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Creating germane knowledge in dynamic environments

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Abstract: Today's dynamic business environment requires germane knowledge to ensure that organisations are prepared for the future and ready to meet sudden challenges. At present, knowledge creation techniques tend to focus on either human or technology aspects of organisational development. However, the complexity of a global business environment necessitates transformational rather than linear development of knowledge that is centred on a broad-based (holistic) knowledge creation approach. The paper discusses the concept of knowledge creation that underscores the significance of nonlinear, interdomain thinking based on fast extraction and processing of information derived from a rapidly changing operational environment.

Keywords: tacit knowledge; explicit knowledge; germane knowledge; knowledge spiral; knowledge creation; Knowledge Management (KM); OODA loop; competitive advantage; Information and Communications Technology (ICT); business management.

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1 Introduction

> "Problems cannot be solved at the same level of awareness that created them."
> (Albert Einstein)

Knowledge is now considered to be central to organisational performance, and integral to the attainment of a sustainable competitive advantage (Davenport and Grover, 2001; Drucker, 1993). The rapidly evolving field of Knowledge Management (KM) provides tools necessary for the enhancement of the efficiency of core business processes and for the support of continuous innovation that are the essential ingredients of competitive superiority.

The way knowledge is created has a very important bearing on all subsequent steps of the KM process. Unsurprisingly, a lot of attention has been devoted to the manner in which knowledge is generated (Davenport and Grover, 2001; Wickramasinghe, 2003; Markus, 2001; Alavi and Leidner, 2001; Wickramasinghe and Lichtenstein, 2005; Wickramasinghe, 2005; Schultze and Leidner, 2002; Mentzas, 2004; Wickramasinghe and Sharma, 2004a; Paiva, 2004). While different conceptual frameworks exist for explaining knowledge creation, they tend to view the process in a specific and potentially constraining perspective (Wickramasinghe, 2005; Mentzas, 2004; Wickramasinghe and Sharma, 2004a; Paiva, 2004) of either people-oriented (Nonaka and Nishiguchi, 2001; Nonaka, 1994; Newell *et al.*, 2002), or technology-based context (*e.g.*, KDD – Knowledge Discovery in Databases, see (Fayyad et al., 1996; Holsapple and Joshi, 2002; Choi, and Lee, 2003; Chung and Gray, 1999; Becerra-Fernandez and Sabherwal, 2001; Award and Ghaziri, 2004; Cabena, et al., 1998; Bendoly, 2003; Adriaans and Zantinge, 1996). However, with the increasing intensity of influence by factors that, until recently, had no impact on traditional business transactions (*e.g.*, emergence of protectionist economies, terrorism, global disease threats, *etc*.), a new holistic approach to knowledge creation is required in order to provide a more flexible instrument for interaction with the increased dynamics of the business environment.

2 Knowledge creation

In most general terms, Knowledge Management (KM) involves four key steps (Table 1, see Davenport and Grover, 2001; Markus, 2001; Alavi and Leidner, 2001; Wickramasinghe and Lichtenstein, 2005; Wickramasinghe, 2005; Schultze and Leidner, 2002; Yen *et al.*, 2004). With knowledge creation constituting the first step, the quality of inputs will also determine the quality of the output (Schultze and Leidner, 2002), *i.e.*, the generated knowledge. Given the continuous and tightly interrelated nature of these steps, the entire process of knowledge creation continues to attract a lot of attention (Davenport and Grover, 2001; Wickramasinghe, 2003; Markus, 2001; Alavi and Leidner, 2001; Wickramasinghe, 2005; Schultze and Leidner, 2002).

Table 1 Key steps involved in knowledge management

Key step	*Description*
Create/generate knowledge	Starting point in the organisational knowledge cycle ▪ Involves both the capture of existing knowledge as well as the creating of new knowledge
Store knowledge	In order for knowledge to be used it must be represented and stored ▪ Involves development of knowledge cartographies of where what knowledge is stored
Access/use/reuse	The main purpose for knowledge is to be applied to specific organisational situations ▪ Involves the updating of knowledge as new scenarios arise
Transfer/disseminate	Ensures that all areas of the organisation have the same knowledge about how to address a particular problem ▪ Especially important for large global organisations

In the recent past, two conceptual mainstreams of thought emerged that describe knowledge creation either as a: people- or technology-centric process (Wickramasinghe, 2005). The former is represented by different models (Wickramasinghe, 2005; Newell *et al.*, 2002 and Table 2), while the latter has a more monolithic nature. Although the detailed description of these models goes beyond the scope of the paper, their principal attributes are given in Table 2.

People-centric Nonaka's knowledge spiral (Nonaka and Nishiguchi, 2001; Nonaka, 1994) is the most widely used framework for knowledge creation. It employs ideas of Polyani (1958;1966 Award and Ghaziri, 2004), and views knowledge as an object existing in two forms of explicit or factual knowledge (*i.e.*, 'know-what') and tacit or experiential one (*i.e.*, 'know – how') (Wickramasinghe, 2003; Malhotra, 2000). Nonaka's model underscores the dynamic nature of knowledge (Nonaka and Nishiguchi, 2001; Nonaka, 1994; Newell *et al.*, 2002), and the continuous conversion of the existing tacit knowledge into new explicit knowledge and vice versa, *i.e.*, 'knowledge spiral' (Nonaka and Nishiguchi, 2001; Nonaka, 1994).

Nonaka identifies four principal conversion forms (Nonaka, 1994):

1. *Socialisation* (tacit to tacit knowledge) – usually occurs through apprenticeship type relations where the teacher or master passes on the skill to the apprentice.
2. *Combination* (explicit to explicit knowledge) – formal learning of facts.
3. *Externalisation* (tacit to explicit knowledge) – articulation of nuances.
4. *Internalisation* (explicit to tacit knowledge) – associating newly acquired facts to enrich one's pre-existing expertise and skills.

Table 2 People centric perspectives of knowledge creation

Theory	*Explanation of knowledge creation*
Nonaka's knowledge spiral (Nonaka and Nishiguchi, 2001; Nonaka, 1994)	Two types of knowledge ▪ Tacit ▪ Explicit Creation of knowledge results by spiraling between four main conversions of transforming ▪ Extant explicit knowledge to new explicit knowledge (transformation) ▪ Extant tacit knowledge into new tacit knowledge (socialisation) ▪ Extant explicit knowledge into new tacit knowledge (internalisation) ▪ Extant tacit knowledge into new explicit knowledge (externalisation)
Spender (Newell *et al.*, 2002)	Two types of knowledge ▪ Explicit ▪ Implicit (similar to tacit as described by Nonaka) Two levels of knowledge creation ▪ Individual ▪ Social
Blackler (Newell *et al.*, 2002)	Five types of 'physiological' forms of knowledge that make up a continuum of knowledge types ▪ Encoded (similar to explicit) ▪ Embedded (combination of explicit and tacit/implicit) ▪ Embodied (combination of explicit and tacit/implicit) ▪ Encultured (combination of explicit and tacit/implicit) ▪ Embrained (similar to tacit/implicit)

People-centric Spender's model recognises the existence of both explicit and implicit knowledge in both an individual and social sense (Newell *et al.*, 2002). Spender's definition of implicit knowledge corresponds well with Nonaka's tacit knowledge (although Nonaka does not differentiate between individual and social dimensions of knowledge (Nonaka, 1994)).

People-centric Blackler's approach (Newell *et al.*, 2002) emphasises the fact that knowledge can exist in several, almost 'physiological' forms (encoded, embedded, embodied, encultured and/or embrained) that span the continuum of tacit (embrained) to explicit (encoded) knowledge. The embedded, embodied and encultured types of knowledge exhibit varying degrees of tacit (implicit)/explicit combination and serve, essentially, as the transitional links between the two extremes. A very important derivative of Blackler's analysis that highlights the connection between knowledge and organisational processes is the clear indication of different organisational types requiring different types of knowledge (Newell *et al.*, 2002).

Technology-centric approach derives new knowledge using 'mechanistic' methods such as Knowledge Discovery in Databases (KDD – data mining is probably the most commonly employed method). KDD focuses on how data are transformed into knowledge by identifying valid, novel, potentially useful, and ultimately understandable patterns within data sets that would remain opaque without purposeful extraction and analysis (Wickramasinghe, 2005; Adriaans and Zantinge, 1996; Cabena *et al.*, 1998; Bendoly, 2003; Fayyad *et al.*, 1996; Holsapple and Joshi, 2002; Choi and Lee, 2003; Chung and Gray, 1999; Becerra-Fernandez and Sabherwal, 2001). Consequently, KDD-based creation of knowledge is based on providing common (superior) structure to often widely dispersed data sets.

Process-centric approach is the latest adjunct to the two methods described above. Process-centric concept of knowledge creation is based on a widely used (Barnett, 2004) notion of domain destruction and creation proposed by Boyd (1976–2002). Contrary to either people- or technology-centric models, the process-centric concept is based on destructuring pre-existing domains, selection of their relevant components, then recombining these components into an entirely new domain relevant to the activities within the changed environment. The fundamental assumptions of the process-centric model are based on quantitative physics and mathematical analysis (Boyd, 1976–2002), but the model also incorporates both people- and technology-centric concepts.

The pivotal notion of all models of knowledge creation is the demand that the generated product, usable knowledge, remains the paramount concern to any organisation, be it a small business or a nation-state.

3 Limitations of the current process of knowledge creation

Theoretically at least, the primary reason for any organisation to implement a knowledge management initiative is its need to gain a sustainable competitive advantage (asymmetric advantage) within its sphere of operations (action space – see Davenport and Grover, 2001; Drucker, 1993; Alavi and Leidner, 2001; Malhotra, 2000). All being equal, advantage asymmetry is attained through the uncompromised access to idiosyncratic resources (Grant, 1991). Within an organisation, knowledge is one of such resources and, particularly in hyper-competitive environments, constitutes the critical asset allowing sustainment of the competitive asymmetry (advantage) (Alavi and Leidner, 1999; Davenport and Prusak, 1998; Zack, 1999; Kanter, 1999).

Despite theoretical considerations supporting the competitive value of knowledge, recent reviews of literature (Schultze and Leidner, 2002; Massey *et al.*, 2002) point out the paucity of successfully developed and implemented KM initiatives. While different solutions to the problem have been offered (Alavi and Leidner, 1999; Chang Lee *et al.*, 2005; Shin, 2004), all authors call for increased rigor in the use of information technologies as the conduit for meaningful KM operations. Yet, before any attempt at the incorporation of mere or more elaborate technologies is made, the process of knowledge creation itself needs a much closer scrutiny.

Examination of the existing models of knowledge creation indicates apparent incompatibility of people- versus technology-centric models (Wickramasinghe and Lichtenstein, 2005; Wickramasinghe, 2005). Although the process-centric model appears to incorporate the two other concepts, it also requires the existence of an external force ('observer') capable of objective selection of domain-centred objects and their realignment into another, superior and meaningful entity (Boyd, 1976–2002). As a solution, it has been suggested that a much broader approach to KM may provide the necessary conceptual bridge to unify currently incompatible theories of knowledge creation (Wickramasinghe and Lichtenstein, 2005; Wickramasinghe, 2005).

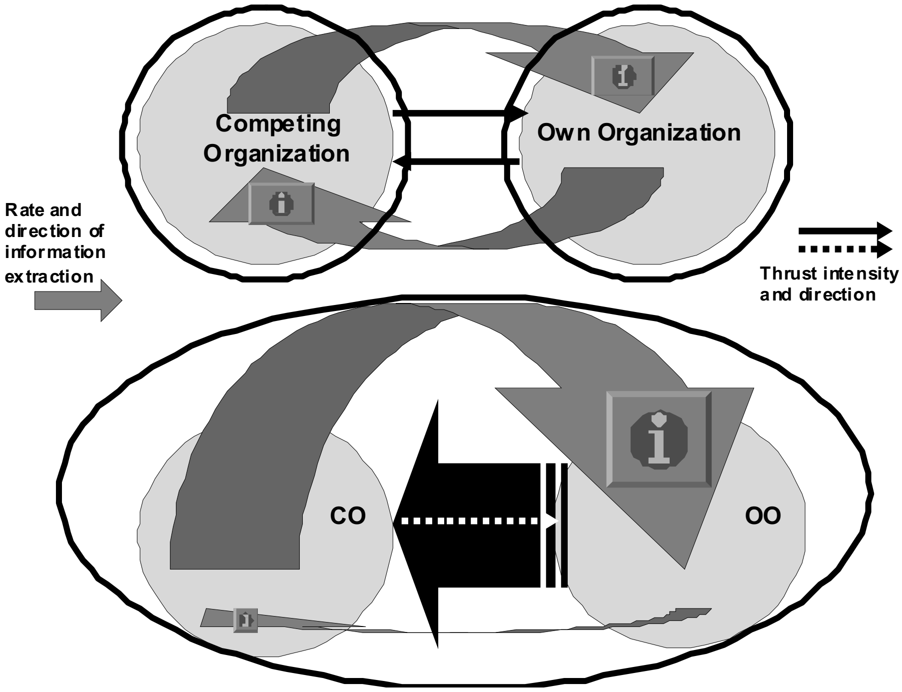
4 Knowledge generation in dynamic and unpredictable environments

Hierarchically, gathering of information precedes transformation of information into useable knowledge (Alberthal, 1995; Courtney, 2001). Hence, the rate of information collection and the quality of the collected information will have, as already pointed out, major impact on the quality (usefulness) of the generated knowledge (Brown and Duguid, 2002).

During the past 20 years, the world of business changed, and its prior West-dominated stability transformed into the present volatile environment of political, economical and social tensions (Barnett, 2004; Chua, 2004). While the laws of supply and demand are still the foundation of global economy, the concept of competitiveness left the traditional boundaries of 'better, cheaper, faster', and must now also include the profound sense of global awareness and sensitivity to factors that once have been considered as minor or even inconsequential (*e.g.*, emergence of dominant ethnic minorities; see Chua, 2004). The new environment of global business generates and, in order to be successful, requires vast quantities of multispectral data from sources as divergent (and seemingly irrelevant) as geography and the nature of local religions (Barnett, 2004; Chua, 2004). In order to be meaningful, the widely dispersed and apparently disconnected (or irrelevant) data must be processed into coherent information. The latter must then be rapidly converted into a knowledge-base that, in turn, serves as the foundation for the purposeful and flexible rule-set that allows goal-oriented interactions with the environment within which business transactions are conducted (*e.g.*, Drucker, 1993; Schultze and Leidner, 2002; Bendoly, 2003; Malhotra, 2000; Zack, 1999; Courtney, 2001; Wigg, 1993).

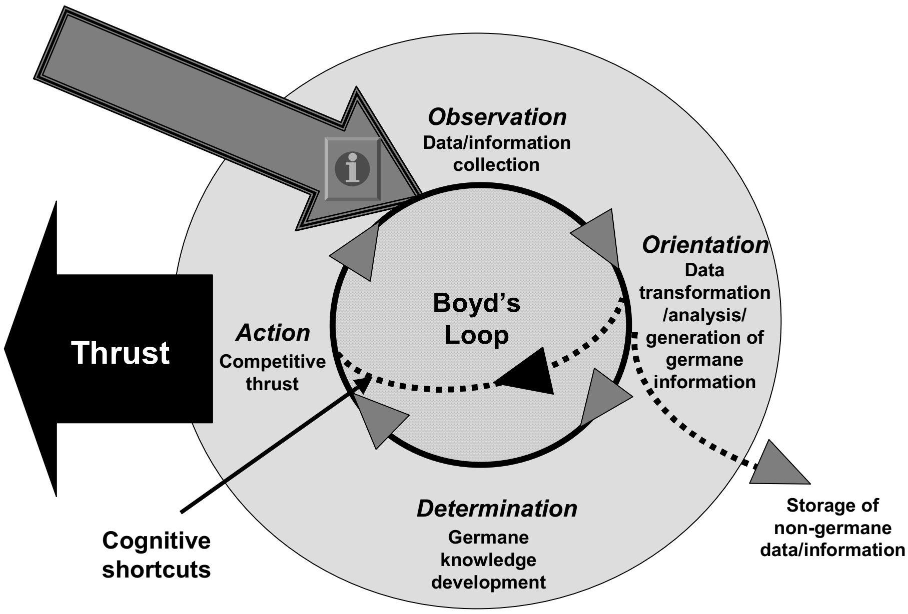
In the dynamic and, to a large degree, unpredictable world of global business, 'action space awareness' (or synonymous 'competitive space awareness') and information superiority (Alberts *et al.*, 2000) became the key factors to all successful operations (Figures 1 to 3).

Figure 1 Information superiority enhances competitive thrust



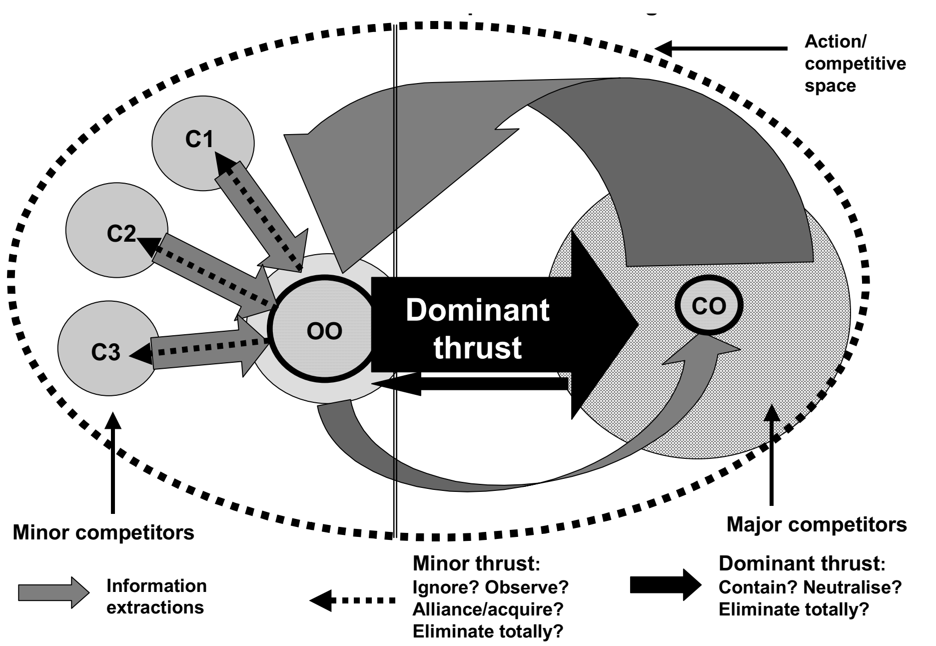
Information superiority is one of the essential elements of competitive advantage. Information superiority depends both on the rate of extraction and on the quality of extracted information (cumulatively depicted as the size of block arrows). Attainment of information superiority is critical for the development and strength of the competitive thrust. In the upper diagram both competitors have the same extraction rate/quality. Hence, the intensity of their mutual competitive interaction is the same, and both organisations remain in equilibrium, sharing the same 'action space'. As long as either organisation occupies its own, well-defined niche (black circle) within the space, their existence is mutually non-threatening. However, when the niches overlap (black oval, lower figure) the organisation with a faster extraction rate and higher quality information will generate much greater intensity of the competitive thrust, enhancing the chances of its successful survival compared to those of the competitor.

Figure 2 Information extraction, germane knowledge and competitive thrust



Development of competitive advantage has many aspects similar to classical warfare. One of these is 'action space awareness' (or competitive space awareness). Action space awareness is attained through the extraction of multispectral information from *all available resources*. The competence of KM operations within the organisation (denoted by the size of the inner, bold circle) is critical in this process, since generation of germane knowledge is contingent on these operations. Rapid, continuous extraction of high quality information from a multiplicity of sources (*i.e.*, multispectral sources, many of which may not be among the most obvious ones) helps to determine the nature of the existing threats and the priority of addressing them. Action space awareness is essential in the identification of sources of competition, their classification (minor and major threats), and the development of appropriate and flexible threat interaction policies and counteraction strategies. Action space awareness allows economy in the allocation of competitive resources (sufficient to contain threats posed by minor competitors and concentration of force aimed at the major ones), and the development of superiority of force needed to interact with the major competitors. High efficiency of own KM operations (OO) will sustain advantage even when the competitor (CO) is a much larger but with less effective KM organisation.

Figure 3 Action/competitive space awareness, economy of resources and competitive advantage

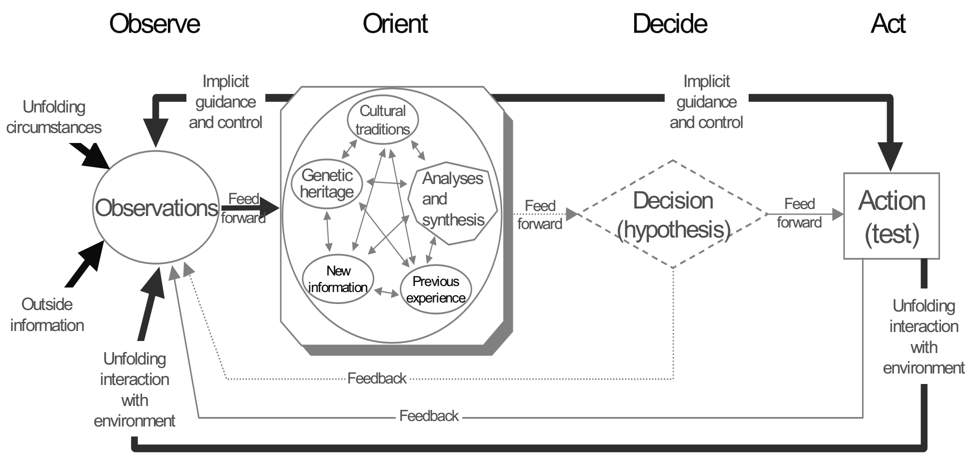


Boyd's loop governs the process of information extraction, generation of germane knowledge, and the development of competitive thrust. Loop-centred KM operations allow continuous monitoring of the action space, identification of present and potential threats, generation of germane knowledge necessary for their containment, and formulation of actions required to sustain competitive advantage. Factors such as experience, access to additional sources of information, or intuitive prediction of the opponent's strategies allow the elimination of some stages of the loop (cognitive shortcuts) thereby increasing the speed of its revolutions. KM organisation whose loop revolves faster is the winning one, thereby improving the competitive advantage its parent company holds in the action space.

Network-centric operations have been suggested as the most efficient means of reaching the state of information superiority and action space awareness (Alberts *et al.*, 2000), and a healthcare-related modification of this concept has been recently proposed in order to address the issues of critical (often life-saving) access to, and flow of information within the entire spectrum of healthcare operations (von Lubitz and Wickramasinghe, 2005a). The cornerstone of network-centric philosophy is the OODA loop (Figure 4) that provides formalised analysis of the processes involved in the development of a superior strategy (Boyd, 1976–2002; von Lubitz *et al.*, 2004a; Boyd, 1987). Both OODA loop and the network-centric concept of operations found widespread practical applications in business, medicine, warfare, *etc.* (Boyd, 1976–2002; von Lubitz *et al.*, 2004a; Boyd, 1987).

The loop is based on a cycle of four interrelated stages revolving in time and space: Observation followed by Orientation, then by Decision, and finally Action. At the Observation and Orientation stages, multispectral implicit and explicit inputs are gathered (Observation) and converted into coherent information (Orientation). The latter determines the sequential Determination (knowledge generation) and Action (practical implementation of knowledge) steps. The outcome of the latter affects, in turn, the character of the starting point (Observation) of the next revolution in the forward progression of the rolling loop. The Orientation stage specifies the characteristics and the nature of the 'centre of thrust' at which the effort is to concentrate during the Determination and Action stages. Hence, the loop implicitly incorporates the rule of 'economy of force', *i.e.*, the requirement that only minimum but adequate (containment) effort is applied to insignificant aspects of competitive interaction. The loop exists as a network of simultaneous and intertwined events that characterise the multidimensional action space (competition space), and both influence and are influenced by the actor (*e.g.*, an organisation) at the centre of the network.

Figure 4 Boyd's OODA LOOP

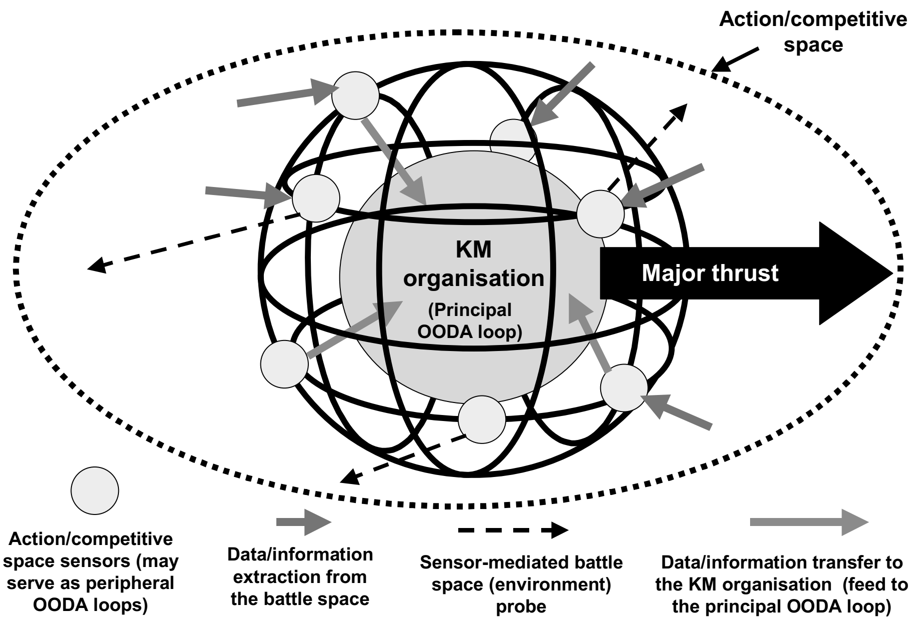


Source: Boyd (1995)

OODA loop as depicted by Boyd. Note that the inputs to the loop derive from a multiplicity of sources, and that the loop is based not only on the active information extraction *from* the environment but also on the active interaction of the observer *with* the environment (Boyd's loop is the source of the 'man in the loop' concept). The faster the speed of loop's revolutions compared to the competitor, the greater competitive advantage ('staying inside the loop' is another commonly used derivative of Boyd's model).

It is the incorporation of the dynamic aspect of the 'action space' that was fundamental to the rapid adaptation of the OODA loop by disciplines characterised by high operational tempo (OPTMEMPO), unpredictable changes within the theatre of operations (action space), and the 'fog of war' (operational uncertainty), *i.e.*, medicine, business, and warfare (*e.g.*, von Lubitz *et al.*, 2004a; Boyd, 1987; Papapdimo, 2003; Leitch, 2004; Knoll *et al.*, 2000; Riachards, 2004; Lind, 1985). In a sense, the multidimensional nature of activities within such fields necessitates transformation of the loop into an OODA sphere (Figure 5) whose speed of revolutions determines both *information superiority development rate* as well as the consequent *rate of germane knowledge generation*. Both have a critical impact on maintaining competitive advantage, particularly within action space occupied by more than two competitors (Figure 3) not only at the national but also (if not predominantly) at the global level of business operations.

Figure 5 OODA sphere



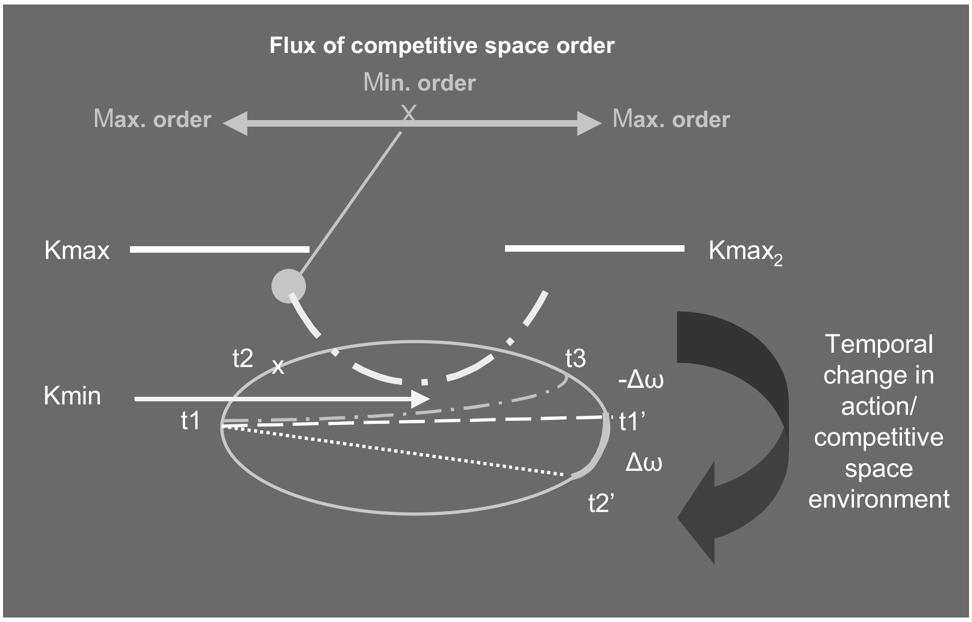
Simultaneous need for interactions with a wide range of entities contained within a complex, rapidly evolving action space transform Boyd's loop into a sphere. Operations of the latter permit space-wide sensing (creating the state of information superiority) and rapid development of space-wide dominance of the current and emerging competitive threats. Located at the centre of the sphere, the KM organisation of own company (the principal OODA loop) receives data/information inputs from a wide variety of peripheral action space sensors ranging from human (*e.g.*, legislature, trade organisations, or customers, trade) to electronic (stock exchanges, databases, or even weather reports). The sensors may also function as peripheral OODA loops that independently sample the local environment (broken arrows) and provide instantaneous response to the local changes (situation seen in the operations of complex, distributed commercial entities, whose individual units such as stores or manufacturing plants respond locally to the environmental fluctuations, and adjust their operations accordingly). The information obtained from a multitude of the peripheral sensors (multispectral information) allows the KM organisation to form a multidimensional view of the competitive (action) space. Incorporation of multispectral information (*e.g.*, social/political/economical trends, action space stability, or potential sources of competition) into the space view provides the foundation for space-wide response to the current and anticipated events (large black arrow). Broad range of peripheral sensors and their capabilities combined with high operational efficiency of the Principal OODA loop (KM organisation) assure enhanced state of 'action space awareness', and the consequent sensitivity and precision of responses to space-wide challenges. Several aspects of the 'China shock', for example, are the result of inadequate sensing of the Far East action space (*e.g.*, US failure to understand the cultural and national values of the Chinese, failure to perceive the highly individual nature and development of the Chinese Communism, failure to anticipate the commercial flexibility of the Chinese Communist Party, failure to perceive warning signals generated by the Sino-Soviet ideological cleft). Lack of information superiority led to the consequent inefficiency of the majority of the US political, economical, and trade KM organisations in generating appropriate germane knowledge necessary to contain the rapidly emerging (but hardly perceived) threat. The resulting loss of action space dominance caused the ultimate failure to anticipate and contain the explosive emergence of Chinese economy as the presently most significant competitive danger to the US economy.

5 Knowledge pendulum, knowledge pendulum, and the unpredictable 'battle space' of business

Generation of knowledge can be a perfectly abstract process (*e.g.*, continuous attempts to refine the value of the π constant, which in the context of purely practical applications may be considered irrelevant). However, interaction with the rapidly changing environment of the modern 'business action space' requires application of knowledge that has immediate and direct relevance to the encountered problem, *i.e.*, *germane knowledge*.

Knowledge is the product of many complex interactions (data collection, transformation into information, information classification and analysis, *etc.* (Alberthal, 1995; Courtney, 2001). Since the execution of each step along the knowledge generation pathway requires a definitive amount of time, it is likely that the product of the pathway (knowledge) may lose its relevance due to the protracted nature of the generating process, and the consequent delay between the demand for knowledge and the time of its application. The error is magnified by the complexity of the environment in which the generated knowledge is to be applied, a fact particularly true of the germane knowledge since it is both context- and time-specific (Figures 6 to 8). Moreover, the process of generating germane knowledge that starts at the same time the challenging event takes place, has a tendency of neglecting the evolution of both the event and the environment in which it takes place. Hence, germane knowledge is generated along a linear trajectory, *i.e.*, based on the assumption that both the event and its environment remain constant despite the passage of time. However, in the unpredictably changing, destabilised environment of the competitive space, the characteristic aspects of such an event may often change rapidly, unpredictably, and drastically, leaving a practically worthless body of knowledge at the hands of the actor within that space. The assumed conditions do not exist, while the new ones, for which the operator is neither ready nor prepared (von Lubitz *et al.*, 2004a), emerge and upset predetermined strategies. A vastly simplified overview of the conflict in Iraq offers a pertinent, recent example of such situation.

Figure 6 Knowledge pendulum

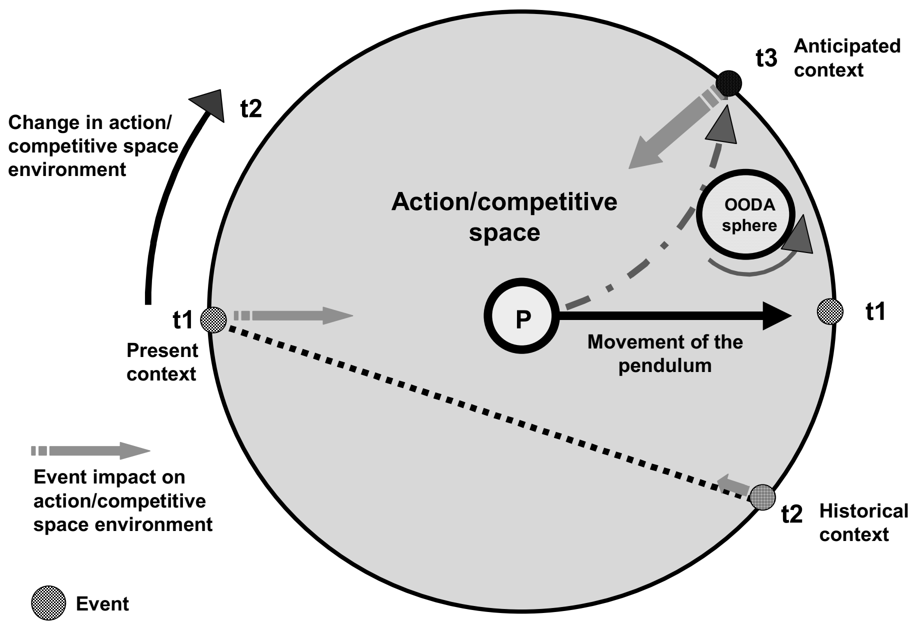


Germane knowledge is generated (or exists) as a response to, and in the specific context of the new challenges posed by the environment (competition space – depicted as the oval). The need to address these challenges provides the principal source of energy (motor) for the generation of the new knowledge. However, a very close relationship exists between these needs and the degree of order (flux) within the competition space. Thus, in the ideal state of maximum order (*e.g.*, a Utopian society) there are no challenges and no need to create new germane knowledge (or, for that matter, any other form of new knowledge). Maximum order prevails at all times (max. order). The state of the available knowledge is also at its maximum (Kmax) and the creative energy of the actors within the competition space (kinetic energy of creation) transforms into latent (potential) energy; there is no 'need for knowing more'.

In reality, random internal pressures within the competition space (*e.g.*, population growth, resource availability, weather changes, *etc.*) will create events that cannot be addressed by the existing knowledge. If such event takes place at time 't_1', it will impact and perturb the existing state of the competition space (indicated by a centre pointing arrow in Figure 7). In order to address these perturbations and their immediate consequences, new knowledge will have to be created. However, the process of creating such knowledge is not instantaneous. It takes time ($\Delta\omega$) during which the environmental context of the original event at time 't_1' to changes ('t_2' – see also Figure 7). The change induces further immediate competitive pressures (indicated in Figure 7 with a centre-pointing arrows) within the competition space and 'ripple effect' pressures (denoted by the rotation arrow). Consequently, at 't_2' the discrepancy between the adequacy of the knowledge existing at 't_1' and its suitability to address the new conditions at 't_2' and thereafter will start to increase rapidly (depicted by the downward movement of the pendulum). At the time the perturbations within the competitive space caused by the mismatch of the need for knowledge and its availability reach their peak (Min. order), the applicability of the available germane knowledge is at its minimum (Kmin). The acute need to re-establish order provides maximum energy for the process of knowledge generation (upward swing of pendulum). However (and quite commonly; see the example of China-generated competitive threat in the legend to Figure 5), the newly generated knowledge (upward swing of the pendulum) instead of being directed at the finally evolved challenge (t_2'), is aimed at the challenge *as it existed at 't_1', i.e.*, at the *original competitive perturbations* caused *at the time the event was perceived at 't_1'*. Hence, the newly generated knowledge is either sub-optimal or entirely unsuitable (Figure 7: 'fighting the last war' approach.) and, as the result, the pendulum will approach $Kmax_2$ asymptotically but never reach it. The entire process will repeat itself.

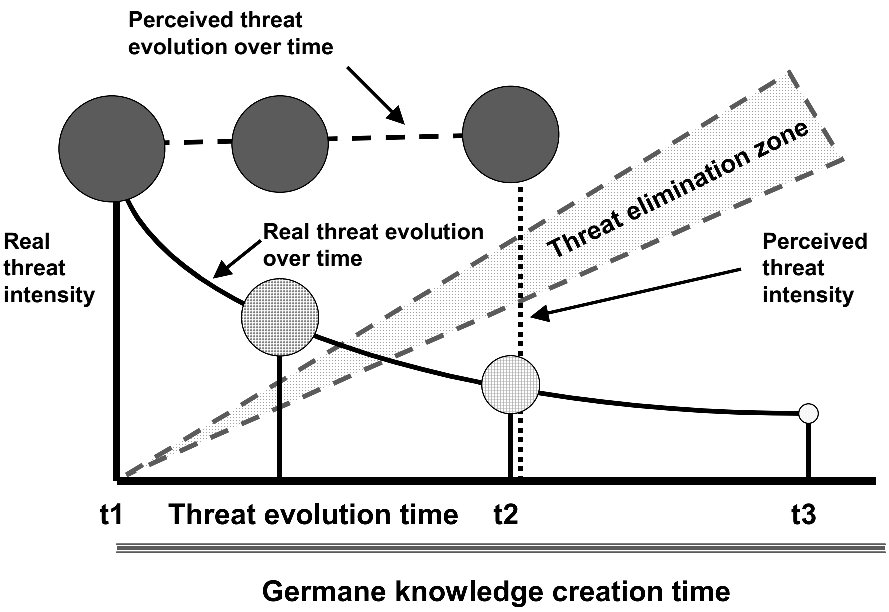
To assure that generation of germane knowledge corresponds to the factual demands existing within the competition space, future events (t_3) must also be taken under consideration. Information superiority and competition space awareness are the essential prerogatives allowing reasonable predictions for the occurrence and nature of such events despite the often chaotic nature of the competition space ('$-\Delta\omega$'). Boyd's loop has been successfully implemented as the essential tool in the development of information superiority and action space awareness necessary for the accelerated acquisition of complete competition space dominance (Figure 8).

Figure 7 Influence of OODA sphere on the movement of the knowledge pendulum



'Aerial' view of the knowledge pendulum over the competitive space and the role of the OODA sphere in controlling the movement of the pendulum. All abbreviations as in Figure 6; the size of broken-tail arrows indicates the strength (width) and the significance (length) of the effect caused by the new event on the competitive space. Note that the germane knowledge whose generation starts at 't_1', is developed under the assumption that the characteristics of the event will not have changed between 't_1' and 't_2', and that the nature of the competition space will have remained constant as well. However, since the event evolved (or its characteristics mutated) over time, the knowledge addresses the problem (stippled line) in its historical rather than the true (evolved) context ('t_2'). Such knowledge will have only minimal (if any) applicability to the challenges posed by the evolved event ('t_3'). Operation of the OODA sphere allows continuous sampling of the competition space and contributes to the development of space awareness. Hence, the involvement of the OODA sphere redirects generation of germane knowledge at the challenges *as they evolve* rather as they have been in the past (lateral shift in the direction of the pendulum swing).

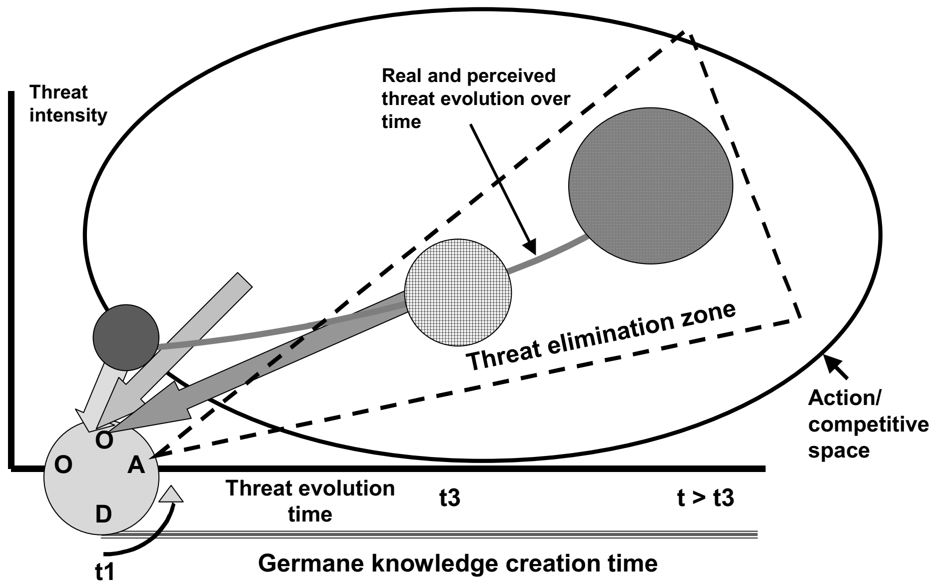
Figure 8 Germane knowledge generation in the absence of OODA loop



Assumption of the unchanged threat characteristics over time (threat constancy) can lead to either waste of resources or a dangerous misdirection of germane knowledge generation. Perception of threat constancy is common when OODA sphere is not involved in the generation of competition space awareness (see the example of Chinese competitive threat given in the legend to Figure 5). In the example shown in the figure, the intensity of the competitive challenge decreases over time. However, the germane knowledge generated between 't_1' and 't_3' is created both under the assumption of threat constancy and under perception that no other threats exist. As a result, the created knowledge misses its target entirely: the effort results in resource waste, frustration of inadequacy, and, as discussed in the text, the ultimate organisational dissatisfaction with the 'failure' of its KM arm to produce results'.

The Coalition command was unprepared for the speed with which the war ended (Franks, 2004). While the oil wells were not blown up by Saddam Hussein's forces (assumed), the 'interregnum' existing between the arrival of Coalition units in Baghdad and establishment of a resemblance of order allowed for regrouping of Ba'athist sympathisers and influx of foreign extremist fighters (unpredicted delay in constituting new government of Iraq). The quick rebuilding of Iraqi infrastructure and return to stability (assumed condition for which germane knowledge was developed prior to the outbreak of hostilities) failed to materialise (unpredicted). Instead, the country is torn by insurgency, its economy a complete failure, and the expectations for a steady export of Iraqi oil and decrease in soaring prices, slim (unpredicted). While the detailed analysis reasons for the failures of predictions in Iraq is beyond the scope of the paper (although see Barnett, 2004; Richards, 2004), most were based on a domain-centred (predominantly USA) perception of the environment as it seemed to appear prior to the conflict and discounted information from other domains that clearly indicated the existing tensions and inherent instability of that and neighbouring regions (*e.g.*, Barnett, 2004; Chua, 2004; Timmerman, 2003).

Figure 9 Germane knowledge generation in the absence of OODA loop



Involvement of the OODA sphere in the process of germane knowledge generation may be instrumental in anticipation of threat evolution and mutation (denoted by the change of size and pattern of the threat circle). Operations of the OODA sphere (*i.e.*, an efficient KM arm within the organisation) help to detect the threat and characterise its nature. The sphere continuously samples both the threat environment and the rest of the competition space (denoted by arrows centred on the sphere). Hence, it is instrumental in a timely detection of threat evolution (increase in significance) and mutation (change in nature), and of the effect of these changes on the rest of the competition space. As a result of

OODA sphere operations (enhanced information superiority and action space awareness), the generated germane knowledge is not only adequate to intercept and neutralise the evolved threat but also to eliminate other challenges/dangers that either have emerged or may emerge in the foreseeable future (‘$t > t_3$’). The significance of OODA sphere involvement (in this case known as ‘critical thinking’) is particularly prominent in situations requiring rapid interactions with rapidly changing, unpredictable environments seen, for example, in emergency and trauma medicine, rescue operations, aviation, *etc.*

The rise and fall of the companies based on the electronic (ICT-mediated) conduct of business (‘dot.coms’) in the 1990s provides another example of the validity of the knowledge pendulum concept and the need for generation of germane knowledge that anticipates the future course of events rather than aims at the solution of the present ones.

Despite unprecedented opportunities offered by the rapidly spreading access to- and use of ICT (Information and Telecommunications Technologies), the lack of sustainable business models (Sharma *et al.*, 2002) became one of the principal causes of the fall of several organisations. Many of these organisations concentrated on harnessing technology as the (assumed) mediator of their success (assumed outcome) (Brown and Duguid, 2002) and dismissed the fact that the means were not the goal; business was (McNealy, 2000). The ‘new’ germane knowledge generated to develop and control the technology of doing business in cyberspace failed. Instead, in a most unpredictable manner (or was it?) the environment of ‘cyber battle space’ presented the actors with an ancient challenge of the need for a model of sustained growth; *i.e.*, germane knowledge applicable not only to the immediate present but also the future. There was no such knowledge, and the collapse of the ‘dot.com boom’ was as spectacular as its rise (Brown and Duguid, 2002; Sharma *et al.*, 2002; Affuah and Tucci, 2001; Kalakota and Robinson, 1999).

The two examples illustrate the fundamental trait of germane knowledge: the need to anticipate the requirements for such knowledge and the need for such knowledge to anticipate changes within the action space. After all, it is the germane knowledge that is the best tool in the mitigation of the suddenly emerging uncertainties and competitive threats within that space as those observed during the ‘roaring 1990s’ (Stiglitz, 2003; Wickramasinghe and Sharma, 2004b). Importantly, organisations that managed to survive the collapse of the ‘dot.com era’ and that continue to thrive (*e.g.*, Amazon.com or Ebay.com) understood the key issues of sustainability, *i.e.*, the need to generate germane knowledge with the future-directed thrust.

6 Conclusion

Several authors (Wickramasinghe and Sharma, 2004a; Argote, 1999; Huber, 1991; Argyris, 1982; Argyris and Schon, 1978; March, 1981) have discussed knowledge creation and its connection to organisational learning, noting that through the process of creating knowledge, organisational learning is effected. The latter occurs in a specific context (known as single loop learning) and, when the lessons learnt are subsequently transferred and applied in a different context, the phenomenon of double loop learning results. Double Loop Learning (Argyris, 1982; Argyris and Schon, 1978; March, 1981) differs from Boyd’s loop in the manner that defines the connection between knowledge and learning: the former is grounded in the process of knowledge transfer while the latter centres on a dynamic, unceasing process of transformation of information into knowledge. The differences may relate to the origins of each model, with the Double Loop Learning having theoretical roots (Wickramasinghe and Sharma, 2004a; Argote, 1999; Huber, 1991; Argyris, 1982; Argyris and Schon, 1978; March, 1981) while Boyd's loop emerging from the theory and practice of aerial combat (Coram, 2002). Irrespective of their origin, both models reach the same conclusion: learning is closely associated with the process of knowledge creation, and knowledge creation is contingent on prior learning (Kalakota and Robinson, 1999; Stiglitz, 2003). However, neither learning nor knowledge creation are linear processes since both are affected by random events, and, in similarity to DNA and RNA, subject to evolutionary and haphazard (mutational) pressures.

Creation of knowledge, no matter which model one selects, is an evolutionary process. Competitive pressures have a much shorter life-span, expose inhabitants of the competitive space to much sharper transients, and often demand responses whose speed exceeds that of the normal (evolutionary) process of knowledge creation. In biological terms (of which much is made in the business world (Boland and Tenkasi, 1995)), the key element behind such responses is the desire to survive either by improving one's operational capacity (better 'metabolic rate' through, for example, better use of resources), actions ('flight or fight' approach), or either by seeking another ecological niche or expanding the present one (ecological compensation). However, the time span of biological responses is comparatively long. The cycles characterising business operations are much shorter and frequently governed by a single, cataclysmic event (*e.g.*, almost overnight onset of the Depression in the 1920s or the collapse of the 'dot.com' market.) with long-term repercussions. The chances of survival and its success are thus defined by the speed and appropriateness of reaction, the latter contingent on the rate of germane knowledge generation determined, in turn, by the prevailing state of information superiority. Overall, 'time is of the essence', and it is in this respect that Boyd's loop shows particular strength: it incorporates and accounts for the critical importance of time and time-related dynamics of cognitive processes (von Lubitz and Wickramasinghe, 2005b). It also allows for the multiplicity of cognitive input sources that are essential for the development of information superiority and representation of changing phenomena in the context of a changing environment (Cebrowski and Garstka, 1998; Report to Congress: Network Centric Wardare, 2001). Boyd's loop accounts for the 'fog of war' that other models either do not, or do so to a far lesser extent. It is maybe for these reasons that 'OODA loop thinking' found such applicability in the disciplines where time and uncertainty are regular operational ingredients: medicine (particularly emergency and trauma) and warfare (Coram, 2002; von Lubitz *et al.*, 2003; von Lubitz *et al.*, 2004b).

In summary, germane knowledge is among the most essential 'quick response' tools in the dynamic environment of the competitive space of modern business (in any of its definitions). However, germane knowledge generated under the assumption that its contextual environment will remain constant may be the source of calamity rather than continued success. Germane knowledge must be generated with the close look for the ongoing changes in its contextual environment (competitive space), with a clear view of all events in the context of the future, and how the future will change that context. Three years ago, the context of war in Iraq was different from the continuing military operations today. Yet, it is only now that the Coalition leaders realise that, at the onset of hostilities, they failed to build germane knowledge applicable to the vastly changed context of today: germane knowledge generated in 2001 was projected at 2005 as if, in 2005, nothing had changed and all stayed the same. Nothing did, and thus, germane knowledge that should have been generated then, is developed now, at the immense expense of lives, funds, and escalating dangers. Hopefully, the germane knowledge that is currently developed is created with the understanding of the dynamics involved in that particular competitive space, and encompasses change rather than a defined goal of reaching yet another fixed objective that will change in a year or two (Barnett, 2004).

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