

Research Design for Developing and Validating Ice-Hockey Team Diagnostics Scale

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Abstract—In the modern world, ice-hockey (and in a broader sense, team sports) is becoming an increasingly popular field of entertainment. Although the main element is most likely perceived as the show itself, winning is an inevitable part of the successful operation of any sports team. In this paper, the author creates a research design allowing to develop and validate an ice-hockey team-focused diagnostics scale, which enables researchers and practitioners to identify the problems associated with underperforming teams. The construction of the scale starts with personal interviews with experts of the field, carefully chosen from Hungarian ice-hockey sector. Based on the interviews, the author is shown to be in the position to create the categories and the relevant items for the scale. When constructed, the next step is the validation process on a Hungarian sample. Data for validation are acquired through reaching the licensed database of the Hungarian Ice-Hockey Federation involving Hungarian ice-hockey coaches and players. The Ice-Hockey Team Diagnostics Scale is to be created to orientate practitioners in understanding both effective and underperforming team work.

Keywords—Diagnostics Scale, effective versus underperforming team work, ice-hockey, research design.

I. INTRODUCTION

ICE-HOCKEY is a fun activity that may offer its players plenty of joyful, emotionally uplifting and real-life experiences. Both its complexity and the speed in ice-hockey are outstanding features compared with other team sports. Thus, researching phenomena in ice-hockey offer a great chance to the author to create a scale, which both academics and practitioners may find useful when dealing with parameters of team efficiency, and especially with underperforming teams.

Based on early consultations with experts of the field, underperforming is quite strongly influenced by the coach's or manager's expectations, therefore, the main target of constructing such a scale is to collect and create the most objective, and commonly accepted factors that work well in the operation of a highly functioning team. When we know which important factors must be measured in a team, we may create the items of the scale to successfully identify the underlying, and mostly non-visible causes of the underperformance.

As the nature of performance of a team may only be seen by professionals around the team, the results of the game may be an aid to help better understand the level of performance that can be classified as sufficient or insufficient. A performance which is not sufficient is underperformance in the author's concept, and must be evaluated with the help of the Ice-Hockey Team Diagnostics Scale (IHTDS).

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II. LITERATURE REVIEW

Reference [25] offers a reliable starting point for qualitative research, as it compares four main types of qualitative research design: case study, ethnography, narrative and phenomenology. Each design has its own strength and weakness, subject to the different foci. For the purpose of constructing and validating the scale, the phenomenology design is proved to be the most suitable one as it explores the experience of the experts who are going to help the author to construct the categories and the items for the scale. Reference [26] deals with the problem of qualitative researches from a sample design and sample size point of view. It suggests that when designing researches containing qualitative and quantitative methods, targeted sampling method is most capable to ensure the validity of the research. Reference [5] used interpretive phenomenology and focus group interviews in order to measure adolescent HIV self-management in South African environment. The research design contained three major steps: firstly, making interviews and focus groups using interpretive phenomenology, secondly, triangulation of literature, theory and qualitative data, thirdly, item validation and refining using cognitive interviewing. The importance of this method for the current paper is that phenomenology can be used as an approach when qualitatively obtaining information through interviews. Reference [3] offers a method description for phenomenological interviewing. The author of the present paper learnt from the literature that interview questions should be asked in a way such that the interviewees present state rather than their past state be addressed.

Reference [4] examined the roles a coach must be willing to play in order to successfully optimize team functioning in curling, namely: technical/tactical specialist, mediator, manager, facilitator and motivator. These roles may be used in the proposed model of team functioning. Reference [11] examined how elite soccer team's performance changes when the coach is replaced mid-season. In the linear regression analysis, the research focused on four variables of the coach's operation and environment: experience of the coach, budget of the team, and whether the coach was a former elite player, and whether the coach was a novice or had experience. In the used model, performance is equal to summing up the four variables, adding intercept and disturbance term. The results: 1. A team's short-term performance increased significantly after the coach replacement; however, this effect declines on the long-term and 2. This winning effect has no connection with the coach-related

factors mentioned earlier, suggest that the stimulus a team receives when the coach is replaced may motivate the players to play their bests, and the knowledge of the coach does not play a crucial role in the success of the team. When researching elite-level players of soccer, it is reasonable to assume that they all possess a high level of knowledge about the game, and this fact decreases the team's need for high level knowledge of the coach. Also, elite soccer is much more optimized and advanced both in theory and practice as elite ice-hockey does, and the variables the research uses are limited to only 3 factors (experience, former player and novice in the league), as if these would perfectly explain the coach's operation when coaching a new team. Therefore, the author questions the applicability of these findings in ice-hockey, and the proposed model for building and constructing the IHTDS. Reference [22] studied six Swedish elite league teams with the data of 21 years (1975-2006) in order to better understand how the performance of the team relates to key variables like coaching experience and coaching ability. It found that coaching ability is strongly correlated to team performance, and that managerial succession has a significant negative effect on team performance. As the results for the six teams differed, it is reasonable to assume that there is no strict formula that works the same in every team – the coach must be flexible and must fit into the operation of the team in order to achieve great results, and make the team high performing. However, in all the six cases, the coaching ability was strongly correlated to team success (0.77, 0.74, 0.75, 0.72, 0.75, 0.73). This means coaching ability must be included in the IHTDS scale. The study does not specify what sub-variables sum up as coaching ability, the author of the current paper considers the most detailed model is found in [4].

Reference [17] examined how soccer players perform when receiving feedback from a coach expressing different emotions: pride, happiness, neutral and shame. In the results, it was concluded that when the player and the coach have a close relationship, the expression of different emotions by the coach influenced the performance of the player. Although the players could only weakly distinguish pride and happiness expressed by the coach, they showed increased performance while no performance increase was found when the coach expressed shame when giving feedback. These results suggest that the utilization of emotions – which is a subscale of The Emotional Intelligence Scale – is an unmissable element of any model describing a team's performance where the coach is included as well [15]. Reference [29] examined the cultural differences between high and low performance Korean university soccer teams, with using The Organizational Culture Assessment Questionnaire. The questionnaire measures four main factors of culture: 1. managing change, 2. achieving goals, 3. coordinated teamwork, 4. cultural strength. As a result of the research, significant differences were found between high- and low-performing teams in factors 1, 2, and 4, meaning culture is strongly related to the performance of a soccer team. Although the results show relationship, it remains unclear whether the culture causes the higher performance of a team, or high performance causes the culture to be more developed inside the team. As no regression analysis was made, finding the place of

culture factor in the model creation needs further reading in the topic. Reference [1] carried out a throughout regression analysis when examining organizational stressors, coping and outcomes in competitive sports. As a result, the regression model values were calculated between variables team & culture frequency and duration, and performance satisfaction. The beta values of the models were -.042 and -.045, meaning the team & culture stimuli has a slight negative effect on the performance satisfaction of the athletes. Although the results are statistically significant, the sample in the research contained team sport players and individual athletes as well, making the results questionable from the author's perspective. The Organizational Cultural Assessment Questionnaire is usable when measuring cultural factors in teams [23]. Reference [20] analysed the data of National Football League in the time period of 1970-2017 in order to measure the head coach's and the defensive coordinator's effect on the defensive performance of their teams. The research constructed a regression model, including team and league characteristics (offensive and defensive performance, player experience and player quality, defensive alignment), defensive coordinator and head coach characteristics (coach's tenure with the team, coach's background, internally promoted coach or an external hire) along with their individual effect on defensive performance. It was found that only in around 10% of the cases a significant effect could be measured in case of defensive coordinators, and a low 11% could be proven in case of head coaches. As the players of the NFL league are known to be the best players of the world playing American football, the role of a coach and a defensive coordinator might play a slighter role in the performance of the team, meaning the findings of the study must be used cautiously in the model building process. As the validation of the IHTDS scale is planned to be made on Hungarian data, it is mandatory to consider the differences of Hungarian and top-level leagues, such as NFL in American football. In the highest-level Hungarian ice-hockey league, the pool of players is much more limited, and the players might require the coach to be more involved in the performance of the team. Therefore, the author keeps the coach's involvement in the performance of the team as a factor to use in the proposed model. Reference [14] used regression analysis in order to measure the causal relationship between coaching efficacy and coaching behaviours on the outcomes of the functioning of Botswana Premier League soccer teams. For the analysis, it used multiple scales. Out of four, only the Game Strategy Efficacy subscale of Coaching Efficacy Scale had a significant effect on team atmosphere and performance. This phenomenon is explained with the fact that the Botswanan Premier League is very far from being a totally professional league, and the training hours of the players are limited to an average of 7.5 hours a week, and the teams are partly managed by volunteers. The findings support the author in the model building with empowering the idea that the involvement of the coach in the performance process can be different when examining multiple teams. Revised Leadership Scale for Sport and Coaching Efficacy Scale is an instrument that may be capable of being used in the model building [31], [7]. Reference [30] analysed the

effect of the coach's overconfidence and the team performance, with a regression analysis-based research design. According to the results, opposed to the preliminary ideas, the coach's overconfidence was not affecting the number of scored and allowed goals, but an overconfident coach might motivate the players better than a coach with average confidence. As the motivation of the players might play an important factor in their team's performance outcomes, further reading must be done regarding motivation & team performance in order to successfully build motivation into the proposed model. Reference [6] studied the importance of motivation in sport context, from a psychological point of view. It emphasizes the role of the coach in the motivation process and identifies motivation as the key element for sports achievement. As achievement in professional sports is mainly acquired through results, and result is the most important measure of the performance of a team, the author assumes that the coach's ability to motivate and the player's intrinsic motivation are important factors when dealing with team performance. Reference [12] offers a great insight how deeply ice hockey can be analysed through the statistical data available in a top-tier league like the National Hockey League (NHL). It used regularized logistic regression modelling to accurately measure an individual player's contribution to goal scoring. As the used statistical method is quite advanced and deep knowledge is needed when using, the author questions the usability of their model in the proposed model building. Although the regression model will not be built in the current paper's proposed model, the authors wrote: "The popularity of traditional plus-minus is informative: player ability can be measured from the subset of events that actually lead to goals" [12]. Therefore, plus-minus data can be used as a measure in the upcoming model. Reference [21] used structural equation modelling with the aim to better understand the nature of ice-hockey. Two structural equation models were used, in which latent variables were offense, defence and possession. According to the results, the latent variables are best understood if a small number of measured variables were used and offense mediates the relationship between defence and possession. One major contribution is present to the current research: however complex ice-hockey is, simple measures are used to record individual and team performance, and the author should not fall into the mistake to overcomplicate the proposed model. Reference [19] analysed the odds ratio of NBA superstar Kobe Bryant, and how his performance related to the success of his team, based on plus-minus as an independent, with team wins/losses as the dependent variable. In the findings, it is stated that playing in the home court may have an effect on the performance. The research offers a great method to better understand how individual performance is related to team performance, with the method of creating a matrix in which team wins and losses are the y axis, while individual player's plus-minus data are on the x axis. With this method, players' competitive characteristics are well definable, along with their contribution to team performance. The author considers this method as a useful and usable part of the proposed model.

Reference [10] examined the effect of cognitive abilities of

players on their performance in soccer. Basic cognitive abilities of the adolescent players were measured using Corsi block and concentration grid tasks, and their soccer performance was measured through five soccer skills – tactical ability, technical skills, physical ability, mental toughness and situational awareness. As a result, visuospatial capacity was found to have a significant effect on the soccer performance of the players. As adolescents were the participants of the research (age mean: 16,5, SD: 1,13), further reading is required to understand whether visuospatial capacity decreases as people become older. Reference [28] examined how visuospatial performance predicts motor learning in older adults. They found that higher-level visuospatial functioning caused the increase in performance, meaning that visuospatial ability is not only possessed by children, but may be used with adults as well when identifying factors that may cause an individual's, and a team's performance. Therefore, visuospatial functioning may be used in the proposed model building.

Reference [9] tested the hypotheses whether playing ice-hockey helps its players to improve their emotional intelligence and resilience abilities. According to the linear regression analyses, playing ice-hockey does not improve the emotional intelligence, and only has a slight effect on the resilience level of their players, however, the older the player is, the better it is in these abilities. Therefore, the age of the player must be a powerful factor in the model, and not the ages spent playing ice-hockey. The contradiction in this question can be assessed with the help of convertible knowledge. The more convertible knowledge the player has from different areas of life, the better chances it has when scoring opportunities arise. Therefore, further reading is required in this topic, in the field of convertible knowledge and collective intelligence. Reference [2] examined in three studies how individual IQ's and collective intelligence are related, with using regression analyses and structural equation modelling. It was found that group IQ can be caused with 100% by individual IQ ability levels. This means the cognitive ability of people has no synergic effect when working together, so the emerging ability which the current research is partly aiming for must be found somewhere else in a human's operation. Reference [27] dealt with the question of faith and belief, how they are connected and concluded that nor belief nor faith should stand alone, and mentioned Binswanger's phenomenology of love. Although this field seems far from the literature processed previously, human factor is present in the operation of an ice-hockey team, love is an inevitable phenomenon for the model building. Reference [24] examined the age-related differences in motivational climate and extrinsic-intrinsic motivational factors, with data of Hungarian national wrestling teams. It concluded that amotivation shows a descending pattern when becoming older. Motivation may play an important role in the proposed model. "Hockey Confidence Survey" was provided to the author, which may be used as a measurement instrument in the proposed model [7].

Reference [16] examined the effect of non-linear pedagogy compared to linear pedagogy to better understand what non-linearity in pedagogy causes to athlete's performance. The

researchers experimented with tennis players, measuring their hit accuracy and movement clusterability. It was found that linear and non-linear pedagogy both increased the hit accuracy, but the non-linear teaching method increased the number of clusters of movements, therefore, offered a greater variability in movement toolbox. However, this does not mean non-linear teaching method is superior to linear. As the aim of this paper is to build the proposed model and prepare the author for constructing and validating the IHTDS scale, the pedagogical linearity vs non-linearity must be a factor in the model as part of the coach's operation. If the coach wants to have the players

behave and move the same way, linear methods are to be used, while if the coach wants diversity and colourfulness, non-linear pedagogical methods are effective.

III. MODEL CREATION

In order to be successful in the interviews with the experts of the field, a proposed model must be created by the author to serve as the base of the interviews. According to the literature and the knowledge obtained from the experts, the proposed model for constructing the scale is seen in Fig. 1.

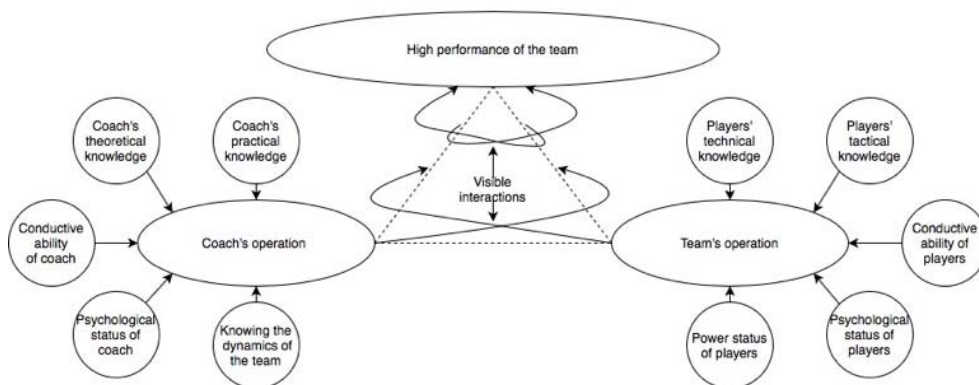


Fig. 1 Proposed model of ice-hockey team performance

The coach's practical knowledge comes from experience from coaching, and other sources of practical knowledge. The most ideal case is when the coach has convertible knowledge that it can be converted to ice-hockey as well. The same is the case with the coach's theoretical knowledge. Connected to psychology, the optimal charging of positive and negative feedbacks in the coach-player relationship is capable of reaching the state in which the player can optimally perform. The knowledge and experience of the coach plays a crucial role in this process. The best case is, when a coach has transdisciplinary knowledge. According to the transdisciplinary model, knowledge is neither interior nor exterior [18]. The conductive ability of the coach started as leadership ability when the author started to build the model. Leadership would meet the traditional standards better, but the phenomena when a coach influences the players to perform better are more likely to be explained by conductive influence. The conductive ability is to manage the energy flow in the players both by emotions and thoughts. In the proposed model, the conductive interactions work both ways, as the players may influence the coach as well. The psychological status of the coach is important, as the more problems the coach faces, the less likely for it to find the best possible solutions. Knowing the dynamics of the team is mostly the history of the team, as many conflicts and non-understandable phenomena gain significance when the coach knows the story behind.

The player's technical knowledge plays an important role in the performance of the team, as without high-level technical abilities, the team will play under its full potential. The same applies for the tactical knowledge of the players. Once again,

transdisciplinary knowledge is the aim for the players as well. The conductive ability of the players is also required for high-performing teams, as in many cases, the players must influence the coach in order to make the team high-performing. The conductive ability of the players started as followership ability when the author started to build the model. Followership is widely used in the literature, although the influence the players make on the coach is more understandable with the use of conductive influence. The psychological status of the players is important as well, the better status they are in, the higher they can perform. The power status of the players has multiple meanings: firstly, their power and endurance, secondly their power position inside the team.

When the cooperation of the coach and the players starts, the peers start to work in their own way, both working for the performance of the team. Their orbits cross each other, making a visible interaction arise. There the conductive ability is used the most, as both peers do their bests to merge the orbits. Assuming that the coach and the players are at the same level in conductive ability, both continue their own orbits. As the model indicates, the orbits go behind the triangle, representing the observer in the model. Behind it, the orbits cross each other as well, where non-visible interactions happen. Once again if the team and the coach continue their own process, they will have more interactions that are visible, and it goes on and on until the high performance happens. The proposed model has a universality claim.

IV. RESEARCH QUESTIONS AND HYPOTHESES

The observer can create and apply specific models that help to see through and understand diverse problems in ordered thought structures, done by interpreting the connection between concepts, processes, states, positions, cooperations, and interdependencies. It is also a basic assumption that beyond the individual level of the study, the operation of the team with emergent characteristics allows for team-level interpretation or analysis. The meaning of the whole is more than the sum of the meanings of the parts.

As the proposed model serves as a base of the interviews, we are determined to base the research questions and hypotheses on it as well. As the aim of the study is to build the highest-level research design for building and validating the IHTDS scale, the components of the model must be focused on in the research questions and hypotheses.

- RQ1: Are the five factors of the coach's operation relevant and sufficient for understanding the complex operation of a coach?
- H1: The author assumes that the five factors of the proposed model are relevant and sufficient for understanding the complex operation of a coach.
- RQ2: Are the five factors of the team's operation relevant and sufficient for understanding the complex operation of the team?
- H2: The author assumes that the five factors of the proposed model are relevant and sufficient for understanding the complex operation of a team.
- RQ3: How does visible and non-visible interactions arise in the cooperation of coach and players?
- H3: In the cooperation of coach and players, visible and non-visible interactions turn into practice that supports high performance of the team.
- RQ4: How does the cooperation of the coach and the team function as a system that supports high performance?
- H4: The coach's and the players' cooperation build up a balanced system, which supports the highest possible performance.

VII. METHODS

The proposed model is going to be tested through a two-step method: firstly, interviews with experts of the field are going to be carried out in order to finalize the proposed model. Secondly, the IHTDS scale is going to be constructed based on the final model and evaluated with a statistical process. Reference [8] used principal component analysis when creating the scale for the study. An important and unique characteristic of the current study is that the proposed model is highly based on theoretical background, and the factors influencing the performance of the team are identified, therefore, a Confirmatory Factor Analysis is going to be carried out to test the fit of the final model on data, with SPSS version 24.0 software (Chicago, SPSS Inc.) [13]. The items for the scale are going to be created when the final model is ready, and the factors serve as subscales. The future user of the scale will want a clear identification about the cause(s) of underperformance. As the final model serves as the

base of the scale, the model itself must be included in the use of the scale, with proper, understandable explanation. When the user of the scale has a proper understanding of the model, the results of filling the scale will be meaningful.

The author is going to perform structured interviews with 15 experts of Hungarian ice-hockey, including 5 senior national team players, 5 national team coaches and 5 national team leaders. The structured interviews offer a great chance to improve the proposed model, and to find the hidden connections among the factors, and to test whether the five factors of coach's, and players' operation covers the whole ice hockey team's operation. Therefore, the following interview questions arise:

- 1) According to your experiences, how would you describe the relationship between the coach's practical knowledge and team performance?
- 2) According to your experiences, how would you describe the relationship between the coach's theoretical knowledge and team performance?
- 3) According to your experiences, how would you describe the relationship between the conductive ability of the coach and team performance?
- 4) According to your experiences, how would you describe the relationship between the psychological status of the coach and team performance?
- 5) According to your experiences, how would you describe the relationship between knowing the dynamics of the team and team performance?
- 6) Do you think the five mentioned factors cover the whole operation of a coach?
- 7) If not, what would you add to the model?
- 8) According to your experiences, how would you describe the relationship between player's technical knowledge and team performance?
- 9) According to your experiences, how would you describe the relationship between player's tactical knowledge and team performance?
- 10) According to your experiences, how would you describe the relationship between conductive ability of players and team performance?
- 11) According to your experiences, how would you describe the relationship between psychological status of players and team performance?
- 12) According to your experiences, how would you describe the relationship between power status of players and team performance?
- 13) Do you think the five mentioned factors cover the whole operation of a team?
- 14) If not, what would you add to the model?
- 15) According to your experiences, should the coach and the players have visible and non-visible interactions in order to perform well?
- 16) According to your experiences, when the coach and the players acts as two opposing objects in the same team, do they perform well?
- 17) According to your experiences, when the coach and the players keeps their orbits and the system is balanced, does

it support high performance?

18) Do you think the model describes the operation of a high-performing team?

19) If not, what would you add to the model?

The data for the CFA analysis are going to be gathered from the Hungarian first league teams. All of the Hungarian professional players, and all of the Hungarian elite-level coaches will be included in the research, in the direction of making it as representative as possible. The questionnaire is going to use Likert-scale, scaling from 1 to 6.

VIII. DISCUSSION

Many of sport teams, including ice-hockey teams, face the phenomenon of underperformance, as it is human beings who are playing the games. Various factors are influencing how they perform. We read the most recent literature with the aim of creating a model that would explain and help academics and practitioners to gain understanding why underperformance happens. As a consequence, if the main factors of performance are well known by the experts, underperformance can be understood and actions may be taken in order to dissolve the cause behind it. Although the paper aims at dissolving the cause of underperformance, a high-performance team with the knowledge contained in the current paper may further improve its performance as well, by having a competitive edge over the competitors. The proposed model and its qualitative and quantitative testing are an adequate background for gaining such a competitive edge, which may add novelty to the ever-growing scientific knowledge-domain and professional practice.

IX. CONCLUSIONS AND LIMITATIONS

Many reasons might be present for a researcher to conduct a research. The most important reason for the author is to add a valuable instrument to the knowledge base of sport science. We conclude that theoretical model building is an important activity when conducting a research, as theoretical and practical knowledge is becoming more useful when both are acquired, and the transfer is available from theory to practice and vice versa. The future of society depends on people who have this ability.

As the type of the current study is research design, the proposed model has not been tested either by interviews or by statistical analysis. The author is convinced that a theory-driven approach and testing in practice constitute a trustworthy future for scientific research.

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