the purpose of sports talent identification. The seven layers are accommodated at three levels viz. a viz. data acquisition layer, fog layer and the cloud layer. Each layer is designed to perform a distinct function to deliver efficient services to its neighbouring layers. In layer one, the necessary data needed for talent identification purposes is acquired. Layer two corresponds to the fog layer which hosts services for handling the data received from the data layer. Layer three is the cloud layer that performs all the necessary computations needed for sports talent identification.

Fig. 2 Cloud/Fog-based framework for sports talent identification



The layers of the proposed framework are as follows:

Layer 1 – Data acquisition layer (DAL)

The data-gathering sensors, smartphones, smart wearables, watches, etc. are hosted on this layer to gather the needful data for sports talent identification. The appropriate sensors are used for the corresponding parameters to get data. Since the data to be retrieved (set of parameters) differs from sport to sport, this layer provides room for the diversity of desired gadgets and sensors to be employed. The data can be structured, unstructured, or even graphical (motion analysis). The details depend on the form of implementation. The devices connect with fog/cloud via a secure channel (using the normal wireless mobile networks available). The acquired data is forwarded to the fog layer for further processing. The data being retrieved is saved on the storage sublayer of the cloud layer. Some web-based models provide a web form for the candidates to put the values for parameters. There is no reason to trust the manually added values. This framework proposes the use of direct sensors and gadgets to gather the data and by employing some API's or applets, we can ensure the device's non-repudiation.

Layer 2 – Fog layer

Fog computing, (a term coined by CISCO) is relatively a new concept. Fog computing fits on a layer between the data acquisition and the cloud layer. Since there is no (or insignificant) computational dimension on the client-side of the network and the computing resources are accumulated at the centralized cloud, fog computing has been devised to handle the necessary computation at the edge of the network instead of the cloud layer. Algorithm 1 shows the process at the Fog layer. On this layer, the devices called nodes are deployed. The number of nodes depends on the type of workload. On the intermediate fog layer, we propose the following sublayers:

(i) FOG application sublayer

This layer provides space for APIs' for the varied gadgets that are sending the data. Moreover, it hosts applications that are needed to get quick and initial responses from the candidate. It will prove useful for initial validation as well. E.g. If some values are not allowed for some parameters, it can generate an alert to the user from the alert generation procedures and prompt for the correct format. Moreover, the required preferences (e.g. inclination towards bowling, batting, wicket-keeping, etc.) can also be recorded by the user with the help of an applet.

(ii) Initial pre-processing/classification sublayer

At this phase, the data acquired is filtered and lightly (in terms of computation) checked for proper format. Since sensors generate a lot of continuous data, the data may be erroneously containing missing or abnormal values. Moreover, this layer also decides the binary classification like eligible and not eligible. The 'eligible' candidates are those who possess the least requirements expected from a potentially talented candidate and the 'not eligible' category is the candidates who are not meeting these

requirements. This can also filter out a wide number of entries and save a lot of computational resources.

Layer 3 – Cloud layer

Fog computing, (a term coined by CISCO) is relatively a new concept. Fog computing fits on a layer between the data acquisition and the cloud layer. Since there is no (or insignificant) computational dimension on the client side of the network and the computing resources are accumulated at the centralized cloud, fog computing has been devised to handle the necessary computation at the edge of the network instead of the cloud layer. This layer performs the core functionality of sports talent identification. In this layer we propose the following sublayers:

(i) **Application Sublayer**

This layer is the powerful version of the application sublayer of the fog layer. The Web Software needed for interfacing will be deployed here. It will be a gateway for all the stakeholders like experts, coaches, candidates, institutes, laboratories, etc. It will also host other related software modules and APIs.

(ii) Business/Processing Sublayer

This sublayer will deploy the core business models (talent) that will be used for talent identification. A lot of talent identification models already exist, any efficient model can be deployed and in the case of unified talent identification systems, the option to deploy more than one model (for different sports) is also available. With the aggregation of expert knowledge and coach supervision, the talent assessment scores are generated on this layer and a list of potentially talented candidates is generated.

(iii)Data Storage Sublayer

All the relevant data like candidate measurements, expert knowledge, Coach Assessments, Laboratory measurements and Institute Preferences will be stored on this layer. Cloud storage will act as the backbone of all the other layers so a fast data storage system is recommended to be deployed here.

Case study of cricket talent identification

Cricket is a bat & ball game with an estimated 2.5 billion fan base across the world. It is most popular in the regions like Asia, Australia and the UK. In Sub Asia it is celebrated like a religion. Ahamad et al. (2013), propose a talent identification model for cricket. The authors have identified twenty-eight parameters that determine the talent of an enthusiast shown in Table 1. We consider the same model as a case study to demonstrate our proposed framework. We identify the Coaches, Experts, Candidates (enthusiasts), Institutes and Laboratories as the stakeholders of this system. Coaches are the designated persons responsible for the talent hunt. Experts are the resources having domain knowledge. Candidates are enthusiasts whose talent is to be identified. Institutes are various organizations interested in Sports talent identification. Laboratories are the institutes /organizations that will provide the scientific measurement standards of the parameters and also measure the data for those parameters whose data is

not possible to be gathered from the sensors and smart gadgets (if any). A web platform may be developed for the purpose which is hosted on the cloud. The web platform will provide access to all the stakeholders for their corresponding tasks.

To begin with, the data for 28 parameters is needed. The same will be gathered by the sensors and data acquisition devices like wearables, fitness trackers, smartwatches, etc. The data will be stored on the cloud data storage unit and forwarded to the nodes on the fog layer. The light applets deployed on the fog will get the preference details from the candidates on basis of the data collected. The computational nodes deployed on the fog layer will perform the initial pre-processing of the data. Thereafter a binary classification for the categories like 'eligible' and 'not eligible' will be performed. The Eligible candidates are the candidates fulfilling the least requirements for playing cricket and not eligible candidates are not eligible to play cricket e. g., extremely physically damaged candidates. This will reduce the number of entries for further processing. The expert contextual knowledge will be provided by the experts on their respective web spaces. The scientific talent identification model will be deployed on the cloud to assess the talent based on expert knowledge (stored from expert preferences) and the candidate data (against 28 parameters). A web software will be deployed on the application layer and the core model will be deployed on the business layer. With the help of web software, the coach will initiate the process of talent identification and processing thus saving the computational resources.

Table 1: Parameters for cricket talent identification:

S. no	Parameter name
1	Speed
2	Agility
3	Endurance
4	Stress
5	Self-motivation
6	Upper body strength
7	Lower body power
8	Reaction time
9	Flexibility
10	Fatigue index
11	Bowler accuracy
12	Through catching accuracy
13	Under arm through accuracy
14	Catching ability
15	Ground fielding

16	VO2 max
17	Body mass index
18	Hand- eye coordination
19	Creativity
20	Decision making
21	Self-control and self-monitoring
22	Will power
23	Self -confidence
24	Integrity and work ethic
25	Shoulder flexibility
26	Balance
27	Balance in static form
28	Concentration and focus monitoring

Cloud utilizes its computational power to perform the core TiD tasks along with the data storage. All the stakeholders of sports TiD like experts, coaches, institutes, enthusiasts, etc. have been taken into account. The proposed ICT-based framework promises to deliver an effective talent identification service remotely and help the institutions to deal with COVID-19-like challenges in the future as well. The core characteristics of such TiD frameworks are convenience, mobility, accessibility, latency reduction, improved response time, scalability, cost efficiency, security, platform and location independency and bias reduction. We also illustrate one application case study of cricket talent identification using this framework. Since this is a novel framework in the domain of sports talent identification, the future scope remains wide open. A follow-up study is needed to implement and validate the framework with factual numbers. Detailed studies from the domains of the IoT, Fog, and Cloud computing need to be conducted. Moreover, the studies for the specific parameters of sports along with the digital sensors/devices that can measure them will prove beneficial for the implementation of this framework. To achieve the goal of a unified TiD framework for multiple numbers of sports, a gateway at the fog layer will prove to be useful. Machine learning models can be implemented at this layer to automatically classify a particular sport that is best suited for the candidate on basis of the data acquired by the sensors.

Source: Khan J. N, Ahamad G., & Naseem M., (2021), International Journal of Information Technology (August 2022) 14(5):2513–2521

Required

a) As a sports consultant, using evidence from the case study, prepare a draft presentation for Zimbabwe Cricket on the benefits of adopting and implementing the proposed Talent Identification Framework during pandemics. **(25 Marks)**

b) In your presentation, highlight challenges likely to be faced during the implementation phase and suggest possible strategies for minimizing these challenges. **(15 Marks)**

Section B.

2. 'Inventory management is at the heart of every organisation, sporting clubs included'.

Task:

As a sports supply chain specialist for a premier soccer league club, advise the club's management on the importance of managing inventory in every aspect of the sports supply chain. **(20 Marks)**

3. You have been invited to a sports conference to present on the topic entitled; 'Global quality strategy and its impact on supply chain decisions in sports.'

Task

Prepare a draft of your presentation. **(20 Marks)**

4. As a sports consultant for the Zimbabwe Olympic Committee, enlighten management on how they can effectively leverage the use of ICT technologies such as EDI and other supply chain tools, highlighting how these can deliver value to the sports industry in Zimbabwe. **(20 Marks)**

5. 'The use of outsourced logistics operation as a strategy is evidenced in the sports industry but is characterised by many risks'.

Task:

Prepare a draft presentation to the management of a sport of your choice, on the benefits and risks of this outsourcing strategy, suggesting possible solutions to the risks likely to be faced.

(20 Marks)

6. 'Forecasting in supply chains can improve supply chain agility and responsiveness.'

Task:

As a sports specialist, how would you apply collaborative planning, forecasting and replenishment (CPFR) in sports for agility, responsiveness and efficiency to fan demands? **(20 Marks)**

END OF PAPER