EXPLORING A METHOD TO CREATE MUTUAL UNDERSTANDING OF INTEROPERABILITY AND STANDARDISATION CONCEPTS IN THE DEPARTMENT OF DEFENCE

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ABSTRACT

The political changes in South Africa extended its international obligations by getting actively involved in the social well being of troubled African states. Under the auspices of the United Nations it is manifested by means of peacekeeping operations and other standard international practices. The ability of African Allied forces to train, exercise and operate efficiently, effectively and economically together depends on the interoperability of their operational procedures, doctrine, administration, materiel and technology. This implies that all parties must have the same interpretation of interoperability. This article tries to create a mutual understanding of interoperability in terms of the levels of standardisation by relating it to the concepts of systems, systems hierarchy and systems engineering during their life cycles.

1. Introduction

South Africa's regional conflict-resolution and peace-building efforts commits the South African National Defence Force (SANDF) in alliance with other regional forces to peacekeeping operations. It includes military diplomacy and participation in international and regional defence structures such as the Inter-State Defence and Security Committee (ISDSC) and the Southern African Development Community (SADC). RSA DOD (2003/4:11). It is therefore crucial that capability development should enhance the interoperability between the SANDF and other forces in the sub-region that will ensure effective multinational operations.

The new government's initiatives regarding co-operation with other forces, the accessibility to global markets and the international trend to buy rather than develop equipment encourage armament project managers to think more in terms of interoperability. But do the Minister of Defence, the military strategic planners and project managers really understand the concept of interoperability and what its implications? What do they know about standardisation as an integral part of all the systems in the DOD? Are they familiar with systems and systems hierarchies? At what management level does the DOD management perceive the initiation of standardisation? Is there a common point of departure when explaining the concepts of standardisation to DOD management? What methods of knowledge transfer are available to top management to learn about standardisation?

This research project tries to determine and explore the DOD's knowledge and application level regarding standardisation in the DOD by finding answers to the six questions raised above. It also tries to ascertain what related concepts can be used in a model to promote the understanding and application of standardisation in the military context by linking current standardisation theories and applications with other system elements.

2. Interoperability and Standardisation

The USSR's imposition of undemocratic forms of government and the repression of effective opposition, basic human and civic rights and freedoms in many Central and Eastern European countries as well as elsewhere in the world, lead to the signature of the Brussels Treaty of March 1948 that marked the determination of Western European countries to develop a common defence system and to strengthen the ties between them. NATO (2001: 1-31) Negotiations with the United States and Canada followed on the creation of a single North Atlantic Alliance based on security guarantees and mutual commitments. The North Atlantic Treaty of April 1949 was established within the framework of Article 51 of the United Nations Charter.

The Organisation provides the forums in which they consult together on any issues they may choose to raise and take decisions on political and military matters affecting their security. It provides the structures needed to facilitate consultation and co-operation between them, in political, military and economic as well as scientific and other non-military fields. NATO (2001: 1-31)

One of the key structures that emerged was the NATO Standardisation Organisation (NSO). The NSO's current role is to enhance interoperability in order to contribute to the ability of Alliance forces to train, exercise and operate effectively together, and when appropriate, in the execution of their assigned tasks with forces of partner and/or other nations. It undertook this by initiating, harmonising and co-ordinating standardisation efforts throughout the Alliance and providing support for standardisation activities. NATO (2001: 14-1)

In 1999, NATO's Heads of State and Governments launched a Defence Capabilities Initiative, with the object to improve NATO defence capabilities in future multi-national operations. A special focus was made on improving interoperability among Alliance forces, and where appropriate between Alliance and Partner/other forces. UK Def Stan (2002: 4)

From Chapter 17 of NATO's Handbook NATO (2001:17-1) it is clear that the following aims of NATO and the AU, SADC etc are similar:

- NATO policy is to encourage nations to develop, agree and implement common concepts, doctrines, procedures, criteria and designs to enhance operational effectiveness and improve the efficiency in the use of available military resources.

- Major changes in NATO involving new and more delicate missions, Partnership for Peace (PfP) and enlargement will necessitate clearly defined standardisation parameters and require an appropriate level of standardisation to allow collaborative operations, training and exercises In particular, the identifications and implementation of interoperability objectives for PfP-nations will become increasingly important, likewise the involvement and integration in the standardisation process.

- Through NATO standardisation, Alliance nations will enhance their capability to perform the whole range of Alliance tasks and missions. NATO standardisation also adds a political value as an outward demonstration of cooperation and solidarity.

Reflecting on the fifty years experience of forces working together it will be wise to learn from NATO when designing the African Standby Force Brigades. The idea is not to copy NATO but to start with NATO's established knowledge base as point of departure when developing own African systems. In this context the NATO's definition of interoperability and standardisation is used as the entrance point to establish a South African understanding of the concepts.

In accordance with Alliance policy, national and NATO authorities are encouraged to develop, agree and implement concepts, doctrines, procedures and designs which will enable them to achieve and maintain interoperability. This requires the establishment of the necessary levels of compatibility, interchangeability or commonality in operational procedural, materiel technical and administrative fields. NATO (2001: 1-31)

The definitions of compatibility, interchangeability and commonality used by the International Organisation for Standardisation (ISO) and the United Kingdom MoD are as follows: UK Def Stan (2002: 5)

- Compatibility (lowest level of standardisation): The suitability of products, processes or services for use together under specific conditions to fulfil relevant requirements without causing unacceptable interactions (Units shall function together within operational environment)

- Interchangeability: The suitability of products, processes or services to be used in place of another to fulfil the same requirement (Units can be swapped within operational environment)

- Commonality (highest level of standardisation): Utilization of the same doctrine, procedures or equipment (Units are identical within operational environment)

NATO's definition for standardisation reads: "The development and implementation of concepts, doctrines, procedures and designs in order to achieve and maintain the compatibility, interchangeability or commonality which is necessary to attain the required level of interoperability, or to optimise the use of resources, in the fields of operations, materiel and administration." NATO AAP (2003:4) According to NATO's understanding of interoperability and standardisation, these concepts are interrelated and inseparable. The intensity of interoperability can thus be defined in terms of the levels of standardisation.

The broad goals of standardisation as determined by the UK MOD (1999: 5) are summarised as to:

- Promote improvement in the quality of products (goods), processes and services.

- Promote improvement in the quality of life i.e. safety, health and protection of the environment.

- Promote economies in manufacture through the economic use of materials, energy and human resources.

- Facilitate collaboration and promote conditions for trade.

- Provide a recognised yardstick against which products processes or service performance can be assessed.

- Set out unambiguous technical requirement in a form suitable for reference or quotation for tactual purposes.

Reflecting on these goals it is clear that these could be the goals of any standardisation program in industry, as well as the government and its respective departments such as the military.

Michael Codner (2003:6) confirmed that interoperability could further be analysed by reference to the actors and parties involved. (In the military environment parties are the arms of service and actors their operations commanders). He explained: "There are organisational, behavioural, logistic and technical aspects to joint interoperability. A shift towards joint command and force structures is organisational. The adoption of a common doctrinal hierarchy is behavioural." The integration of logistics into a single national logistics command and the integration of single service command

systems into single joint strategic, operational and tactical command systems would be examples of logistic and technical interoperability. Codner (2003:69)

The definitions and discussions pertaining interoperability and standardisation call attention to the importance of the interface between elements at different levels to create jointness. The principle of ‘interface between elements’ is very closely related to systems, which are embedded in systems hierarchies. These interfaces must be managed through the respective systems’ life cycles that give rise to considering the principles of systems engineering which in turn encompass practices such as configuration-, standardisation-, project-, and quality management. The question arises: can the research questions be answered by indicating the relationships between interoperability and standardisation with the system related concepts mention earlier in the paragraph? This necessitates a broad review of these concepts to see their relationships with standardisation and interoperability.

3. Systems, Systems Hierarchy, Lifecycles, Systems Engineering and Standardisation

A very acceptable definition for a system is owed to the late Austrian Biologist Ludwig von Bertalanffy, as quoted by Bellinger (2004:1)[7]: “A system is an entity that maintains its existence through the mutual interaction of its parts”.

Bellinger also states that open systems are organic and must interact with their environment in order to maintain their existence. All systems are subsystems of larger systems and composed of subsystems at the same time. Bellinger (2004:3) It stands to reason that be inferred that interaction can only happen if there is a certain level of interoperability and standardisation between the parts.

Hodge and Walpole (1999:1) from the Australian DoD adapted economist Kenneth Boulding’s, one of the founders of The Society for General Systems Theory, general systems hierarchy to a range of defence systems and 'systems of systems', using the systems' capacity to handle data information and knowledge as the key discriminator.

The current systems hierarchy used by the SANDF, levels L1-L8, is very closely related to that of the Australian model. However there is one South African difference between the hierarchies of Boulding and the Australians that will later be highlighted. The validity/justification of these hierarchies is beyond the scope of this article and not discussed.

Military systems are known for their long life cycles and complex compositions. The life cycle is in turn synonymous to systems and the systems hierarchy as Boulding (1956:201) said: "There is hardly a science in which the growth phenomenon does not have importance, and though there is a great difference in complexity between the growth of crystal, embryos, and societies many of the principles and concepts which are important at lower levels are also illuminating at higher levels."

There is definite standardisation actions during the life cycle of a system as identified by the UK MoD as reflected in Figure 1. UK Def Stan (2000:10). The indicated interface and existence of standardisation throughout the life cycle justifies the presence and linking thereof with systems. It can be deduced from this model that standardisation is a definite process that must be executed and managed.

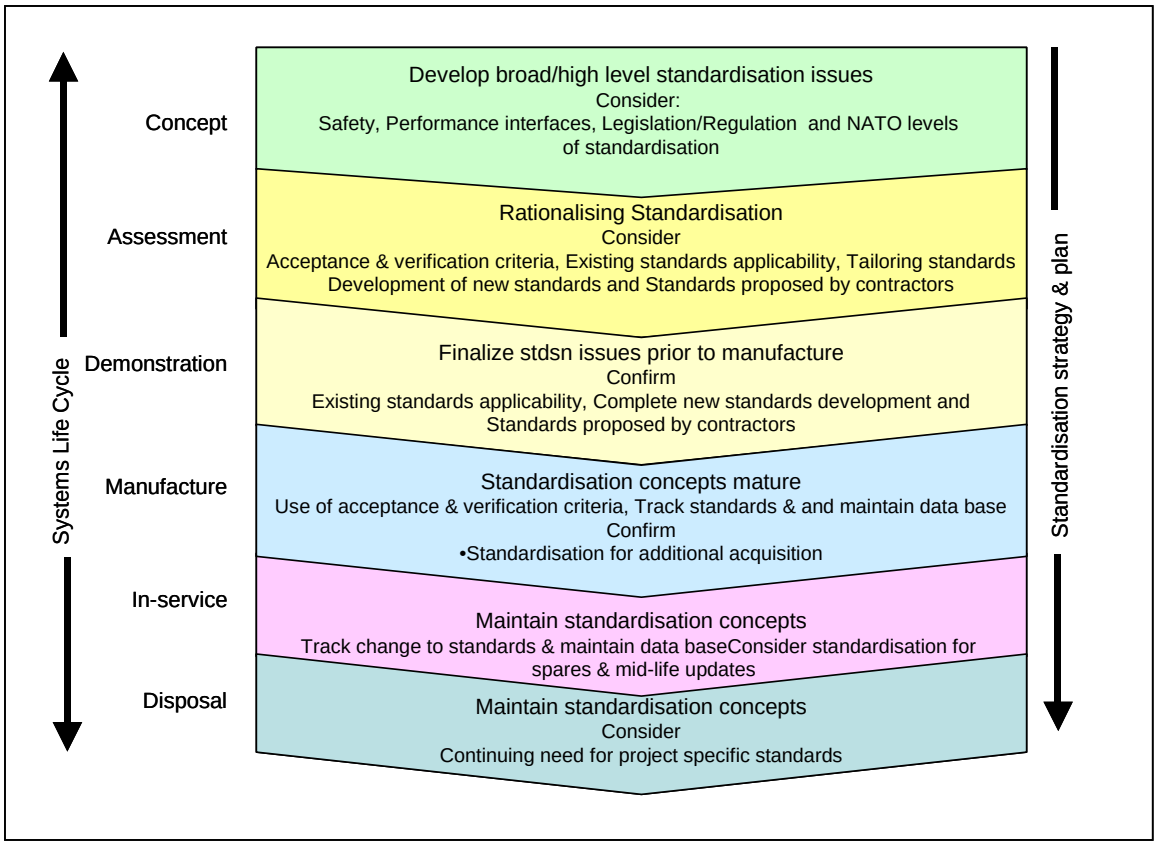

Figure 1: Standardisation Activities During The Through Life Cycle

It is obvious that an interdisciplinary engineering management process that evolves and verifies an integrated, life cycle balanced set of system solutions will satisfy this requirement. This management process is captured in the concept of systems engineering.

The USA DOD considers a logical sequence of activities and decisions that transforms an operational requirement into a description of system performance parameters (standards) and preferred system configuration (interoperability) as one of the generally accepted definitions of systems engineering. The systems engineering process is a top-down, comprehensive, iterative and recursive problem solving process, applied sequentially through all the life stages of a system. Within the systems hierarchy framework the systems engineering process is applied sequentially, one level at a time, adding additional detail and definition with each level of development. USA DOD (2001:6) The detailed process is reflected in Figure 2.

The performance parameters (standards) and systems configuration (interoperability) and the top down process all through life stages justify the use of systems engineering as part of the concept to explain standardisation and interoperability

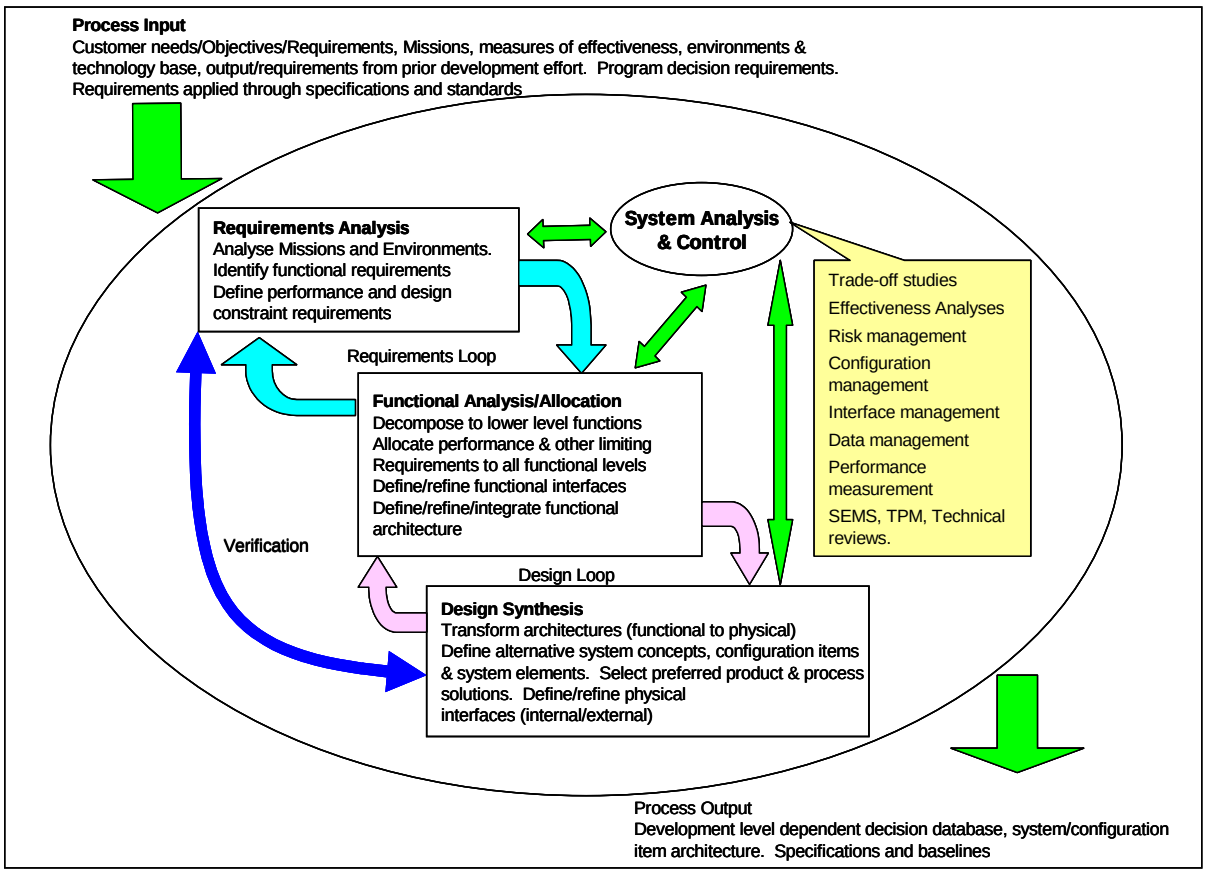

Figure 2: The Systems Engineering Process

4. Conceptual Model

From the abovementioned discussions it is clear that a conceptual model is required that links all the concepts required. A model that explains interoperability and standardisation in terms of the abovementioned concepts is proposed.

The systems hierarchy used by the RSA DOD, as shown in Figure 3, does not address level 9 (Transcendental) as designed by Boulding. If the DOD wants to consider the strategic visions of the Government in terms of the AU, ASF and the Developmental Peacekeeping initiatives, they have to extent their hierarchy to place themselves in perspective. To achieve this, two additional levels to the systems hierarchy were added as shown in Figure 3.

Michael Codner (2003:36) said that the higher the likelihood of combat during an operation and the more intense the level of fighting, the greater the requirement for a high degree of interoperability. This sparked the idea to align these concepts with the systems hierarchy as shown in Figure 3.

The linking of the NATO definition to the systems hierarchy is as follows:

- Levels 9 & 10: Interoperability.
- Levels 7 & 8: Compatibility (lowest level of standardisation)
- Level 6: Interchangeability (medium level of standardisation)

- Levels 1-5: Commonality (highest level of standardisation)

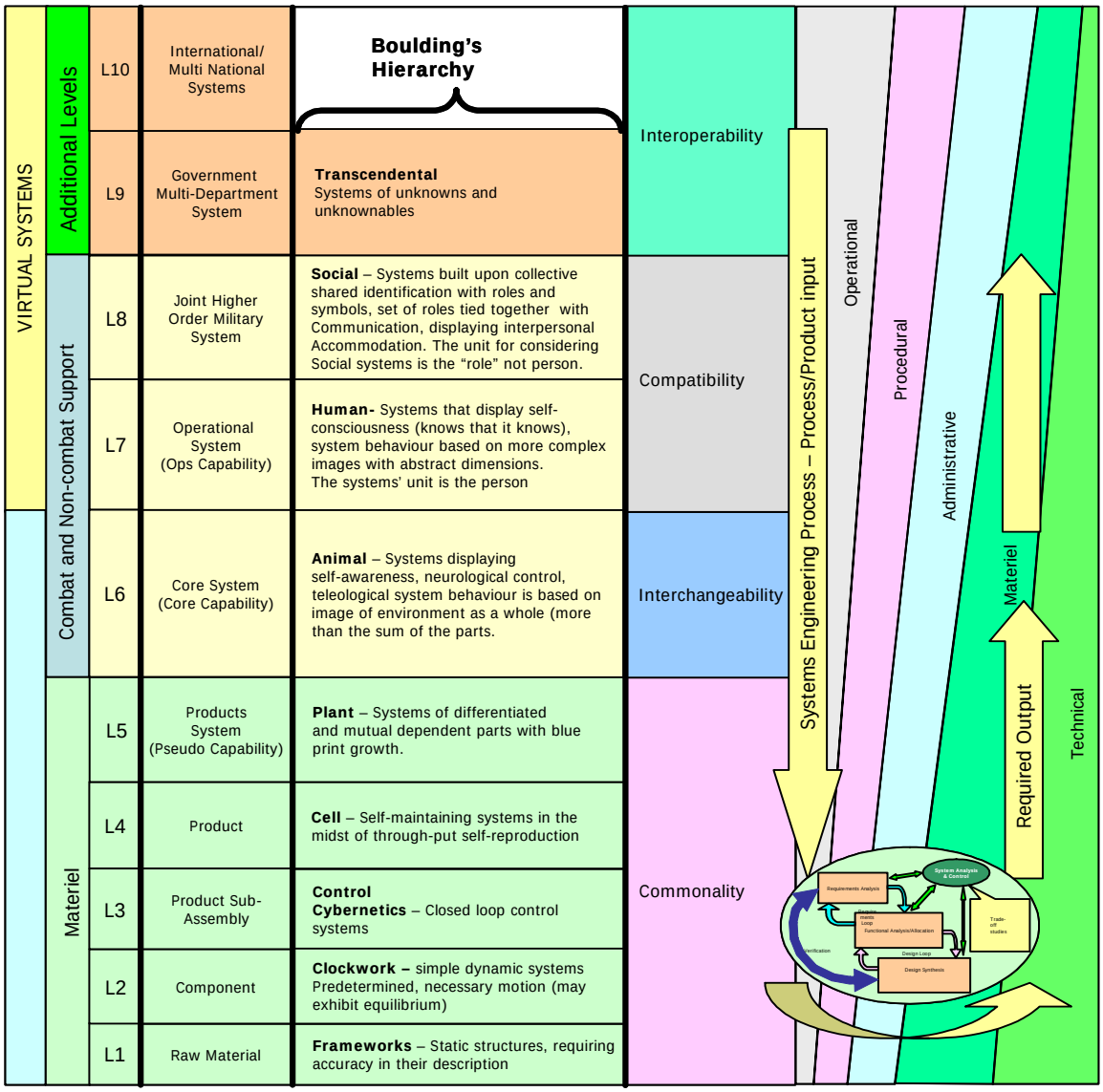

Figure 3: The Systems Hierarchy - Adapted

The NATO definition also states standardisation occurs in the operational, procedural, administrative, materiel and technology fields. The execution of standardisation in the defined fields, expressed in terms of the levels of standardisation, implies that the fields are present at each system hierarchy level as reflected in Figure 3.

The fact that each system has a life cycle and there is definite standardisation action during each cycle, regardless at what systems hierarchical level the system operate, support the argument that the standardisation levels (interoperability, compatibility, interchangeability and commonality) do occur on each hierarchical level as reflected in the final model Figure 4

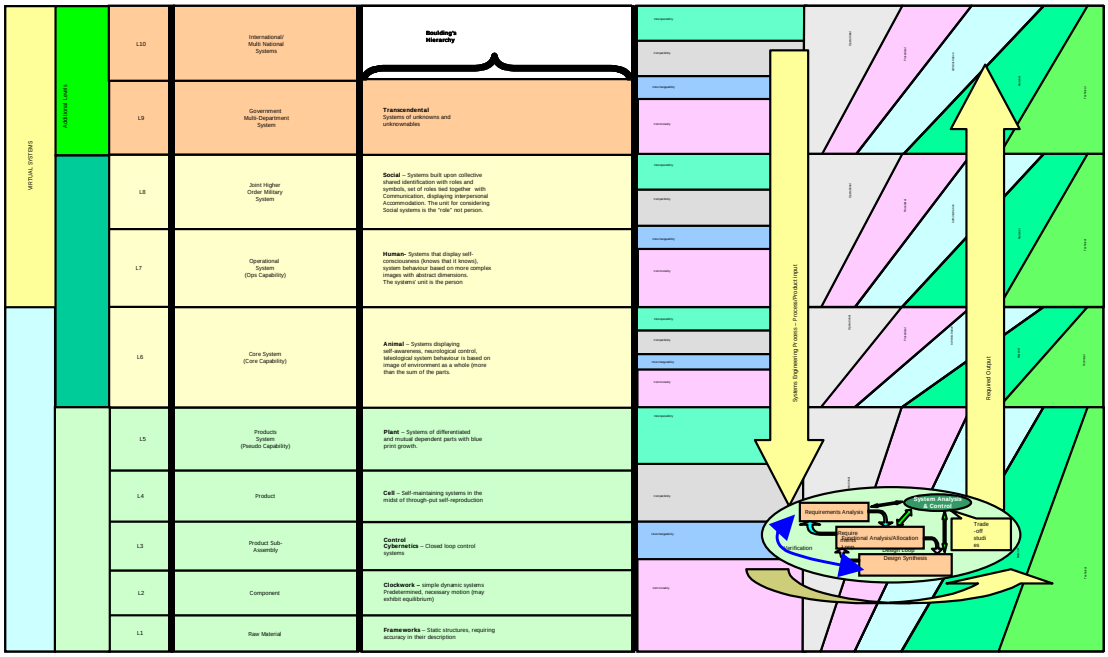

Figure 4: The Final Model

A top-down (inputs), bottom-up (output) approach covering all the standardisation fields with different levels of standardisation are thus required US DOD (2001:6), thus justifying the systems engineering process in the model as suggested in Figure 3. and Figure 4

The next step is to explore the DOD's management knowledge base regarding the elements of the model.

5. Understanding Interoperability and Standardisation in the DOD

The proposed model, being a full representation of a set of relationships including statements about assumptions and interactions, was based on theories and common practices that were derived from secondary data. The justification of the concepts within the model is further explored by analysing new data obtained by means of structured interviews and observations. A questionnaire was the main instrument used. The questions were not open-ended but designed to measure participant's agreement or disagreement with specific statements.

The population of interest were managers from the DOD and Armscor. The total number of participants was 175. Of these 36 were at top management level, 96 were middle managers and 43 were at supervisory level.

The concepts, interoperability, compatibility, interchangeability and commonality, used by NATO in their standardisation definition were presented to determine if the group could relate the four concepts to standardisation. The group did relate the four concepts to standardisation as reflected in Figure 5. However it is interesting to note that commonality, which is the highest level of standardisation, is the least related/recognised

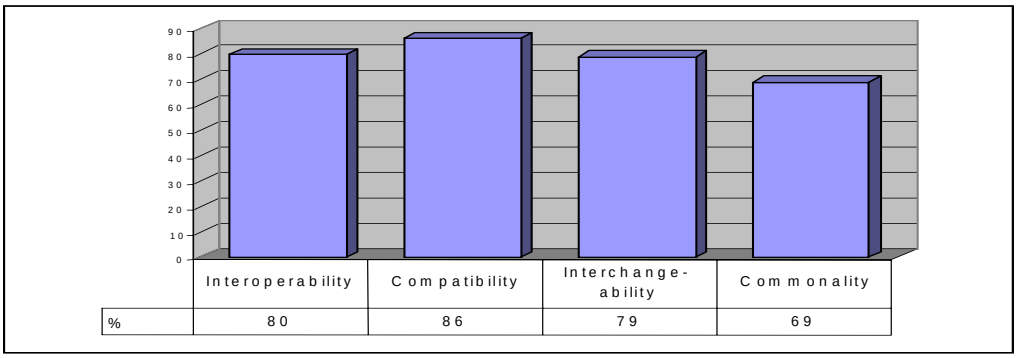

Figure 5: Concepts Related to Standardisation

The level of understanding is measured by the group's ability to precisely link the concepts; only 60% could link it as graphically reflected in Figure 6. The validity was however not tested, it was realised afterwards that by asking the group to place the concepts in the correct order would have been more effective. Even though they couldn't precisely link the concepts, 95% of the total group were aware that there are levels of standardisation as mentioned in the definition.

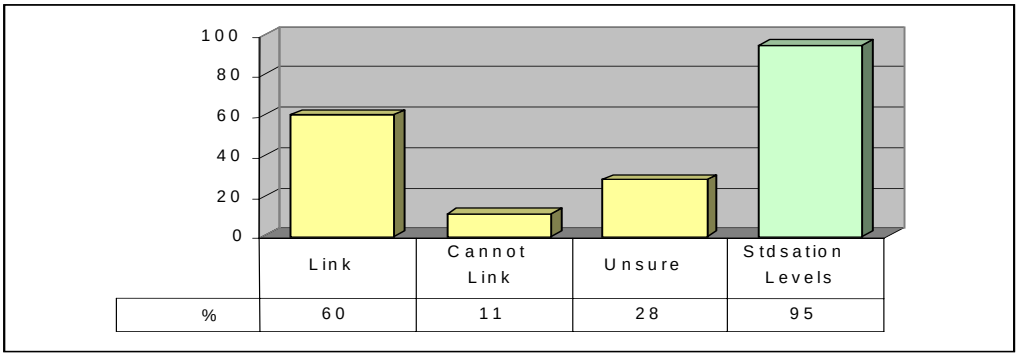

Figure 6: Linking the Concepts Related to Standardisation

Assuming group consensus on the presence of standardisation in processes it was necessary to determine in which field they expect standardisation to take place. The group indicated in which field they see standardisation ensued. This result was verified by their reaction on the question whether standardisation is restricted to materiel/equipment only. Ninety five percent of the respondents confirmed that standardisation encompasses more than the standardisation of materiel/equipment. The results are reflected in Figure 7

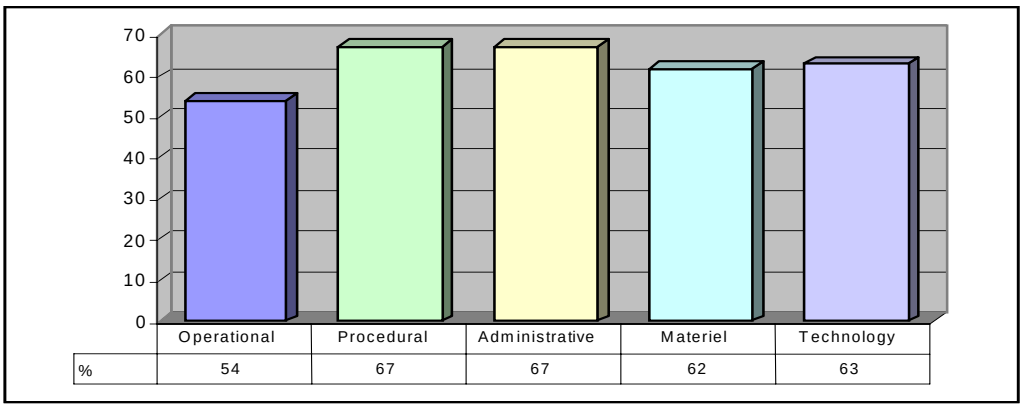

Figure 7: Respondents Allocation of Standardisation in the Different Fields.

The group's familiarity towards systems and the systems hierarchy were also tested. A high percentage (88%) indicated that they are familiar with systems and the systems hierarchy (80%) and those that can plot themselves on the systems hierarchy (75%), as shown in Figure 8.

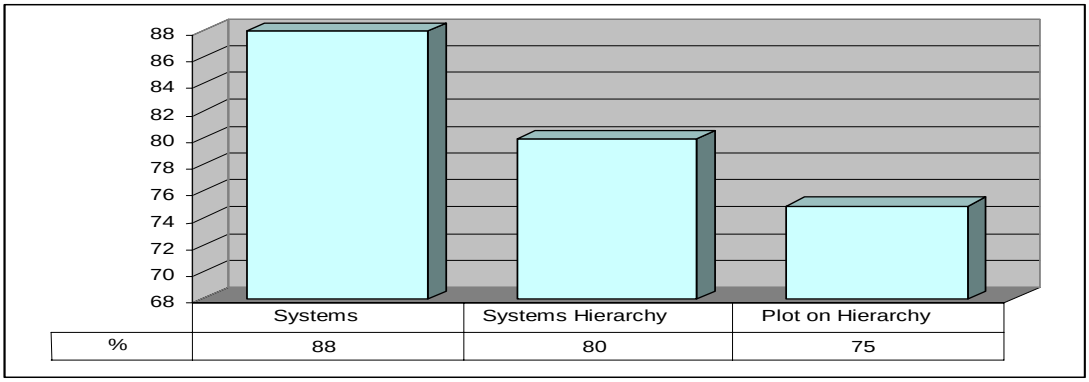

Figure 8: Knowledge of Systems

The group were asked at what management level standardisation should be initiated. The majority (78%) indicated that it must start with top management that in turn indicates that the top-down systems engineering process (Figure 2) can be used in the model. The systems engineering process is initiated with a requirement statement derived from a mission and environment analysis with the aim to identify functional requirements and define performance and design requirements. These requirements must satisfy the organisational missions. The group was also tested in this regard and 62% indicated that the DOD is mission driven.

Seventy eight percent of the sample group indicated that their knowledge concerning standardisation is not high but medium, but 95% have a strong desire to better their knowledge. Different possible methodologies of knowledge transfer were suggested and the group responded that they prefer a workshop. Their response is reflected in Figure 9

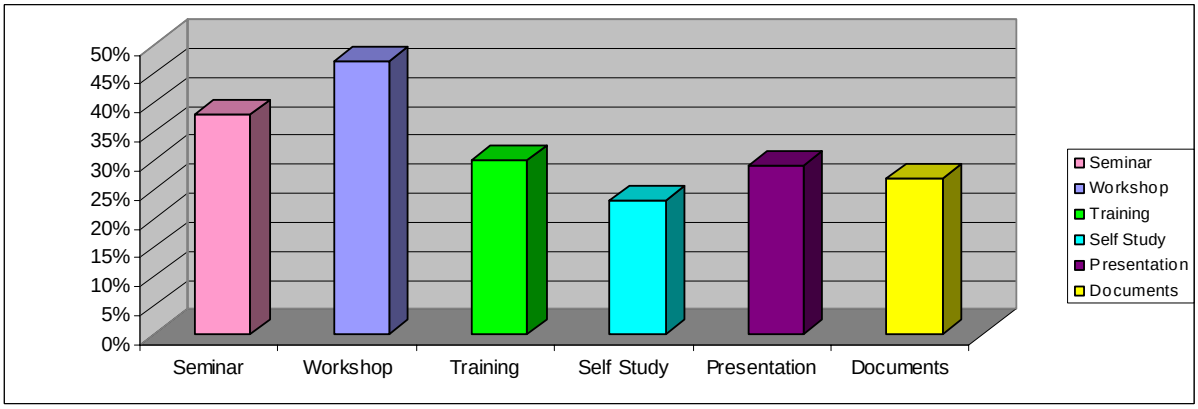

Figure 9: Methodology to Promote Standardisation

6. Conclusions

In terms of the problem statement and objectives it is clear from the data analysis that the following is achieved:

- The research did determine and explored the DOD's knowledge pertaining standardisation to a certain extent.

- The six research questions (par) asked were answered as follows:

  The managers from strategic to execution level do not have the same understanding of the concepts of standardisation and interoperability. The need to enlighten them does exist.
  They realise that standardisation form an integral part of all systems but are uncertain to what extent. The need to present the proposed integrative model is confirmed.
  They indicated that they are familiar with system and systems hierarchies; however the uncertainty about placing themselves on the systems hierarchy indicates that recapping systems theory is required when the proposed model is to be used.
  They have consensus that standardisation should be initiated at top management level which means that the process of creating the same understanding of interoperability and standardisation should also start at top management level. This gives substance to the use of systems engineering principles.
  The common point of departure when explaining the concepts of standardisation to the DOD Management was determined.
  They are however indifferent of how they want to attain the standardisation knowledge, however a combination of workshops and seminars with prior-study materiel are envisaged.

7. Recommendation

The model and its elements combined in this configuration is a worthwhile method of visualising the relationships of these concepts that can also be used to better the understanding thereof. The current knowledge base (definitions and concepts) and pictured relationships can create a generally accepted interpretation of interoperability, compatibility, interchangeability and commonality (standardisation) and must thus be exploited.

The efficiency of the model must be tested as soon as it is presented to the different forums. A questionnaire testing the efficiency must be developed and completed with every presentation opportunity. Testing the depth or increase in knowledge will verify the efficiency of the model. Workshops with its discussion-methodology (with clarity questions and discussions asked) will help to identify gaps and further shortcomings in the model and must be recorded.

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