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ADVANCEMENT OF SUSTAINABLE DEVELOPMENT, CONTRACTING, DESIGN, AND SUPPLY BUSINESSES VIS-A-VIS CONSTRUCTION MARKETS

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Abstract
The background involves the multiplication of Porter's (1980) five forces framework and the prior design of the 8-arena framework for capturing complexity of managing businesses within each of hundreds of (inter)national construction markets. In turn, the aim of this theoretical paper is to advance environmental sustainability as part of managing the four primary businesses. The sustainability of construction-related business management is enabled by implanting drivers into each of the eight competitive arenas. In life-cycle contracting and development businesses, the novel drivers include the coupling of object development ideas with sustainability advantages. In design-build contracting businesses, such drivers include the re-engineering of value chains with all tiers of designers, subcontractors, and suppliers. In design businesses, such drivers include the transformations of design firms into long viewers, path dependency breakers, stock-specific programmers, object-specific planners, impact blockers, and impact cause tracers. In supply businesses, such drivers include the adoptions of cradle-to-cradle certifications, product formula renewals, and full responsibility takings over the life-cycles of supplied units. In the future, practitioners and researchers alike could adopt this high-sustainability 8-arena framework.

Keywords: building products, business management, construction, design, sustainability

INTRODUCTION

Built environments and their sustainable advancement are herein approached from **a business management viewpoint** as follows. One of the generic definitions on sustainability is adopted and quoted, followed by a brief review of the recent perceptions and concepts for managing businesses in sustainable ways in various contexts outside and inside built environments. This review justifies the aim-setting for the paper as a whole and its focus on the advancement of sustainable development, contracting, design, and supply businesses.

In general, **sustainable** is defined to be capable of, relating to, or designating forms of human economic activity and culture that do not lead to environmental degradation, especially avoiding the long-term depletion of natural resources (OED 2011). On the one hand, an indicative, cross-industrial survey resulted in the finding that only 54% of the 335 managers assessed that their firms are extremely or very concerned about sustainable performance as part of supply chain management. Overall, these firms still focus mainly on **cost and financial concerns**. Moreover, the respondents are not yet convinced by academics, consultants, and others who argue that sustainability improvements may in fact help the bottom line, instead of cutting profits (Prokesh 2010).

On the other hand, the top management in many leading firms are perceiving that environmentally friendly businesses truly determine how successful they will be in the long run and, thus, **long-term goals** are being set along the dimensions of sustainability (Orange 2010). For example, Unilever has declared that they will run their supply chains fully sustainably by the year 2020. In practice, such advancements will require technical,

management, process, and cultural innovations as well as the engagement of all units and people within globally scattered organizations (Senge in Prokesh 2010). Typically, Nidumolu et al. (2009) advocate that pioneering business managers adopt **a generic, 5-stage process** for becoming sustainable, i.e. (i) viewing compliance as opportunity, (ii) making value chains sustainable, (iii) designing sustainable products and services, (iv) developing new business models, and (v) creating next-practice platforms.

Herein, **the focal contexts** involve the four coinciding spheres of (inter)national built environments, capital investment markets, real estate markets, and construction markets. These spheres deal with the design, implementation, services, and life-cycle aspects of both existing object stocks and new, object-specific investments in various sectors, i.e. natural resources utilization, energy supply, telecommunications, transportation, other infrastructure, manufacturing, and general building. Later, only the term **"construction markets"** is used to encompass all these spheres.

Some years ago, Fergusson and Langford (2006) postulated that as **environmental strategies** are developed, competencies in managing environmental issues will grow and lead to improved business performance. Based on the thin evidence in the UK context, they initially verified **the three propositions**, i.e. (a) UK firms are considering environmental issues within their strategic management at least informally in compliance with legislation and contractual obligations, (b) improved environmental performance is increasingly, with a varying rate, included within strategic management plans, and (c) at least more proactive firms are managing environmental responsibility at a strategic level to gain competitive advantages. Recently, Jones et al.'s (2010) survey resulted in the similar, low-sustainability findings in the US engineering and construction industry. It is herein assessed that such low-sustainability states in managing firms and their businesses are prevailing today across the construction globe.

Thus, **the aim of this theoretical paper** is to advance environmental sustainability inside firms and as part of managing their development businesses, contracting businesses, design businesses, and supply businesses in construction markets, respectively. **The three sub-aims** are as follows: (i) to re-introduce the 8-arena framework that Huovinen and Kiiras (2005a-c, 2006, 2007, 2009) have designed for capturing complexity of managing a business across the eight competitive arenas that are embedded inside each of targeted (inter)national construction contexts, (ii) to implant the high-sustainability drivers into the six of these competitive arenas and as part of the managing of each of the four primary businesses, and (iii) to conclude with some remarks on the future advancement of high-sustainability business management, including the validation of the 8-arena framework and the implanted high-sustainability drivers.

The management of the four primary businesses in highly sustainable ways is herein defined to encompass the utilization and development of natural resources in ways which are compatible with the maintenance of these resources, and with the conservation of the natural and built environments, for current and future generations (applying OED 2010). Sustainability calls for incorporating environmental and green concerns into business-level management, but sustainability is causally related to bottom lines and social issues, too. Similarly, project-level management is - along managing contract, quality, schedule, budget issues - considering how every project (or capital investment object) will impact communities, environments, and businesses (applying Fister Gale 2009).

PRIOR MULTIPLICATION OF PORTER'S FIVE FORCES FRAMEWORK VIS-A-VIS CAPTURING COMPLEX COMPETITION IN CONSTRUCTION MARKETS

Within the strategic management literature, **Porter's (1980/1998) five forces framework** offers a generic frame of reference for any firm who aims at attaining its business goals in its industry. This framework applies to high-tech, low-tech, and service industries, including global and local construction industries or markets. There are five basic forces that are attached to one focal competitive arena, at a time.

In turn, Huovinen and Kiiras (2005a-c, 2006, 2007, 2009) have redefined and multiplied Porter's five forces in order **to understand and explain competition** between various stakeholders within several causally interrelated, upstream and downstream arenas and across them in any construction market. In this paper, this multiplication of Porter's five forces into the 8-arena framework is re-introduced as follows.

It is argued that each construction market consists of **the eight competitive arenas with incumbents** who are interacting as procurers and sellers as follows: (1) rivalry among focal sellers in their base arena, (2) the bargaining power of clients in the next downstream arena, (3) the bargaining power of subcontractors, sub-designers, and suppliers in chained upstream arenas, (4) the threats of substitute offerings, and (5) the threats of entrants (Figure 1).

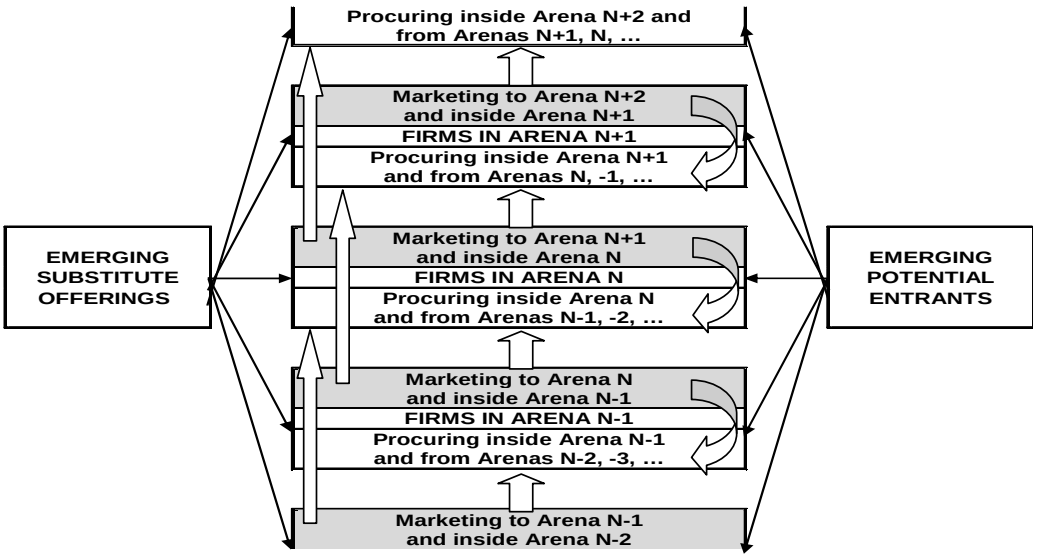

Figure 1: *Incumbents as procurers and sellers across targeted arenas in a focal construction market (Huovinen and Kiiras 2005a; applying Porter 1980/1998).*

It is axiomatic that each procurement route, which each procurer (client) chooses, determines the rules of competition and the nature of marketing in a coupled upstream arena. In turn, a set of marketing routes couple the related duos or trios of downstream arenas into value adding chains even project by project. Each incumbent occupies **the two principal roles** of a procurer and a seller in its base arena. As a seller it interacts via marketing routes with targeted clients in downstream arena(s). As a procurer it acquires inputs via procurement routes from upstream arena(s) and from inside the same arena(s).

The most downstream arena, i.e. **Arena 1 of Uses** involves stakeholders who use **capital object stocks**, including building stocks and infrastructure stocks, as part of built environments. Users occupy and operate individual capital objects, e.g. buildings and pieces of infrastructure over their life cycles. In turn, these various spaces, utilities, and structures enable users to fulfill their purposes and compete for the best effectiveness of their primary operations in a country, an economy, or a society. Many stakeholders are assuming a dual role, i.e. such users act also as the owners (in Arena 2) of the objects that they occupy or exploit.

Arena 2 of Ownership includes stakeholders who own capital objects and stocks. The two primary owner groups are as follows. Owner users compete in terms of (a) enabling the most effective use of and operations related to their objects and (b) earning the best value for their invested capital under long-term ownerships. Professional owners compete for achieving the same goals through speculative or long-term ownerships and renting stocks to desired users as tenants (in Arena 1).

Arena 3 of Life-Cycle Services includes firms who compete for providing various services to owners (in Arena 2) and users (in Arena 1) over (the contract periods of) the life cycles of capital object stocks. The two primary service groups include real estate management services as well as operation and maintenance (O&M) services.

Arena 4 of Capital Investing includes stakeholders who invest in, initiate, and manage their new, modernization, and renovation investments in various sectors. In the short or middle term, these capital investors compete for the highest possible returns through selling their objects to versatile owners (in Arena 2). The four primary investor groups are developers, owner investors, venture capitalists, and financiers. Investors' procurement strategies and routes determine the existence of two other arenas, by each object. On the one hand, many investors are realizing their capital investments by handing out single ("turnkey") contracts to the most competent contractors around (in Arena 5). On the other hand, several investors can themselves manage capital object-specific processes and, thus, hand out multiple subcontracts to firms (in Arena 6) for carrying out all designs, procurements, construction works, and installation works.

Arena 5 of Wholes includes principal contractors and CM consultants who compete for taking full responsibilities via single contracts for the design and implementation of investors' (in Arena 4) object-specific investment plans. Primary competitor groups consist of system, general, turnkey, and design-to-build contractors as well as construction management (CM) firms. Typically, these contractors of wholes (a) arrange competitive biddings and hand out a set of engineering and design contracts to the best designers and a related set of subcontracts for trade-specific works to the best subcontractors, or (b) package first design, procurement, and works into sub-systems, arrange systemic biddings, and hand out contracts to the most advanced sub-system contractors (in Arena 6).

Arena 6 of Parts includes designers and subcontractors who compete for the realization of the parts of investment objects via multiple contracting. The two primary client groups include capital investors (in Arena 4) and contractors of wholes (in Arena 5). Competitor groups involve engineers and designers of various disciplines as well as sub-system, plant, machinery, equipment, main, HEVAC, specialty, and trade contractors.

Arena 7 of Prefabricated Products includes suppliers and traders who compete for delivering versatile prefabricated building products and components to principal contractors

and CM consultants of wholes (in Arena 5), contractors of parts (in Arena 6), and assemblers of components (inside the same Arena 7). By definition, suppliers and traders of these inputs do not take responsibility for works at sites. The three broad supplier groups are building product suppliers, component suppliers, and construction equipment suppliers.

The most upstream arena, i.e. **Arena 8 of Construction Materials** includes suppliers and traders who compete for delivering all kinds of materials such as copper, steel, wood, glass, stone, sand, and ceramics to product or component suppliers (in Arena 7) or directly to contractors at sites (in Arena 6; or even Arena 5).

New substitute offerings may emerge related to one or several primary arenas even in the short term. Annually, **potential entrants** decide to target new construction markets. In each market, entrants may try to enter only one arena or two or more arenas concurrently based on their arena strategies, respectively. In addition, there are **other (in)directly competing stakeholders** such as financiers and traders as well as **supporting stakeholders** such accountants, administrators, lawyers, promoters, trainers, and transporters.

In principle, all procurers have **important latitude** to rethink and influence the internal structure and boundaries of focal arenas and to position themselves relative to other actors. Even leading procurers can never stop learning about their markets and upstream arenas, rivals in base arenas, procurement routes, and building environments in order to improve their performance (applying Porter 1980/1998: xi-xii, xiv).

Indeed, each of these 8-arena sectors and markets are facing **sustainable or green standards battles** in global, international, continental, and national contexts. Such battles are over what constitutes sustainable or green construction and built environments in the first place. It is herein posited that major developers, contractors, designers, and suppliers should become actively involved in debates and shaping rules and standards. Otherwise, managers and their businesses will be assessed sooner or later against sustainability standards that they cannot meet such as the certification of Leadership in Energy and Environmental Design (LEED) also outside the USA (aligning with Unruh and Ettenson 2010).

Within the demand side (in Arenas 1-2), pioneering owners and users will set the required levels of sustainable, societal developments and built environments. In the EU-wide context, one of the exemplary initiatives is the Energy-efficient Buildings (EeB) PPP with a roadmap towards the realization of the challenging vision, i.e. by the year 2050, most buildings and districts could become energy neutral and have a zero CO2 emission. A significant number of buildings would then be energy positive, thus becoming real power plants, integrating renewable energy sources, clean distributed generation technologies, and smart grids at district levels. The rate of change of the built environments will be realized through the six planned intervention or natural mutation moments, i.e. (i) the renovation of energy infrastructures, (ii) new building additions, (iii) refurbishment, (iv) large maintenance, (v) HVAC system replacements, and (6) demolition (EC 2010).

In the next three sections of this theoretical paper, this author is sharing his foresights on the sustainable developments **in the supply side (in Arenas 3-8),** i.e. leading and pioneering firms will implant high-sustainability drivers into and across focal competitive arenas as part of managing their four businesses, respectively, within targeted (inter)national construction markets and contexts (Fig. 2).

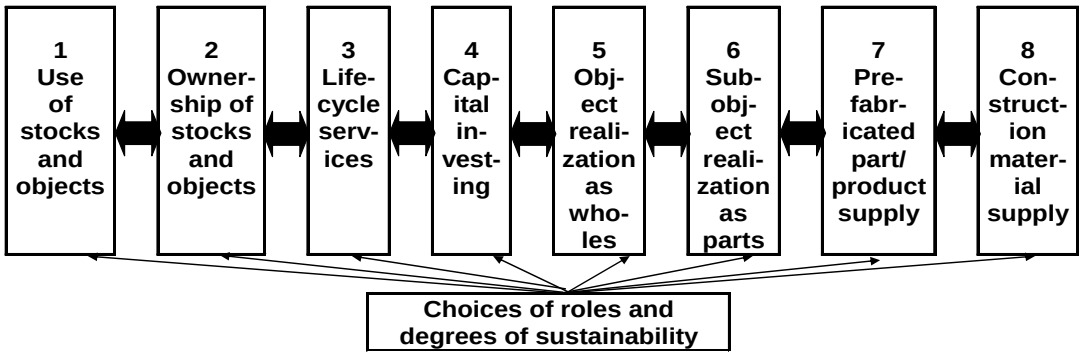

Figure 2: *Choices of stakeholders occupying Arenas 1-8 within each construction market.*

IMPLANTING ENVIRONMENTAL SUSTAINABILITY INTO ARENAS 4-6 AND 3 AS PART OF MANAGING DEVELOPMENT AND CONTRACTING BUSINESSES

Construction contractors are choosing their businesses, respectively, from among many alternatives such as life-cycle, PPP, and other financing-based contracting, object development as well as design-build, main, specialty, and trade contracting, complemented with life-cycle services, in building and infrastructure sectors within (inter)national contexts. New objects are being constructed and the existing ones are being renovated.

The future implanting of high-sustainability drivers into each of (inter)national construction markets will take place **when firms are managing their development businesses and contracting businesses** in targeted arenas as follows (in part applying Fister Gale 2008, 2009) (Fig. 3):

- In life-cycle, PPP, and other financing-based contracting businesses (Arena 4b), firms are orchestrating the planning and realization of object-specific sustainability programs through all internal organizational layers and the 2-5 tiers of external contractors and suppliers. Life-cycle management involves a capital investment ideation, the early crafting of alternative object scopes with sustainability advantages, the sub-setting of high-sustainability goals, and the continuous measurement of impacts on sustainability against these goals as part of a total progress via delivery, use, and maintenance processes (and stages).
- In object, property, and infrastructure development businesses (Arena 4c), developers are launching similar organizational penetrations. In addition, developers are using filters for pre-screening each potential object-specific party in terms of trustworthiness, loyalty, performance, and necessary competencies. Developers are relying on value adding parties to innovate on their behalf. Object-related parties need to trust each other for any sustainable initiative to work.
- In CM contracting and CM consulting businesses (Arena 5a), CM firms are securing buy-ins from all contracted parties according to sustainability plans. CM firms make sure that each designer, sub-contractor, and supplier is actually doing what they say they are doing in conformance with high-sustainability. For this monitoring, CM teams tailor and use a reliable metrics. Open relationship networks are built in order to communicate on a real-time basis and to find viable solutions when something goes wrong.

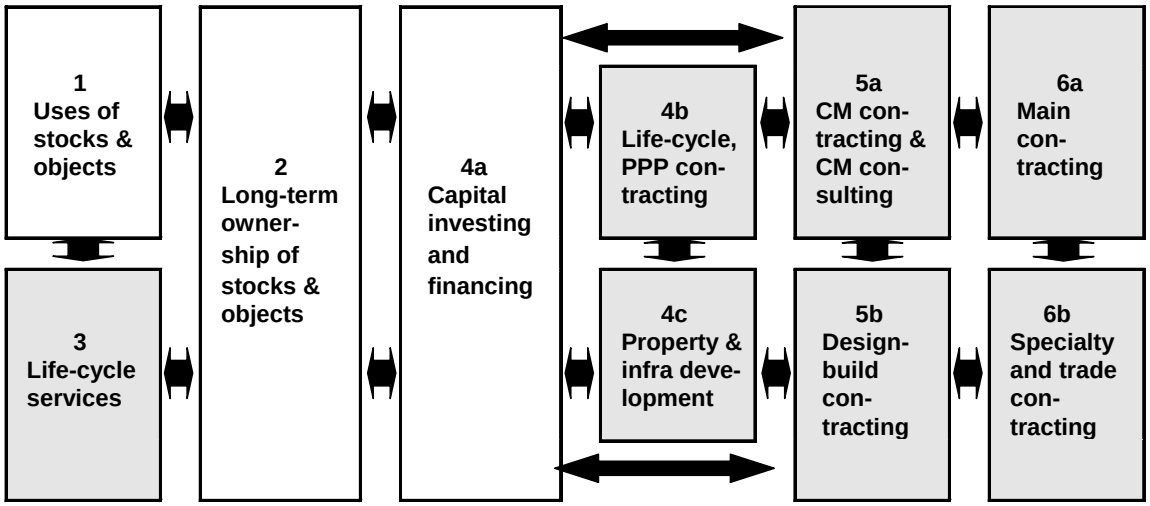

Figure 3: *Implanting of high-sustainability as part of managing of development businesses (in Arenas 4b-c), contracting businesses (in Arenas 5a-b and 6a-b), and life-cycle service businesses (in Arena 3).*

- In design-build contracting businesses (Arena 5b), DB contractors are collaborating with leading designers in order to offer high-quality, high-sustainability, and cost-effective object solutions. Sustainability is one of key drivers for the re-engineering of DB value delivery chains that encompass all tiers of designers, subcontractors, and suppliers. Self-assurance procedures are endorsed.
- In main contracting businesses (Arena 6a) and specialty & trade contracting businesses (Arena 6b), such contractors are planning their dual sustainability management systems that are compatible with their clients' systems (in Arenas 4-5) and their suppliers' systems (in Arenas 7-8). Specialty contractors are improving sustainability that is embedded in their sub-supply chains and the tiers of suppliers.
- In life-cycle services businesses (Arena 3), leading providers are having the in-depth understanding of the types and degrees of the negative and positive impacts of alternative existing and novel solutions on stock-specific and object-specific sustainability, where and when impacts actually occur during each stage. They cultivate intelligence upon how alternative changes made in the particular upstream and downstream stages of life-cycles decrease and even block negative impacts.

In the future, developers ensure their competitive edges by integrating **eco-investing principles** into capital objects and development processes. Likewise, contractors ensure their competitive edges by implanting **eco-contracting principles** into objects as wholes and parts as well as contracting processes (applying Orange 2010).

Typically, **Skanska AB** of Sweden is enhancing green offers for advanced clients. The foundational focus of Skanska Green Business is exclusively on the refurbishment of existing office buildings and it includes green solutions for more energy efficiency. Skanska can cut energy consumption in half in existing buildings. Energy-efficient designs include such features as low-speed, high-efficiency ventilation systems, efficient waste heat recovery systems, the use of district heating and cooling, super-insulated windows, the use of parking facilities as heat sinks in winter, energy-efficient elevators, and low-energy lighting with daylight and occupancy sensors (Fasth 2010).

IMPLANTING ENVIRONMENTAL SUSTAINABILITY INTO ARENAS 6, 5, AND 3 AS PART OF MANAGING DESIGN BUSINESSES

Design firms are choosing their businesses, respectively, from among many alternatives such as societal and urban planning, architectural, feasibility study, engineering, design, consultation, assessment, and inspection services, complemented with programming expertise and software selling, in building and infrastructure sectors within (inter)national contexts. New and under-renovation capital objects are being investigated, designed, and enabled.

The future implanting of high-sustainability into each of (inter)national construction markets will take place **when firms are managing their design businesses in targeted arenas via eight sustainability (S) drivers** as follows (in part applying Fister Gale 2008, 2009) (Fig. 4).

Foresights, visions, and other long views (S1) on sustainable developments up to the years 2030, 2040, and 2050 (and even beyond) are being prepared by specialized teams and experts inside design firms for public and private stakeholders (in Arenas 1-4). Reports contain cross-sectional and longitudinal views on the focal, more or less sustainable states of affairs. Long views are based on the modeling of alternative, causally interrelated developments in societies, built environments and natural environments, resources, and technologies. Thus, design firms deepen their systemic understanding on sustainability in part by collaborating with top universities and research institutes.

Scenarios and forecasts (S2) on more and less sustainable futures are being crafted by teams and experts inside design firms for public and private stakeholders (in Arenas 1-4). Development path dependencies are embedded within each of alternative scenarios on sustainability and paths with milestones leading towards such alternatives. Scenarios are over-viewing the best and worst futures that, in turn, are being guessed by involved stakeholders along the dimensions of sustainability. Forecasts are highlighting likely long- and short-term net changes in sustainability and they are justified by the most recent and historical evidence. In turn, a set of assumptions are underlying each scenario and forecast. Thus, design firms ensure their expertise in part by recruiting both seasoned experts with their deep, tacit knowledge and young talents with their minds open for novel approaches.

Life-cycle knowledge on individual capital objects and object stocks (S3) is being itemized and accumulated inside design firms and then offered as programs and tools for long-term owners, investors, and developers (in Arenas 1-5) in order to enable effective, stock-level sustainability management. Stock-specific programs include criteria for assessing the degrees of sustainability of alternative existing and new objects to be included in focal stocks. Programs include metrics for comparing the life-cycles and stages of each object inside focal stocks. All this is being synthesized into the rating of stock-specific sustainability indexes. Thus, design firms advance their expertise in part by continuous learning about portfolio management, technology platforms, and alike.

Life-cycle knowledge on individual objects (S4) is being systemized inside design firms and then offered as plans and tools for owners and other key stakeholders (in Arenas 2-5) in order to enable effective object-specific sustainability management. Object planning is coupled with tools for taking sustainability into account as part of feasibility analyses, goal-setting, investment management, design management, PM, process management, FM, and other maintenance management. Moreover, pre-structured plans include also the design and rating of pre-planned roles that parties assume from investment ideas to the end of life-cycles

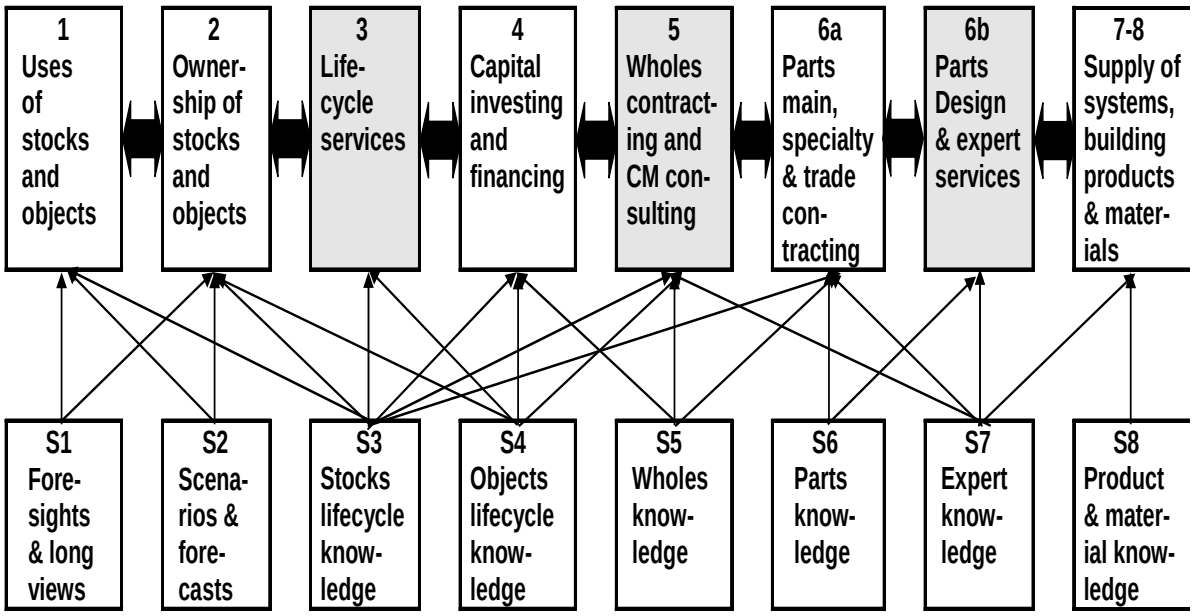

Figure 4: *Implanting of high-sustainability via the eight drivers (S1-S8) as part of managing of design businesses (in Arena 6b), CM consulting businesses (in Arena 5), and life-cycle service businesses (in Arena 3).*

(including reuses). Knowledge covers impacts on environment, biodiversity, fair trade, stakeholder health, and human rights. Thus, design firms also collaborate with and sub-contract external experts in order to master and offer complete knowledge.

Knowledge on wholes (S5) is being cultivated inside design firms and then offered (i) to investors and developers (in Arena 4) who are realizing their objects through single contracts (e.g. PPP, turnkey, design-build, and CM) as well as (ii) to related contractors and CM consultants (in Arena 5) in order to enable effective whole-specific sustainability management. Knowledge on a complex project as a whole and its impacts on communities and environments is a valuable part of avoiding negative impacts, mitigating risks, increasing revenues, and better managing costs. Thus, core design firms extend their expertise bases towards sustainability in CM consulting businesses and managing contracts of wholes.

Knowledge on parts (S6) is being deepened inside design firms and then offered (i) to investors and developers (in Arena 4) who are realizing their objects through multiple part-specific contracts (e.g. trade-based contracts) as well as (ii) to chained contractors and designers (in Arenas 5-6) in order to enable effective part-specific sustainability management. The depth of knowledge on part-specific sustainability is often decisive when parts at hand are being designed and specified. Thus, specialized design firms invest in their own expertise on sustainability. These specialists are also attractive partners in the eyes of other design firms and contractors.

Expert knowledge on sustainability measurement (S7) is being accumulated inside design firms and then offered to contractors, designers, and suppliers (in Arenas 5-8) for the auditing, testing, and verifying the degrees of sustainability as part of the assurance and proving of the conformance or the detection of non-conformance between sustainability

requirements and delivered products and materials. Thus, many design firms specialize towards measurement (and testing) and nourish such hands-on knowledge as part of their total knowledge reservoirs.

Knowledge on systems, structures, products, components, and materials (S8) is being accumulated inside design firms and then offered to suppliers and traders (in Arenas 7-8) and contractors (in Arenas 5-6) in order to enable effective part-specific sustainability management. Technical systems (e.g. elevators, HEVAC systems) consist of structures, products, components, and materials. Part-specific knowledge on sustainability is composed of the three aspects of the making of a particular part, its content, and its use or performance over a life-cycle. Thus, design firms extend and deepen their expertise in order to cover all targeted parts (e.g. components) or they specialize and focus on one or some of them. Specialization is also taking place along the dimension of materials, e.g. sand, concrete, wood, metals, fibers, plastics, glass, and their composites.

In the future, being green and sustainable will mean taking into consideration the entire life-cycles of objects in built environments when designing them. **Eco-intelligence** is a core competency underlying all high-sustainability drivers (S1-S8) in design businesses. When architects, urban planners, and engineers start to utilize the intelligence of natural systems, they can create societal systems, infrastructures, built environments, and single objects that are essentially waste-free and allow nature and societies to successfully coexist (applying Orange 2010).

Typically, **Pöyry Group** of Finland perceives that a sustainable world will not happen by itself. It must be created and new engineering solutions must be developed. This is where Pöyry can contribute and make a real difference by designing realistic and innovative solutions that consider all aspects of sustainability. Pöyry's in-depth expertise extends to the fields of energy, industry (e.g. pulp & paper), urban & mobility and water & environment. The concept of Balanced Sustainability is about improving resource efficiency. This concept involves finding solutions to improve energy, water, material, and supply chain efficiencies while improving overall returns on investments (Pöyry Group 2011).

IMPLANTING ENVIRONMENTAL SUSTAINABILITY INTO ARENAS 7-8, 6, AND 3 AS PART OF MANAGING SUPPLY BUSINESSES

Suppliers and traders are choosing their businesses, respectively, from among many alternatives such as the supply and trading of prefabricated building and infrastructure systems, building products and components as well as construction materials, complemented with life-cycle services, in building and infrastructure sectors within (inter)national contexts. Systems, products, and materials are being delivered for new and under-renovation objects.

The future implanting of high-sustainability drivers into each of (inter)national 8-arena markets in each of respective contexts will take place **when firms are managing their supply businesses in targeted arenas** as follows (in part applying Fister Gale 2008) (Fig. 5):

- In system supply businesses (Arena 7a), the keen understanding of sustainability is prevailing across suppliers' organizations and supply chains. Cradle-to-cradle (C2C) and similar certifications indicate truly that all human and environmental health

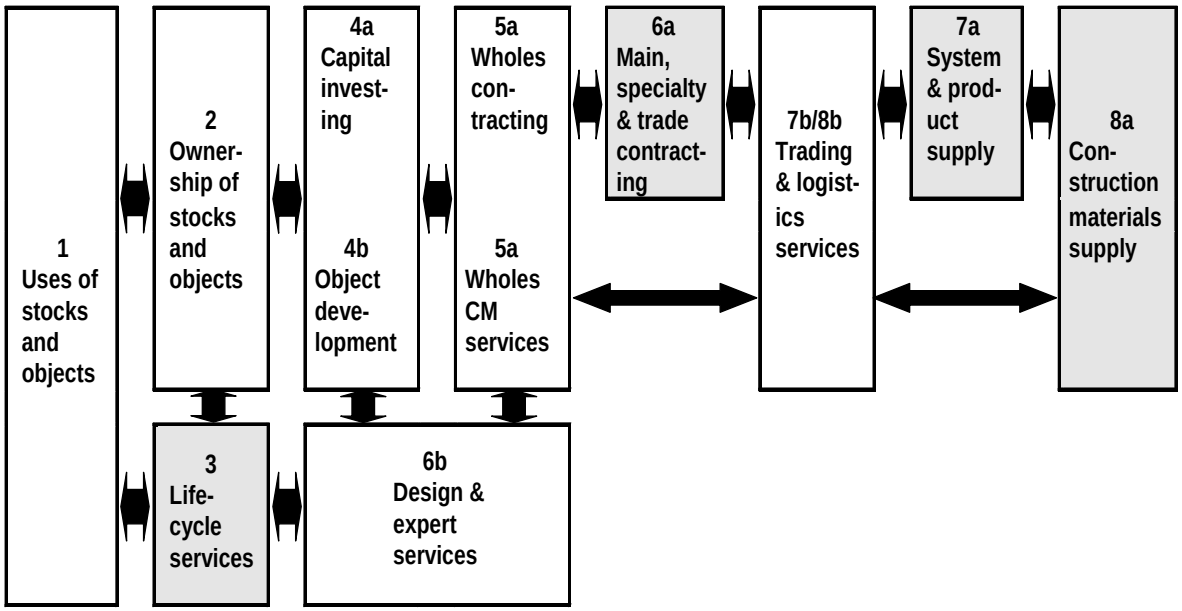

Figure 5: *Implanting of high-sustainability as part of managing of supply businesses (in Arenas 7a and 8a) complemented with contracting businesses (in Arena 6a), and life-cycle service businesses (in Arena 3).*

criteria are being constantly monitored to ensure that materials-based systems are not harmful and that elements can be recycled, remanufactured, or composted. Often this means getting all members in supply chains to agree on changes in their ways of making products and giving system managers access to their product formulas.

- In building product supply businesses (Arena 7a), C2C certifications are forming foundations that, in turn, have to be realized by choosing viable materials together with secondary and tertiary suppliers and by engaging such suppliers with product assemblers' own sustainability vetting processes. In addition, pioneering product suppliers are creating advantages in terms of using sustainable processes and raw materials, offering sustainable packaging, providing more energy-efficient and less polluting products, minimizing energy consumption, advertising environmental impacts, and engaging in product stewardship by taking back products after the ends of their lives.
- In construction material supply businesses (Arena 8a), C2C certifications are likewise prevailing. In particular, material suppliers are training their organizations to participate clients' sustainability programs, e.g. by analyzing, compiling, and handing over lists that cover each ingredient, chemical, etc. Non-disclosure agreements are being signed in the case of proprietary ingredients.
- In main, specialty, and trade contracting businesses (Arena 6a), suppliers are diversifying their core businesses into contracting businesses along their respective parts of supply. New kinds of part-centered (e.g. system-centered and product-centered) contractors become fully responsible for the conformance of their parts' contents and quality, their local assembly or erection operations at sites, and the performance and use of their parts over life-cycles, respectively. Pioneering suppliers are overcoming hurdles for such entries by competency acquisitions, training, piloting, etc.

- In life-cycle service businesses (Arena 3), suppliers complement their core businesses with in-depth services that are based on the understanding of life-cycles of focal parts consisting of systems, products, components, and materials, respectively. Such suppliers are selling their knowledge on sustainability and providing their services for extending the life-cycles of their own or similar offerings in highly sustainable ways. For some parts and sub-parts (and their suppliers), the highest sustainability-increasing or -decreasing impacts occur in the extraction of raw materials. For others, major impacts occur during use and disposal.

In the future, it seems that suppliers and their value and sustainability adding supply chains will involve materials that are perpetually circulated and, once used, can be disposed of in any natural environment and decompose into the soil. Instead of ending up in a landfill, systems, products, components, and materials can be circulated in endless cycles. For suppliers and traders, thinking in terms of cradle-to-cradle design, versus cradle-to-grave design, can be revolutionary. Typically, pioneering **wholesalers and retailers** as gatekeepers will launch market-wide ratings and labeling systems that survey suppliers about their ecological footprints and score building products and construction materials based on how environmentally and socially sustainable they are (applying Orange 2010).

In turn, **internationally leading suppliers** will adopt the toughest external and internal common norms because this actually allows them both to gain leaderships and to save money. Internally, the enforcement of a single norm at a supplier's all manufacturing units allows to exploit economies of scale and to optimize supply chain operations (applying Nidumolu et al. 2009).

Typically, **KONE Elevators** of Finland is seriously responding to a fact that elevators and escalators can account for 2-10% of a building's energy consumption. KONE wants to be the innovation leader in eco-efficient solutions for its industry. Great potential is seen in further reducing the impacts of buildings on natural environments by offering innovative and energy efficient solutions. In the year 2009, KONE released a range of elevators which reduced energy consumption by 30% compared to its previous volume models. KONE is annually re-setting more demanding targets in terms of improving the energy-efficiency and the eco-efficiency over the life-cycles of its products and minimizing its operational carbon footprint (KONE 2010).

CONCLUSIONS

It is herein suggested that **pioneering firms and other key stakeholders** adopt the theoretical, 8-arena framework in order to foresee, envision, set realistic aims, and also attain these aims vis-a-vis the realization of high environmental sustainability across (inter)national businesses, built environments, capital investment sectors, and construction markets at desired future points in time.

In turn, this author is planning to conduct **a series of empirical investigations in order to validate the 8-arena framework and the novel to-be-implanted high-sustainability drivers** concerning leading firms in each of the four primary businesses with targeted (inter)national contexts. Besides, other interested researchers and parties may use the 8-arena framework as **a diagnostic tool** for assessing the current and future degrees of environmental sustainability in focal contexts and preparing their recommendations to key private and public

stakeholders for the enhancement of respective businesses and competitive arenas in highly sustainable and effective ways in the future.

In practice, **the market-wide implanting** of one or several high-sustainability drivers into the eight competitive arenas needs to be planned so that each implanting event corresponds to a focal (inter)national context in terms of current higher and lower degrees in sustainability versus the targeted higher degrees, local environments, owners and investors with their life-cycle preferences, investment programs, and procurement strategies, firms with their sustainable, competitive rationales as well as other private and public stakeholders with their development agendas, legislations, and supporting roles.

So far, most difficulties in **actual sustainability advancements** can be traced down to the fundamental errors of focusing on parts - like energy saving technologies in the case of transiting from fossil-fuel economies to clean-tech economies - rather than on built environments, sectors, markets, and causally routed arenas as a whole. Besides sustainable technologies, many innovative business models, market adoption strategies, and government policies will be needed. A case in point, **the Masdar Initiative** was launched in Abu Dhabi in the year 2006 in order to develop a clean-tech sector and to realize **the world's first carbon-neutral city**. It is too early to say whether Masdar will be successful (Johnson and Suskewicz 2009). Indeed, it is herein perceived that the concept of City of Masdar corresponds well to the adoption of the 8-arena framework for any market-wide or sector-wide renewal and implanting process. Their 5-dimensional business model includes (i) sectoral and area development, (ii) high-sustainability investing in new technologies and solutions, (iii) the design and supply of new systems and products, (iv) carbon strategy development and realization, and (v) sustainability focused university-level research and education.

Finally, it seems that pioneering business management teams keep expanding their expertise by **cross-partnering** between developers, contractors, design firms, and suppliers not to talk about other stakeholders that have in-depth or extensive knowledge on sustainable built environments. Aligning with Senge (Prokesh 2010), it would perhaps be more effective to focus on managing in hands-on, environmentally non-harmful ways - and at the same time to use the word "sustainability" as little as possible because it is too generic.

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