COMPLEX SYSTEMS IN TEAM SPORTS

Felix Lebed

KAYE ACADEMIC COLLEGE OF EDUCATION, ISRAEL

Summary

This chapter examines the cardinal approaches to analysing performance in team sports and challenges a number of prevailing attitudes, relating to: (a) performance as reactive behaviour following interactions with teammates and opponents; (b) competitive play as instrumentally aimed behaviour; (c) performance analysis as a cybernetic system intending to provide feedback to the ‘coach–player–team’ units; (d) playing performance ‘as is’ without consideration of internal and external (environmental) contexts; and (e) a sports team as a playing domain without viewing it as a managed unit within the entire sports institution hierarchy. Review of research reports together with author perceptions on complexity features of sport performance leads to the view of team playing as a result of self-organization in a complex system. Suggestions for improving the scholarly foundations of performance analysis for future research are offered.

Introduction

The win-focus of team sports is supported by many professional processes, one of which is performance analysis. As can be seen from research reports (Hughes, 2004; Nevill et al., 2008; O’Donoghue 2010; Reilly et al., 1997), performance analysis has at least three origins: (1) applied performance analysis used by coaches for real-time and/or post-game analysis and consequent adjustments; (2) cybernetic systems theory, which emphasizes the importance of feedback for controlling a system; and (3) classical scientific method as reflected mainly through behaviouristic psychology, according to which only measured – or at least quantified – parameters of human behaviour should be the focus of analysis. The first source has provided the applied aspect of performance analysis. The second one structured the notion of multiple feedback mediated by performance analysis and is an integral part of pedagogical control in team management. According to this schema, the recorded, selected, and computed data is directed to both the functioning of sports institutions and scholarly research aiming to discover general regularities of performance (Figure 7.1). The third source provided a methodology for conducting performance analysis.

The view of playing athletes and teams as complex systems, which has developed since the 1990s and especially in the last decade, has somewhat altered the picture by challenging the
principles adopted by performance analysis. The challenges relate to both the principles of system control and the use of the Cartesian scientific method, which is built on the axiom of an inherent connection between cause and consequence, which laid the basis for the reactive input → output (stimulus → response) methodology of behaviourism.

This chapter consists of three sections. The first discusses the complexity scientific approach to human systems in general and teams in sports in particular. Here, a team is expressed by two qualities: first, a domain playing competitive games and, second, a unit within a managed hierarchy of other complex systems in a sports institution. The next section considers a playing team as reflected in the functional complexity of team sports. Such complexity must be related to unique features of human playing before connection to extrinsic and intrinsic factors and agents that will influence a team as a complex system. In the last section, the team as a managed unit reflects a structural complexity of team sports. Each level of the sports system (athletes, coaches, managers, staff) has its own complexity, and each must be managed in concert, like an orchestra.

**Complexity as a principle for a proactive approach to team performance**

**Complexity and proactive behaviour**

Classical systems theory evaluates managing efficacy along a loop: planning → preparation → performance → feedback → planning, etc. (Carling et al., 2005). However, this schema has a problem in that performance analysis in team sports does not always play a role in a multi-channel feedback system. Complexity theory explains this phenomenon through one of the main characteristics of live systems. For the most part, these are self-organized dynamics and ‘growth-from-within’ (Dimitrov, 2005: 23) and both these features are based on a series of special characteristics (Bar-Yam, 1997; Cilliers, 2005; Gershenson and Heylighen, 2005; Richardson et al., 2007; Wolfram 2002). These characteristics are as follows: (1) complex systems consist of a very large number of elements (levels), each of which can be simple; (2) the elements interact

![Figure 7.1 Schema of cybernetic control based on multiple feedback mediated by performance analysis (PA) in team sports](image-url)
F. Lebed

dynamically by exchanging flows of energy or information; (3) the interactions are non-linear, and distributed throughout a network; (4) the network consists of many direct and indirect feedback loops; (5) complex systems are open systems – they exchange energy or information with their environment and operate in conditions far from equilibrium; (6) complex systems have a memory which is not located in a specific place but distributed throughout the system; (7) the behaviour of the system is determined by the nature of the interactions and not by the contents of the components – the notion of emergence is used to describe this aspect; (8) all the dynamics of complex systems are expressed purposefully by behaviours that are directed to the most powerful attractor at a given time; (9) complex systems are adaptive, they are flexible enough to be disturbed by environment constraints, and they are susceptible to destruction by internal and external perturbations in the environment; and (10) self-organization is one of the most important cornerstones of complex systems.

One of the most relevant considerations for performance analysis features of complex systems is their unpredictability, which is expressed in a lack of generally expected connections between system input and output. Weak input can result in strong output and, conversely, imposed input may be followed by a weak and/or late response (Gershenson and Heylighen, 2005; Morrison, 2002). Such inadequate responses are caused by a very large number of both external factors and agents influencing complex systems and network intra-connections that compose intrinsic flows. These peculiarities indicate that complex behaviour cannot be comprehended by a rational approach based on the Cartesian world outlook, mainly reductionism, analysis, determinism, and rationality (Cilliers, 2005; Wolfram, 2002). Stated simply, this outlook means that a known impulse leads (or should lead) to a predictable effect, suggesting an implied law of managing behaviour, as if the controlling level of a system (manager, coach, etc.) has the right to expect a predictable response from the levels it controls. And if this response is not obtained, then the implication is that something is wrong in the regulating or managing act because, in the Cartesian world, the ‘right’ stimulus must always lead to the ‘right’ response.

Viewed methodologically, ‘right’ and ‘unright’ (i.e. unexpected) responding of complex systems can be presented through a counter-position of behavioural reactiveness and proactiveness. This counter-position would seem to be expressed, in its shortest form, through the question of primacy of human purpose versus the primacy of the environment as the main cause of an action strategy. The link to a proactive understanding of behavioural causality can be found in the works of early functionalists. Carr (1925) was first to consider motive as a stimulus and then as a primary cause of activity. Maslow’s (1943) view of human motivation continued in this direction and led to purposeful consciousness and then to proactive behaviour. Psychological self-determination theory (Deci and Ryan, 1985; Ryan and Deci, 2000) can also be analysed as a reactive–proactive counterpoint because it presents this dichotomy through the opposing positions of extrinsic (forced) and intrinsic (freely chosen) motivation.

In the modern psychological version of action theory adapted to sports, Nitsch (2009) proposed that the entire world of multilevel intrinsic motivations of a person should be taken into account. Nitsch’s views can be expanded to encompass a number of functional theories in psychology and sociology that offer a systems approach to the complicated phenomena of life, humans, and society. Some of these theories are the antithesis of behaviourism, popular during most of the twentieth century (Vygotsky, 1978; Parsons 1978). They equate reactivity of behaviour to an individual’s proactivity that results from intrinsic dynamics. Returning to Nitsch (2009), one can view social components in this proactiveness. His behavioural model (Nitsch, 2009: 173) includes four levels of person–environment interrelations – physical, biological, mental, and social. According to these views, the social environment creates a person
Complex systems in team sports

(an actor) by prolonged influence, and this actor determines his aims and ‘reads’ current environmental conditions through a ‘subjective situation definition’ (Nitsch, 2009: 170–1).

Basic features of a sports team as a complex system

Viewing sports contests through the complexity prism necessarily entails seeing each side as a domain having ‘grown-from-within’ self-dynamics that are independent of environment. This in turn leads to the claim that sports contests have a high probability of proactive performance, which can be examined mainly by new forms of performance analysis. Such a claim needs to establish one thing: is a sports team a complex system?

Because of its finite number of system elements and the strong limits on their functioning, a team lacks important complex system qualities, such as a large number of levels and flows and unpredictable freedom of behaviour. But this simplicity may be more apparent than real. First, complexity sciences offer a fundamental notion about the emergence of complex behaviours by simple parts (Cilliers, 1998; Wolfram, 2002). Second, being a system, a sports team can be included in a special subset of ‘family’ (Bar-Yam, 1997: 4), which is an example of a complex system characterized by the following qualities: ‘It is a set of individuals. Each individual has a relationship with the other individuals. There is an interplay between the relationship and the qualities of the individual. And the family has to interact with the outside world.’

The case of the family is an illustration of emergent complexity (Bar-Yam, 1997: 5), which is a function of the collective behaviour of simple parts. One may claim that the small number of team levels and the established constraints of strategies do not restrict the emergent behaviour of the whole system for the following reasons. First, ball playing itself has its own complexity caused by specific features of this kind of human activity, by the obligatory presence of a human attitude towards an activity as play and by an emotional state of enjoyment caused by this activity. Second, each one of the levels (athletes) is a complex system exhibiting emergent unpredictable qualities on both the perceptive-motor and the mental sides of behaviour. And third, a mutually active conflict of opposing sides is a primary condition and main pattern of acting in a competitive game. The simultaneous struggle by both sides for a play thing makes the play of each athlete an emergent, uncertain, and unpredictable behaviour based on relative knowledge about every future moment of the contest.

When claiming that the playing team as a whole is a complex system, one has to analyse its features by means of problematic questions of complexity, the first of them being that, in such a situation, performance analysis can no longer be identified with the notion of feedback only. The complexity vision suggested here means seeing team performance both inside and outside of the ‘coach–team’ cybernetic loop (Figure 7.2). As demonstrated in Figure 7.2, many intrinsic and extrinsic factors have an influence, leaving footprints on performance, weakening the coach’s control, and thus making the term feedback unessential. (For a review of intrinsic factors, see Lebed, 2009.) The extrinsic factors have been divided into four kinds (or two pairs) of environment: social–physical and supporting–menacing. The following example illustrates how social factors influence performance. From an analysis of 286 penalty kicks from various soccer games, Bar-Eli et al. (2007) reported that the goalkeeper chose to jump to the side they anticipated the kick would go on 93.7 per cent of trials, despite statistical indications that staying in the centre of the goal offered the best goalkeeping strategy. In other words, the goalkeeper’s action of producing the norm of jumping to protect the goal is a product of social expectations, with teammates, coaches, and fans accepting that the goalkeeper has to jump to safely close one side of the goal. Thus, the norms and values of a given socium influence the choice of purposes.
in the earliest stage of performance. They can correspond or not correspond with personal norms and values, but they influence and alter behaviour.

Only a few factors can be separately registered, recorded, and computed during performance analysis. At the same time, the need to relate to many forces perturbing a complex system (the competing team) has to be taken into account for comprehension of performance. In every game, in every competition, a team of players is influenced by an incomparable diversity of intrinsic and extrinsic factors and exhibits special, unmatchable indications of successful performance. In this sense, Socrates was right in that ‘you cannot step twice into the same stream’ (Fowler, 1921).

Because of space limitations, the discussion cannot cover all schematic factors that influence a team as a complex system. For additional information on these factors, the reader is referred to Lebed and Bar-Eli (in press). Two main factors will be analysed within the framework of functional complexity here: the complexity of playing itself and the complexity view of the opposing side in a competitive game. The first will be discussed because it has not been addressed within performance analysis; the second, because it is important for introducing complexity sciences into the field.

The functional complexity of competitive game playing

Curvature of playing as a background of team performance

Attention dealing with the complexity of human activity has focused mainly on the functioning of complex systems in conditions of uncertainty that border on chaos and seek the attractor. Emergent behaviour of complex systems is always aimed at less uncertainty. But the case of playing humans is special because the playing itself has its own complexity. The following analysis offers interpretation in which game playing can be perceived as a special skilful activity, an amusing mental state, and a spirited, playful attitude to real activity.
Complex systems in team sports

Complexity (uncertainty) of a process and the result of playing

The main thesis here proposes that the potentially playful side of reality can emerge only in a situation of uncertainty of both process and result. This approach is echoed in Huizinga’s (1955: 8) requirement of uncertainty – ‘play turns to seriousness and seriousness to play’ – as an obligatory feature of play. A detailed analysis of the affinity between play and uncertainty is also given by Moore (1975), who used the term indeterminacy, and Turner (1983), who referred to liminality of play. It would seem that, in the philosophy of sport, this issue can be expressed in Esposito’s (1974) concept of possibility and Kretchmar’s (1975) concept of test. Kretchmar explains the situation of test by the unsteadiness between what he calls impregnability and vulnerability.

These approaches concur that the uncertainty created in a play activity by the possibility of both success and failure is what makes physical play and games pleasing. The challenge is adrenalized by possible crashes, uncertain duration of play, and ambiguous results, and is characteristic of all kinds of playing. All of the above focus attention on the issue of games playing which, to be played, must be uncertain and unpredictable. In games, this quality of activity is achieved by rules that introduce constraints for players – for example, complicated conditions for scoring a goal which demand the skills of a virtuoso, high physical effort, and more or less forceful counteraction of an opponent. The scholarly side of performance analysis in team sports usually does not relate to this properly playful side of performance. At the same time, one can recognize references to the subject in publications that separate data taken in games where playing itself displays different faces – for instance, balanced and unbalanced games (Gómez et al., 2008; Sampaio et al., 2010), games with different match status (Lago, 2009), levels of competition (Sampaio et al., 2004), and variations of play parameters depending on the pace of the games (Volossovitch et al., 2010).

Complexity (uncertainty) of a player’s mental state

Using the longitudinal Socratic axiological tradition, one can consider every uncertain situation as satisfying or good for one person and at the same time not satisfying or bad for another. Extreme cases of various contingencies, such as military combat or mortal fighting, can cause joy and pleasure resulting from uncertainty, fear, and threat, or such activities can cause a mental state of fright, paralysis, and aversion. Many philosophical and psychological sources describe play in terms of good (e.g. happiness and amusement), although it can be illustrated that it is more complicated. The mental state of being totally involved in the good of playing is discussed by Csikszentmihalyi (1975, 1997) as a notion of being in the flow. While the flow is defined as a peak experience entailing inspiration and control of the situation, this approach was developed and changed by Csikszentmihalyi during 25 years of experience. In the first publication dedicated to flow, six elements of flow experience as the mental state of playing were distinguished – a merging of action and awareness, a centring of attention on a limited stimulus field, a loss of self-consciousness during play, control of actions and environment, unambiguous feedback on a person’s actions, and the autotelic nature of actions (Csikszentmihalyi, 1975: 38–48). In a later version of flow, a distinction was made between the states of control and flow (Csikszentmihalyi, 1997: 31). This later interpretation of flow opens the opportunity to consider flow as a mental state of inspired loss of self-consciousness during play. According to Csikszentmihalyi, the mental state of play is subjective and depends on the level of uncertainty in a given situation. If the task given to a player is too hard, the mental state tends to anxiety, whereas if it is too easy, the mental state veers towards boredom. In both cases, play as a mental state does not exist.
One can note that the uncertainty of playing is not demarcated only by vagueness about the opponent, conflict duration, result, or current mental state. Play of any kind, even non-competitive, is uncertain because of its double message. Huizinga (1955: 13) noted this phenomenon ‘standing quite consciously outside “ordinary” life as being “not serious”’ and thus having, in our opinion, a double message. On the other hand, Bateson’s (1955) double or meta message for ‘this is play’, regarding the fighting-playing of cubs, could, according to Handelman (1990: 71), ‘be rewritten and rendered as “This is uncertainty”.’ These notions are developed and transformed into a significant dilemma in modern sports philosophy through a discussion of play as an activity versus a stance or an attitude towards the activity. Since the 1970s, a series of sports philosophers have considered play as a kind of attitude towards reality. Schneider (2001) criticized views of Suits (1988) and Meier (1989), who both discussed the issue of autotelicity–instrumentality of play as a kind of activity. Suits (2004) sharply scrutinized Schneider’s view of play as a stance of mind, but, in fact, accepted some of her positions. All advocates of this view argue that any kind of human activity can become play, and this is dependent only on the human stance towards it (Garvey, 1991; Rieber, 1996; Roochnik, 1975). The mechanism of taking such a stance of mind towards the external reality in which one is involved is the temporary relocation, making-believe, or transcendentness of an activity.

It appears then that team sports can constitute a clear instance of both presence and absence of the stance of play in athletes. It is absent when an atmosphere of ‘must’ and hard work is disseminated within a team by the coaches and leading athletes. Being within a frame of ‘must’, athletes work hard until the end of the game, but their performance is different from true playing, as suggested in the observation that ‘the best player can do this playfully, that is, an easy joyful expression of herself’ (Howe, 2007: 54).

Taking the above elements together, one can propose three uncertain origins for the complexity of play. Play occurs when a possible failure in the activity creates a challenge and an intrigue, the latter of which influences motivation and forms the mental play-state and play attitude towards a game. This is the case analysed by Suits (2004) as an action and a mode of action together. Finally, if only one side of this ‘challenge–state–stance’ triangle (Figure 7.2) is removed, play does not occur.

Implications of the above description for performance analysis can be suggested. One of the leaders of modern sports philosophy, Kretchmar, speaks of unbalanced fixed-time games or parts of games in which certain moments of a game cease to be interesting (i.e. they cease to be play) because one of the competing sides has an obvious advantage (Kretchmar, 2005). One interpretation of this approach can be that such uninteresting periods of games lack uncertainty. Thus, the performance demonstrated during such periods is not true. It is a weak indication of a team’s ability to compete in balanced games and to provide performances during long-term competition composed of a series of games. If this philosophical discussion of the essence of playing itself can be applied, one might suggest that unbalanced games and periods of games be excluded from performance analysis.

**Team performance in direct competition with opponents from a complex viewpoint**

Complexity views could influence performance analysis in team games, first of all, in the interpretation of the nature of the opponents’ counteractions. Certainly an opponent is the most influential factor in terms of performance duration and outcome. Three approaches to the issue
can be distinguished from the methodological viewpoint of complexity: the dynamical systems approach, the ecological approach, and the complex systems contest approach.

The first approach to competitive playing through a dynamical systems vision was developed during the first decade of this millennium (Lames, 1998; McGarry et al., 2002). From the unanimity of ideas presented in most of the publications on the subject, one can generalize a list of main characteristics. First, the game itself is a dynamical system (Glazier, 2010; Lames, 2006; Lames and McGarry, 2007; McGarry et al., 2002). Second, both sides (opponents) constitute components of the dynamical system (e.g. players and/or teams) that oscillate in tandem as they interact during a game (Bourbousson et al., 2010; McGarry and Franks, 2007). Third, any of the components can push the system into a zone of instability or, in other terminology, to a phase of non-equilibrium. Here, ‘perturbation’ is a key category symbolizing a critical moment in the process of destabilization (Hughes et al., 1998; McGarry and Franks, 1995; Reed and Hughes, 2006). Based on these key points, one has to interpret goal scoring as a destruction of the system caused by a previous perturbation. This approach seems an important attempt to perceive competing sides in individual and team sports through a complexity prism. However, it can be evaluated ambivalently. So, the notion of human competitive playing at the level of coupled oscillation within a system makes the approach reactive, in my view, as the order parameter describing the coupling behaviours plays a passive reactive role, with its dynamics emerging only to save the balance of the system. Such a dynamical systems perspective applies for brain–motor control (Haken et al., 1985; Kelso, 1995), but it is not enough for a complexity vision at the level of playing human persons having free will and his/her own emergent dynamics. Another essential problem for this approach, in my assessment, concerns relation to the environment, which is an important element for understanding complexity in general and complexity of competitive play in particular. If both competing sides are levels of the same system game, then what is the environment of such a system? For additional considerations and debate on these points, the reader is referred to Lebed (2003, 2006, 2007) and McGarry and Franks (2007).

Despite using dynamical systems rhetoric, the ecological approach to sports performance analysis especially emphasizes the issue of environment, a rather ambiguous concept in the preceding approach. The view discussed here (Araújo et al., 2006; Araújo and Davids, 2009) is based mostly on the Gibsonian version of ecological psychology (Gibson, 1979). In short, this approach claims that humans in action are in systematic perception–action relations with the environment, with conditions and constraints affecting decision making and acting. At the same time, this doctrine claims that an action is always a function of three interacting constraining factors: environment, task, and organism (Newell, 1986). From a complexity point of view, this relation does not contradict the main principles of complex systems emergent behaviour (Dimitrov, 2005; Varela et al., 1974), that of self-dynamics, coupled interaction with the environment, and growth-from-within. However, the notion of self-constraints (individual constraints) may be associated negatively with the self-dynamics usually connected to creation and not only adaptation. Regarding self-constraints, Glazier and Davids (2009) raise Newell’s notion of ‘organismic constraints’ to the level of ‘specific individual constraints’, but it is still not enough in comparison to the principle of proactiveness provided by other scholars for socially created persons acting within an environment (Nitsch, 2009; Vygotsky, 1978). Finally, because of its adaptive tone on one hand and the vision of a playing subject as an independent system on the other, the ecological psychology approach to complexity vision of competitive playing may be situated in the middle of the reactiveness–proactiveness scale, and this makes it a rather balanced approach between traditional and complex methodologies of human performance research in team sports.
When comparing both dynamical systems and ecological approaches with the complex systems’ contest model suggested by Lebed (2006, 2007, 2008), we see that the latter approach has adopted some of the important elements from each and has left out those that seemed debatable (Figure 7.3). Specifically, the dynamical systems approach enriched the proposed model of two contesting complex systems by the notion of perturbation. The importance of perturbations that lead to scoring in a game is widely comprehended as a main tool of performance analysis of team play (Reed and Hughes, 2006). But the principle of mutual proactiveness of both complex systems demands a broadening of our understanding of perturbation to include not only offensive acts (Hughes et al., 1998) but defensive activity as well. The defence-created perturbation is a most powerful weapon for destroying attacks. The efficacy of defence perturbations was illustrated by Holland’s ‘total football’ back in the 1970s: ‘The game . . . was about space and how you controlled it: make the pitch big when you have the ball . . . make it small when you do not and it becomes far more difficult for the opposition to keep it’ (Wilson, 2008: 218). The total control of space in defence, when, at least, two players surround an attacker possessing a ball, is a brief example of proactiveness creating perturbations in defence. The ecological psychology contribution to competing complex systems (teams) creates a central place for environmental factors and, as such, forms a relation with this model. In the complex systems’ contest view, each team in a contest is part of a menacing environment for the other team. However, as we have seen, not all environmental influences are constraints and menaces; some of them are supports instead. Thus we take one more step and claim that the playing team is backed by supporting forces because it is included in an entire hierarchy of higher-level complex systems of a sports institution. In this way, we come to the notion of structural complexity in team sports.

Structural complexity of competitive game playing

Epigraphs have not been attached to each part of this chapter, but an appropriate one for this section would be: ‘. . . new properties emerge at every level of organization, which are not predictable from lower levels in principle’ (Kelso and Engstrom, 2006: 80).

![Figure 7.3](image-url) Three approaches to a complexity vision of competition in team sports: (a) player coupled oscillations within a dynamical system ’game’; (b) a team’s ’ecological’ systematic interaction with environmental constraints, one of which is an opponent; and (c) mutually proactive contest of two complex systems surrounded by environmental supports and constraints
Our analysis of complex systems in the field of team sports investigates the following basic notions (Lebed, 2005, 2006, 2007). First, a player (i.e. a single athlete and/or a team) and a sports institution are complex systems acting in institutionalized games. Second, the complex systems in team sports should be comprehended as a three-level hierarchy – athlete, team, and sports institution, which can be functionally interpreted as skilful and/or powerful movements, playing, and control and managing processes. Third, this hierarchy is expressed not only by levels of human organization, but also by synergetic interaction (flows) between levels. Each of the levels is supported and regulated by a higher one, providing needed flows of energy and/or information.

This case demands a special definition, ‘a hybrid complex system’ (Bar-Yam, 1997). It is hybrid because it acts both by its own internal self-organization and by external control by virtue of it being within a hierarchy. The hierarchical structure represents a command control, whereas self-organization indicates emergence of a network structure. The hybrid systems approach promotes an additional form of complex regulation. Because the internal self-organization must be synergized with the external control, one has to use a new approach that we call regulation of equifinality. By this we mean a professional intervention utilizing soft control that directs the self-organization of a human complex system from the outside and causes it to achieve a mutually agreed target in its own way.

The competition of athletes joined within a team creates a level of complexity that necessitates supervision by professional managing, coaching, and physical training, supervision that is carried out by a coach designated for this role by the sports institution. In elite team sports, the high level of complexity is higher yet. Therefore, this function is performed by a coaching team and managing staff, each of which incidentally has its own complexity, dynamics, and hierarchy. Thus, studies of complexity in team sports and performance analysis must relate to the entire hybrid complex system, which consists of a hierarchical connection of five sub-systems as follows: (1) the athlete as a bodily movement dynamical system. Motion and biomechanical performance analysis are tools for professional diagnostics on this level; (2) the athlete as a person, both playing with and against others and having a rich world of internal mentally and socially related dynamics. Notational quantitative and qualitative analysis, as well as psychological diagnostics, are the tools on this level; (3) the team as a domain. Notational quantitative and qualitative analysis, and socio-psychological diagnostics, serve as tools for this level; (4) the coaching team. Coach behaviour analysis, socio-psychological dynamics, and self-reports can be tools for professional diagnostics on this level; (5) the sports institution represented by the managing team and staff. This level is usually excluded from the field of performance analysis. In light of the model of structural complexity in team games suggested here, however, this issue should be a topic for future research.

**Concluding remarks**

Complex human systems are usually managed by ignoring their infinite openness towards diverse environments, intrinsic drives, and the variable relationships between the two. In this way, one is often surprised by inadequate reactions and behaviours of subalterns. In the frame of traditional systems theory, unexpected or inadequate feedback or responses cannot be accepted as normal. Hence, the axiomatic predictability of controlled behaviour stands as an obstacle to the complexity approach, which holds that unexpected responses are possible and even reflect a normal state of complex system functioning. The complexity sciences treat the unexpected as independent. This approach challenges the traditional scientific vision as well as traditional performance analysis. This chapter presented an attempt to reconceptualize this vision and offered three main conclusions.
First, the parameters of playing provided by performance analysis are not exactly feedback or responses to coaches that reflect the quality and intensity of preparation. These parameters are output that conceal extensive information and are only linked tangentially to a controlled system’s input. This is because a team as a complex system has its own dynamics created both by playing against an opponent and by additional (non-playing) social, motivational, and other stressor influences. Note that a team’s self-dynamics are quite independent from the environment. This independence characterizes a complex system’s emergent behaviour and is also a cause of a team’s possible grown-from-within proactive activity. As indicated through the term and process of perturbation, the episodes of clearly diagnosed proactive activity might be an essential display of successful performance.

Second, playing has its own complexity expressed through uncertainty and unpredictability. Understood in this way, complexity makes it possible to distinguish between just competing and truly playing. The latter is not obligatory during a match and this demands answers from performance analysis procedures. As a first step in this direction, these procedures should exclude from its computations and analysis clearly unbalanced games and parts of games where playing itself, as it can be understood from Kretchmar (2005), simply does not occur.

And third, the sports team is a unit within a sports institution. It cannot escape the influence of managing dynamics coming down from higher levels of the institute’s hierarchy. Thus complex, all-enveloping performance analysis must include the managing and coaching level’s performances as they are connected to and influence a team’s competitive playing. Complex diagnostics, real-time notational analysis, and pre- and post-time quantitative and qualitative analysis (Franks, 1997; O’Donoghue, 2010) might give a fuller picture and bring more adequate answers in future about a team’s performance as viewed through the complexity approach to playing in team sports.

References


85