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Towards Holonic Academia: The theoretical framework and literature review

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Abstract

The author is interested to develop a holonic model for the management of higher learning institutions. Though the idea of holons or holonic systems introduced by Arthur Koestler in 1967 has been adopted into many fields of study over these decades, it is still rarely attempted on educational management. Such a remarkable gap in past research motivates the author to come up with a practical model called "Holonic Academia" (HOLACA) that can help enhance university processes to survive the greatly challenging industry of higher education. By and large, the major processes within a university encompass strategic planning, operational management, academic research, teaching, and learning. There are four academic facets to be brought together in this particular research, namely psychology, pedagogy, rationality, and relations (2P2R). At the very outset of constructing the HOLACA, a critical review of literature is needed so as to map out the theoretical framework.

Keywords: higher education, holonic model, literature review

1. Introduction

Firstly, the HOLACA was born with a two-way motivation:

To: holonic theory has rarely been applied to managing higher education;

Fro: various educational works have not been compared to any holonic viewpoint.

In this paper, the author would like to touch on relevant issues and concerns, theories and practices, solutions implemented or offered, together with the methods employed in literature, which can be given a "holonic sense" to discover new potentials for conducting research. The term "holonic" is derived from the word "holon", coined by a Hungarian philosopher Arthur Koestler, in his book *The Ghost in the Machine* (Koestler, 1967). The word "holon" is rooted from the Greek *holos* meaning *whole* and the suffix *–on* meaning a *particle* or *part*, as in proton or neutron. It was initially meant to describe a basic unit of biological or social organisations, in which Koestler observed that fully self-supporting, non-interacting entities do not exist. According to his findings, every identifiable unit of organisation, like a single cell in an animal or a family unit in a society, is composed of more basic units (e.g. plasma and nucleus, parents and siblings) while at the same time is forming a part of a larger unit of organisation (e.g. muscle tissue or community). Autonomy and cooperation are the prime attributes of holons.

Academia is the commonly-used term for the community of people engaged in higher education, and hence, it can represent a collective of universities, or even a single university with its internal and external environments. A university, equipped with teaching and research facilities, may grant academic degrees in a variety of subjects and involve a wide range of processes, requirements, and stakeholders. The HOLACA is intended to assist a university in analysing and ameliorating its own institutional policy while adhering to national policy, coexisting with counterparts, as well as dealing with related bodies.

2. Educational Management and Leadership

Bush (2003) classifies the main theories of educational management, adapted from industrial settings to meet the specific requirements of schools and colleges, into six major models: formal, collegial, political, subjective,

ambiguity, and cultural. Each of them has been linked to a parallel leadership model:

Table 1. Linking management and leadership models (Bush, 2003)

Management Model	Leadership Model
Formal	Managerial
Collegial	Participative
Political	Transactional
Subjective	Post-modern
Ambiguity	Contingency
Cultural	Moral

Each of these models or parallel links has its noticeable features, such as strengths and limitations. Some of them are found consonant with and explainable in terms of the holonic attributes. Brief examples are thus given. The formal model consists of some basic features or sub-models: structural, systemic, bureaucratic, rational, and hierarchical (pp.37-38). For the collegial model, power is shared among some or all members of the organisation, who are thought to have a shared understanding about the institutional aims, to determine policies and make decisions though discussion and consensus (p.64) — seem like the autonomy and cooperation of holons in accomplishing the common goal of an organisation. In the political model, policies and decisions are expected to emerge through negotiation and bargaining, wherein a conflict is viewed as a natural phenomenon and power accrues to dominant coalitions (p.89). This is because individuals are thought to have a variety of interests, which may contrast sharply with the aims of other sub-units (Morgan, 1997). The ability of resolving conflicts via mutually acceptable plans is also a cooperative requirement for holons. Negotiation, from the point of view of multi-agent systems, means the convergence of various solutions through compromise and communication (Davis & Smith, 1983) and can take place in heterarchical control. Holonic architecting is said to have combined the best features of hierarchical (i.e. top-down, commanding) and heterarchical (i.e. bottom-up, cooperative) structures, as it balances both the needs of stability and dynamic flexibility (Dilts, Boyd, & Whorms, 1991).

There are researchers who have attempted to infuse organisational theory into learning environments. Galbraith (1999) views universities as learning organisations, wherein achievement pressures and competitive aspects introduced at all levels have both structural and personal implications for the operation of such a culture. Johnson and Owens (2005) concern about the school-classroom relationship and teacher autonomy, as schools are complex organisations and the decentralised nature of schools invites the creation of sub-cultures counter-cultures. Ogawa and Kim (2005) map the influence of business on education, which may include shaping policies, consuming products, competitions, supplying inputs, and doing business.

Ancient wisdom may also be borrowed. The Analects of Confucius (Legge, 1893) contain principles of leadership, gentlemanship, and scholarship. Jeffrey (2011) adopts the Art of War (AOW), an ancient Chinese military classic written by Master Sun Tzu around 2500 years ago during the turbulent Spring-and-Autumn period of China's history, into the professional development needs of contemporary educators. Jeffrey used a teacher diary study in his methodology by reason of "teacher diaries are written accounts of experiences that teachers encounter, not only with students in the classroom, but also within the broader context of their work, such as the administration, colleagues and the wider professional, even personal, environment". Today, the AOW continues to have a great influence on decision-making, not only in the military but also in the competitive areas of sports and business, in order to advocate judicious strategic planning and positioning for the resolution of conflicts.

Gorton and Alston (2009) discuss the administration, management, and leadership in the educational world, embodying the importance of decision-making, communication, conflict management, organisational culture, and change. They also contend that authority, power, and influence should have a reasonable basis. Their methodology was focused on qualitative case studies and simulations. Muijs (2010) finds that leadership has a significant indirect impact on student outcomes, for which he discusses the literature evidence of transformational, distributed, and

instructional leadership.

Several more studies that inquire into academic satisfaction are picked up. Zhang, Han, and Gao (2008) develop a student satisfaction index model inclusive of college reputation, student expectation, perception quality, perception value, student satisfaction, and student loyalty in China and analyse the influences between these structured variables based on factor loadings and route coefficients of a questionnaire. Nilufar, Zaini, Yong, and Alam (2009) prove a negative relationship between job satisfaction and job stress among Malaysian academicians by means of cross-sectional analysis, descriptive analysis, and regression analysis. Ahmed et al. (2010) investigate the effects of motivational factors on the administrative staff's job satisfaction with a quantitative case study at the University of Punjab. These examples are inspiring to the HOLACA in such a way that the author can administer questionnaires to university staff (i.e. both academic and administrative) as well as students, in order to study the relationship between their satisfaction and the breadth-and-depth of holonic features of the university.

3. University Processes

In literature, the university processes include strategic planning, operational management, academic research, teaching, and learning. While handling such activities, some psychological, pedagogical, rational, and relational (2P2R) aspects can be taken into account.

3.1 Strategic Planning and Operational Management

Paris (2003) discusses the importance of the strategic planning process in the university, whereby resources are concentrated in a limited number of major directions in order to maximise benefits to stakeholders. In higher education, the stakeholders include students, employers of graduates, funding agencies, society, and internal parties like faculty and staff. A strategic plan can therefore provide guidance to recruitment, retrenchment, and reallocation (p.1). The strategic planning model used at the University of Wisconsin-Madison (p.3) was meant to set up operating principles, situational analyses, budgetary requests, and periodic checks, together with a list of self-evaluation questions (p.22). In other words, the strategic planning may serve a university in policy-making so that the operational management of the university has some guidelines to rely on or comply with. According to Galbraith (1999), a typical strategic plan for a university should include the reputation of the university, quality in teaching and learning, excellence in research and postgraduate training, strong relationships with the community, and effective management of resources.

Starsia (2010) conducts a study on the relationship between strategic planning and operational success in the US collegiate athletic departments. Three distinct planning models as independent variables were used: linear, hybrid (i.e. adaptive, interpretive, emergent, and contextual), and chaos, whereof some qualitative criteria can be linked with holonic attributes. The targeted success was measured based on championships, graduation rates, and financial performance, namely the dependent variables. Questionnaires were distributed to athletic directors for collecting the data required, on which factor analysis, variance analysis, and regression analysis were performed (pp.86-96).

Observing the supply and demand can be part of strategic planning. In regard to student enrolments, both the higher learning market (i.e. student supply) and the professional job market (i.e. graduate demand) need to be considered, and consequently, this may involve marketing and branding efforts (Mungaray, 2001; Ho & Hung, 2008; Bonnema & Van der Waldt, 2008; Beneke, 2011). Waggoner and Goldman (2005) study twelve factors that influence a student's decision to enrol in which institution based on a qualitative methodology: open coding (Strauss & Corbin, 1990). The codes were generated from selected university documents and student retention literatures, analysed for the frequency of appearance, and ranked (i.e. from 1 to 12). They picked out the top three descriptors (i.e. academic success, academic quality, and educational goal), which provide evidence for analysing institutional and rhetorical isomorphism.

Balzer (2010) proposes Lean Higher Education (LHE), for which he incorporates Toyota's Lean manufacturing principles and practices into managing university processes. Any of such counterparts in manufacturing research, including the one based on Koestler's idea (i.e. the HMS stated in *4.2*), may also be brought into the realm of higher education. There are five major steps in Balzer's LHE model: launch initiatives, identify expectations, create visual maps, eliminate waste and improve the flow, and implement specific solutions and sustain the gain. An LHE project

team needs to be formed and trained, so as to save time and resources required by a particular process. His case studies or "proofs of concept" were taken from various administrative and service processes of several universities in the United States (pp.48-74), while simulation was used on a fictitious example for the freshman move-in process (pp.26-43). In passing, this shows that simulation is a tool or technique suitable for anticipating the improvement of university processes.

Agha, Kuhail, Abdelnabi, Salem, and Ghanim (2011) apply a data envelopment analysis (DEA) model to access the relative technical efficiencies of academic departments. They formulate the efficiency measure as the weighted sum of outputs over the weighted sum of inputs. The inputs include operating expenses, credit hours and training resources, while the outputs are the number of graduates, promotions and public service activities. They use a multiple linear regression to find the relationship between super efficiency and input and output variables, thus concluding that the differences in the efficiency scores may guide the administrators to reallocate the amounts of different resources to the different departments. The way Agha et al. measure the efficiency is a valuable reference, whereby some inputs and outputs can be added or removed, and their respective weights can be adjusted, to suit any specific condition.

3.2 Academic Research, Teaching, and Learning

While the contents in *3.1* are inclined to the 2R (i.e. rational and relational) facets, this section is prone to underlie the 2P (i.e. psychological and pedagogical) facets in education. Santrock (2011) writes a book about educational psychology that is worth further reading and citing. Crosling, Heagney, and Thomas (2009) discuss some ways of retaining college students from the teaching and learning perspective.

Esbjörn-Hargens (2007) uses the four quadrants of the "All Quadrants, All Levels" (AQAL) framework (Wilber, 1997, 2000a) to provide a helpful lens for educators to understand their own role in teaching and learning: if you are a teacher, you have the "I" of your perceived embodied self, the "We" of the intersubjective relationships between yourself and the students, the "It" of your own actions and behaviours in class as well as the activities your students engage in, and the "Its" of the educational system with its rules, regulations, policies, and institutional dynamics. These four quadrants, as shown in Figure 1, represent the four irreducible perspective-dimensions of a holon in education:

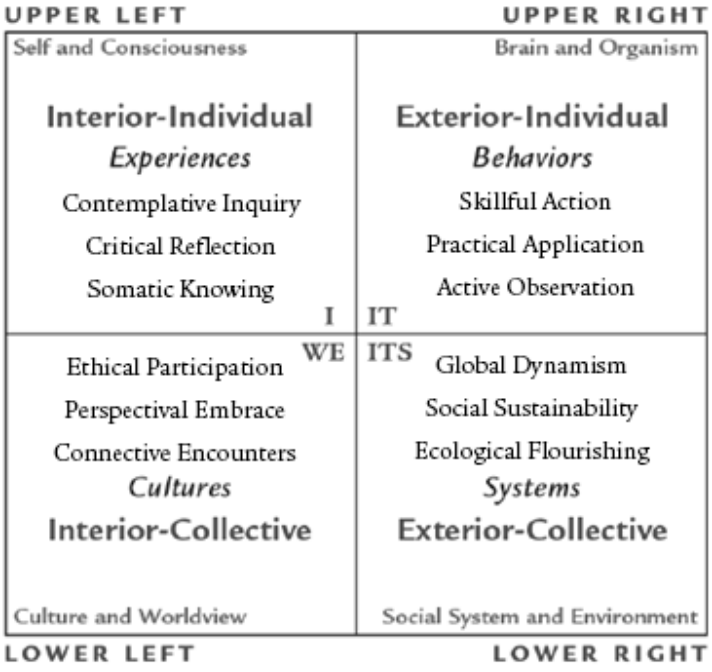

Figure 1. Four quadrants of integral education (Wilber, 1997; Esbjörn-Hargens, 2007)

In each of the quadrants, there are four general levels of developmental altitude of consciousness based on a colour spectrum, inclusive of amber, orange, green, and teal (Wilber, 2006; Rentschler, 2006) — represent the traditional, modern, post-modern, and integral worldviews, respectively. There have also four lines of psychological development: cognitive, emotional, moral, and kinaesthetic (Wilber, 2000b), four states of awareness: gross-waking, subtle-dream, causal-formless, and witnessing (Wilber, 2003), and four general typology approaches to learners: personality, gender, sensory, and narrative — one per each quadrant. As a whole, the four kinds of each of the five elements (i.e. quadrants, levels, lines, states, and types) constitute the twenty aspects of Esbjörn-Hargens' integral education theory (2007). Owing to some practical judgment and limits, it is unnecessary to include more aspects for gaining better results.

Murray (2009) discusses the progressive and integral pedagogies, which are related to each other and also to the AQAL framework, in order to explore what the integral approach has to offer above and beyond progressive (or alternative, or reform) educational theories, principles, and values. He mentions that some of the AQAL principles focus on the understanding and development of internal mental, emotional, or spiritual capacities (i.e. the upper left quadrant); some prioritise collaborative, community, or ethical elements (i.e. lower left); some emphasise in-the-world action, the creation of artifacts, or physical embodiment (i.e. upper right); and the others highlight the systemic factors in classrooms, the institutions of education, or social and political realities (i.e. the lower right quadrant). Integral consciousness was much explained as it comprises construct-awareness, ego-awareness, relational-awareness, and system-awareness, which might benefit a variety of educational practices.

Some scholars are interested in arranging the teaching and research activities for academic staff. This may involve the operational management. Galbraith (1998, 2010) provides some cause-effect loops and weighted funding formulae for generic research performance and student load structures, whereby competition issues have emerged between faculties for gaining limited resources within Australian universities. According to Vidal and Mora (2003), there is a tension between efforts devoted to teaching and research in Spain because, all Spanish universities are research oriented, wherein their academics spend 46% of their time on teaching, 41% on research, and 13% on administrative and other activities. Vidal and Mora have also noted that research merits are more valued than teaching qualifications, thus resulting in a mismatch between what is needed and what is evaluated. Greater achievement in publishing research works is often required for staff promotion, and yet, the teaching quality may decline as a result (Galbraith, 1998; de Jonghe, 2005; Samuels, 2010; Agha et al., 2011).

In an attempt to reorganise the teaching-research tension, de Jonghe (2005) argues that academic responsibilities need to be broken down into separate activities, which are primarily carried out by different individuals or groups. Her reasons include that "research and teaching are different disciplines with different qualities and characteristics, requiring specific competences" (2005, p.66) and "what researchers or traditional teachers should understand is that many students are not going to be researchers and that the learning process provoked in the student should be much more important than presenting the discipline in a scholarly way" (p.64). On the other side, Samuels (2010) proposes that universities can show how research informs teaching and how teaching is shaped by cutting edge research, by way of retaining a category of professors who are evaluated on both their teaching and research. Feldon (2011) finds out that a mix of teaching and research can make better academics than research-only counterparts, owing to the opportunities to practice and explain their ideas in the classroom.

Since cooperation is one of the predominant holonic attributes, some attention may be given to the literature about cooperative learning (CL). The CL refers to students working in teams on an assignment or project under conditions in which certain criteria are satisfied, namely positive interdependence, individual accountability, face-to-face promotive interaction, appropriate use of collaborative skills, and group processing (Johnson, Johnson, & Smith, 1991). George (1994) compares selected CL methods with traditional non-CL methods, by way of measuring students' achievement and attitude toward instruction. Achievement was measured by test scores, while attitude was measured using the student evaluation form. Her research findings proved the hypothesis that the CL group of students performed significantly better and reported significantly more favourable attitudes than the non-CL group. A key assumption of CL is that students working in groups will learn from and teach one another, so that learning is best achieved interactively rather than through one-way transmission (Haller, Gallagher, Weldon, & Felder, 2000). In order to implement CL methods effectively, some valuable strategies have been proposed together with the issues identified and the benefits expected (Oakley, Felder, Brent, & Elhajj, 2004; Felder & Brent, 2007).

4. Holonic Theory

Arthur Koestler first proposed the idea of "holon" in 1967 to explicate the principle of hierarchical structure, a.k.a. Open Hierarchical Systems (OHS). A holon is an identifiable part made up of sub-ordinate parts and in turn is part of a larger, supra-ordinate whole. A hierarchy consisting of holons is called a "holarchy", wherein each identified holon can itself be regarded as a series of nested, flexibly connected sub-hierarchies that coordinate with the local environment. The "part-whole duality" exhibited by holons is that, they simultaneously represent both dependent parts and self-contained wholes, because they are always parts of larger hierarchies and always contain sub-hierarchies. Rather than physical entities or objects, holons can be seen as reference points or systematic ways or developmental stages in hierarchical series or holarchies, which relate abstract structures and interpret the reality.

4.1 Theory Association and Expansion

The holonic theory has often been associated or equated with systemic, holistic, and integral theories. However, there are some essential differences between them in terms of description and application. The term "holonic" is normally used with settings that sound more objective, structural, or technical. At the Alpbach Symposium organised by Koestler in 1968, the concept of holons was well accepted by Ludwig von Bertalanffy, the father of *General System Theory* (GST), who defined the system as "a set of elements standing in interrelation among themselves and with the environment" (Bertalanffy, 1969, p.252) and derived his theory from the biology which regards an organism as a whole. Moving from the GST towards applied system thinking, Peter Checkland brought up the *Soft Systems Methodology* (SSM) for solving specific problems by building and applying systems thinking rather than constructing a perfect theory. He prefers to use the word "holon" rather than "system" to express the meaning of a "whole" (Checkland, 1988), as his SSM includes a distinctive approach to deal with human affairs and complex organisations in the real world.

Kenneth Wilber II, a contemporary American integral philosopher, has adopted the "holon" in constructing his "All Quadrants, All Levels" framework (AQAL), which regards a holon as the primary explanatory unit for all levels of existence — from matter to spirit. For explaining the intersubjectivity and interobjectivity in the holonic cosmos, Wilber (1997, 2000a) delineates four quadrants that represent the four perspectives within all holons: intentional for "I", cultural for "we", behavioural for "it", and social for "its". An interesting chronicle of Wilber's writings is that, the holon and its various defining qualities have held an increasingly important position since 1995. In his book *Sex, Ecology, Spirituality* (1995), he came up with twenty holonic tenets that govern what he called patterns of existence, among which the first tenet claims that "reality as a whole is not composed of things or processes, but of holons". Edwards (2003a) compares Wilber's twenty tenets with Koestler's OHS principles and enumerates the many correspondences between the two types of holonic theory which prove that they are highly related. Besides, Edwards has also critiqued the AQAL representation that Wilber should not leave the confusions that holons occupy or move around quadratic landscapes, because the readers need a clear-cut conception that "quadrants are first and foremost perspectives that are shared by all holons" (Edwards, 2003b).

4.2 Establishment of HMS

Towards attaining a higher level of efficiency and competitiveness in manufacturing operations, the European Community (EC), European Free Trade Association (EFTA), Australia, Canada, Japan, and the United States (US) founded an international collaborative research programme called Intelligent Manufacturing Systems (IMS) in 1993. This programme consists of six major projects, among which the fifth one is "Holonic Manufacturing Systems (HMS): system components of autonomous modules and their distributed control". Over the four years of feasibility study, the HMS became one of the fully endorsed IMS projects in 1997. The International HMS Consortium was formed in the same year and was dedicated to replicate in manufacturing the strengths that holonic systems provide to living organisms and societies, including adaptability to changes, efficient use of available resources, and stability in face of disturbances (Valckenaers, Brussel, Bongaerts, & Wyns, 1997). A list of holonic definitions was given:

Holon: An autonomous and cooperative building block of a system for transforming, transporting, storing and/or validating information and physical objects. The holon consists of an information processing part and often a physical processing part. A holon can be part of another holon.

Autonomy: The capability of an entity to create and control the execution of its own plans and/or strategies.

Cooperation: A set of entities develops mutually acceptable plans and executes these plans.

Holarchy: A system of holons that can cooperate to achieve a goal or objective. The holarchy defines the basic rules for cooperation of the holons and thereby limits their autonomy.

Holonic Attributes: Attributes of an entity that make it a holon. The minimum set is autonomy and cooperativeness.

A myriad of technical measures are found in the HMS literature. Van Brussel, Wyns, Valckenaers, Bongaerts, and Peeters (1998) present an HMS reference architecture called Product-Resource-Order-Staff Architecture (PROSA), in which there are three basic holons: product holons, resource holons, and order holons. They can be structured using object-oriented concepts like aggregation and specialisation, while staff holons can be added to assist the basic holons with expert knowledge. These allow the use of centralised algorithms and for the incorporation of legacy systems, even though the holonic control paradigm is largely known for decentralised or distributed control. In discussing the human side, Sun and Venuvinod (2001) cite the idea of Van Brussel et al. with an illustration of holons, as in Figure 2, to show their part-whole features (i.e. sub-ordination and supra-ordination) and cooperation with peers:

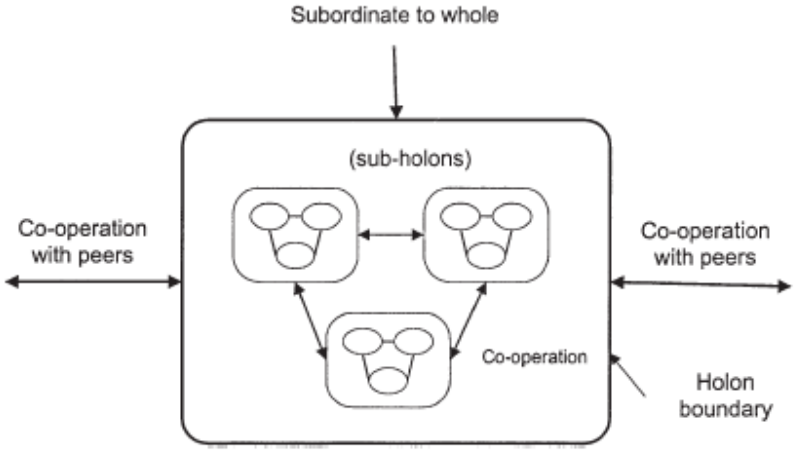

Figure 2. Holarchy (Van Brussel et al., 1998; Sun & Venuvinod, 2001)

Gou, Luh, and Kyoya (1998) create a holonic scheduling model using Lagrangian relaxation for a factory equipped with multiple cells. Huang, Gou, Liu, Li, and Xie (2002) frame a holonic virtual enterprise control consisting of global coordinators and member enterprises for the cost-effectiveness on production planning, resource sharing, and change management. Clegg (2006) builds a process orientated holonic model (PrOH) for a large organisation designing and manufacturing capital goods, wherein he used an action research approach for the improvement of quality and process efficiency as an 18-month project. Leitão and Restivo (2007) present the Adaptive Holonic Control Architecture (ADACOR) that can perform fast rescheduling in line with global optimisation during resource breakdown intervals.

Lim and Chin (2008, 2011a) devise the Holonic Workforce Allocation Model (HWM) in order to make collective worker-task matching decisions based on the worker skill and task urgency parameters, considering specialisation requirements and cross-training opportunities. The HWM was then branched out to Workforce Sizing Plan (WOZIP) and Worker Selection Guide (WOSEG), whereby the formal is meant to periodically estimate the number of workers via exponential smoothing (Lim, 2011a) and the latter picks the best-suited worker for each scheduled task via rational formulation (Lim & Chin, 2011b; Lim, 2011b).

With the many achievements and proofs of concept resulting from the manufacturing world, it is encouraging to incorporate the holonic approach into the education industry.

4.3 Applications in Higher Education

Despite being extensively applied to the manufacturing world as mentioned, the holonic theory has a very limited literature in respect of academic management. Karapetrovic and Willborn (1999) construct a holonic model for quality systems in higher education as to implementing ISO 9000 international standards. Their model contains a set of seven holons to carry out parallel series of tasks on documenting a service organisation. With a purpose similar to this, Srikanthan and Dalrymple (2007) conceptualise a holistic model, which is also to deal with quality issues in higher education as well as to fulfil the ISO 9000. They provide some guiding ideas, such as deep learning cycle and quality improvement cycle, to be connected to some organisational architecture, for which not much specification is contributed yet.

Bell, Warwick, Cooper, and Kennedy (2000, 2001) set up a "holon planning and costing framework" using SSM on a higher education management case study to assist in improving teaching and research qualities with cost constraints. Their target stakeholders include only directors and heads. While enabling a multi-methodology based on software process improvement (SPI) and software process control (SPC), Bell et al. only concentrate on the SPI or the qualitative "soft" part to study "what, who, and where" — still leave the SPC or the quantitative and computational "hard" part concerning "how, when, and why" as a future work (2009). They consider a holon to be an abstract representation of a social situation that captures all problems through several stages: framing, enquiry, visioning, metrication, and action. Montilva et al. (2010) use the combination of holonic networks and business models to design an academic organisation devoted to professional training programmes for software engineering.

Sterling (2003) fosters whole systems thinking (WST) as a basis for paradigm change in education, comprising both ecological and systemic views. His thesis deals primarily with the shift of consciousness and indicates that holonic relationships are important for elaborating WST. Strom (2011) conducts a study of university-community engagement in Australia using chaordic systems thinking (CST), which encourages the holonic capacity by focusing on mutuality and the interdependence of the whole, rather than the independent constituent parts.

The six research works mentioned above, despite having identified their respective problems and stakeholders, appear procedural and propositional rather than strategic and substantive. In their respective models, the instances of each university process and the holonic attributes of each active component were not much explained or emphasised, hence allowing some interesting opportunities to explore this field from different angles by using different methods.

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