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Live ability factors for long term habitable offshore mega floats

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Abstract: Current studies on the design of mega floats focus on engineering and scientific aspects such as stability, strength and safety. Emphasis is on sustainability issues while live ability aspects have not been given sufficient attention. The current study aims to identify the live ability factors for the design of long term habitable mega floats. Data on perception of potential inhabitants has been collected using questionnaires and statistically analyzed. 57.0% of the respondents are 21 to 40 years of age, 50.30% are employed and 53.9% are related to marine industry. The respondents are jointly agree (mean value 4.33 ~ 4.56) that some important live ability factors to be considered are social environment, physical environment, functional facilities and services, safety environment, resources sustainability, information and communication system, economic sustainability and governance. The result reveals that safety environment is the most important factor with correlation to the rest of the factors accounts an average Pearson r^2 value of 0.78. The second most important is functional facilities and service factors with average r^2 of 0.75 and the joint third most important are resources sustainability factor, economic sustainability factor and information and communication system factor. Safety environment pairs itself strongly with resources sustainability with r^2 value of 0.89. The study concludes that for the sake of live ability, safety and resources sustainability must be given great emphasis when designing and operating mega floats.

Key words: Mega float; Live ability factor; Habitable floating structure

1. Introduction

Mega floats are super large floating platforms designed to house huge installations such as oil and gas exploration facilities on the surface of the ocean. Size principally differentiates mega floats from common offshore structures such as those associated with oil and gas industry. One conceptual design of a closed-to-shore mega float is as described by Suzuki (2005) and Watanabe et al. (2004), comprises of the floating structure, a breakwater, a mooring system and access to land. The floating airport in Japan is one example of a mega float. Other applications may include floating port and harbour, leisure and recreational facilities and floating nuclear plant (Shuku et al., 2001; Suzuki, 2005, Wang and Tay, 2011)

Current researches on offshore floating structures incline more towards engineering, technology and safety aspects (Zamani et al., 2013) whereas risk and reliability of offshore structures is, in general, too focused on engineering aspects. Zamani et al. (2013) highlights, for instance, that holistic risk and reliability studies of floating structures have missed many elements that make up the whole system. Another example is conceptual design aspect of space and its importance in creating a desirable living environment of the future as highlighted by Asal et al. (2012) has not been directly addressed. Sustainable green environment framework for mega floats, similar to the concept proposed by Ismail et al. (2013) for civil engineering projects have not been highlighted. Live ability within the context of human expectation of its surrounding environment has been highlighted by Kamani et al. (2010) and in conjunction with the work by Ralph (1976). Kamani et al. (2010) also highlighted claim by Steel (1981) that 'place have great capacity for influencing on people's characteristics and shape their behavior towards the environment in the long and short period'. Live ability within the context of space layout and geometry and the use of vegetation during planning and conceptual designing has also been highlighted by Ahmed et al. (2014) and so as the case on the importance of spaces layout and orientation (Bashir et al., 2014).

Wang and Tay (2011) highlighted that mega floats have attracted the attention of architects, city planners and engineers while Watanabe et al. (2004) anticipated that floating cities on mega floats may become reality in the future with the advancing technology in the construction of offshore structures. Mega floats of the future encompass a larger number of subsystems, each contributing to the whole system's risk and operability. This therefore requires in depth researches. The following paragraphs detail a proposed study that would expand the knowledge on defining the concept of mega float floating cities.

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1.1. System and environment of mega floats

Proetzel (1983) provides the historical perspective on the development of habitable offshore platforms from 1890s to the 1980s. Zamani et al. (2013) summarizes the current models on system development (Wang and Tay, 2011; Ismail, 2012; Michaelis, 2002; Zamani et al., 2012), engineering (Quick, 2011; Okamura, 2013; Suzuki, 2005; Bronneberg, 2008; Michaelis, 2002; Basantani, 2008; Matsoulis, 2013; Watanabe et al., 2004; Ramsamooja and Shugar, 2002) and economic and safety (Wagner et al., 2011; Malik et al., 2012; Suzuki, 2001; Bea, 1990) of habitable mega floats suitable for permanent community settlement. As a floating city, it will use its internal sources, water, energy and nutrients in an optimal way (Graaf, 2012).

However it does not mean that the city would become an isolated completely self-supporting system. It will extract resources from others too. Such settlements or cities could probably import diesel and run conventional power plants or generate energy from solar power, nuclear plants, deep-sea oil deposits and developing/farming a species of seaweed or algae for biofuel. Ocean thermal energy conversion (OTEC) could be another potential energy source (Bolonkin, 2010). Hydroponics agriculture, which has been shown to be much more efficient than conventional agriculture and is less prone to root diseases (Ross and McCullough, 2010) would also be the main preference.

Controlling, managing and operating such system will be fully automated (Fresco, 2007) and fleets of small aircrafts and hydrofoils will ensure that its community will be part of the international communication network (Bolonkin, 2010). Graaf (2012) believes that ordinary governance structures with municipal councils, mayor and elections could equally be applied in floating cities.

1.2. Habitability and live ability

ABS (2012) provides guidelines on the expected crew habitability standards for accommodation area, whole-body vibration, noise, indoor climate and lighting on offshore structures. Table 1 highlights the summarized requirements on offshore crew habitability related to accommodation area. On whole-body vibration, the guideline requires the avoidance of low frequency vibration which can cause motion sickness, body instability and fatigue. This applies also for high frequency vibration of 1 to 80Hz which could create discomfort and possibly resulting in degraded performance and health (Griffin, 1990). Maximum allowable noise levels for accommodation spaces and operating and maintenance spaces are 50 to 70dB and 9 to 110dB respectively. Indoor conditions should be with air temperature of 20 to 27oC, relative humidity of 30 to 70% and air velocity of 30m/s. Lighting for various parts of areas are provided and, on average, ranges between 100 to 500 Lux.

Live ability, according to Leby (2007), is a concept that describes the outcome from the interaction between the community and its environment. This has been aligned with the significance of neighborhood and good living conditions for live ability as have been claimed by Myers (1987), Omuta (1988), Veenhonen (1996) and Lee (2010). They agree with Jarvis (2001), Heylen (2001) and Shafer et al. (2000) that live ability depends on the objects of measurement and on the perspective of those making the measurements as such it is a subjective matter. Along this line, Xu and Wang (2013) stressed that the understanding and expression of the residents whether the community is live able dictate the degree of live ability standards.

Table 1: ABS's crew habitability requirement (ABS, 2012)

NO	SUBJECT	REQUIREMENT
1	General	Accommodation areas and recreational and catering facilities to be located far from engines, steering gear room, etc. and other noisy machinery and apparatus
2	Personnel cabins	Cabin floor area for single occupancy rooms of 7.0 m^2-10m^2
		Sleeping rooms are not occupied by more than two persons
		Separate sleeping rooms shall be provided for mean and for women
3	Mess room	Mess rooms to be located apart from sleeping rooms
4	Recreational area	Recreation accommodation areas, conveniently situated and appropriately furnished to be provided for personnel
5	Medical facility	The personnel accommodation area to be provided with a dedicated medical facility

Live ability by definition encompasses a wider range of elements. MHRC (2007) live ability model includes ten elements which are public services and transport, recreation, consumer goods, housing, natural environment, political and social environment, economic environment, socio-cultural environment, medical and health considerations and schools and education. Leby (2007) developed a much simpler live ability model comprising of four major elements which are physical space, service level, local economy and community life.

Xu and Wang (2013) agree with the definition that focuses on physical building, the layout, environment and management as primary to convenient living by adding intrinsic elements such as residents psychological feeling, consideration of residents opinion, development direction of the community construction and planning, relation with the other community or the past of itself, relation with the places current state, internal and external environment, basic life satisfaction, and demand of the life are also important. Wei and Jiali (2012) livable cities emphasize on enhancing sustainable development capacity of three elements which are livable economy, livable society and livable environment. These elements further subdivide into industry, service industry, agriculture, social civilization degree, economic wealth degree, beautiful environment degree, resources carrying capacity, the low cost of living, public safety degree, residential area, community and urban area. Li and Meng (2013) portrays the concept of livable community as effective combination between the livable natural environment, harmonious social and culture environment resulting in harmony between human and natural environment.

2. Methodology

2.1. Design of research instrument

Likert scale-based structured questionnaire has been selected as the research instrument. Likert scale 1 corresponds to 'strongly disagree', 2 to 'disagree', 3 to 'moderately agree', 4 to 'agree' and 5 to 'strongly agree'. Eight elements have been shortlisted based on the literature review to represent the main constructs in developing the research questions. These are social environment, physical environment, functional facilities and services, safety environment, resources sustainability, information and communication infrastructure, economic sustainability and governance.

The elements for each of the constructs are as listed in Table 2a to Table 2h. The symbol # signifies the elements being currently proposed by the author.

Table 2a: List of live ability element for "social environment"

Construct 1: Social Environment
✓ School - based education (Wei and Jiali, 2012; Wang and Tay, 2011)
✓ Charitable society (Wei and Jiali, 2012)
✓ Connected to nearby communities (Unit's, 2012; Unit's, 2013)
✓ Communal work (Li and Meng, 2013; Lee, 2010)
✓ Connectedness among resident (Li and Meng, 2013)
✓ Family amusement (Li and Meng, 2013)
✓ Comprehensiveness of health service and support (Wei and Jiali, 2012)
✓ Education and life-long learning (Wei and Jiali, 2012)
✓ Green Community (Li and Meng, 2013)

Table 2b: List of live ability element for "physical environment"

Construct 2: Physical Environment
✓ Green spaces (Wei and Jiali, 2012; Li and Meng, 2013)
✓ Noise free (Wei and Jiali, 2012; Li and Meng, 2013)
✓ Air pollution free (Li and Meng, 2013)
✓ Efficient industrial waste management (Wei and Jiali, 2012)
✓ Efficient local waste management (Wei and Jiali, 2012; Li and Meng, 2013; Lee, 2010)
✓ Connectedness around residential (Xu and Wang, 2013)
✓ Closely located community housing (Unit's, 2013)
✓ Green landscape (Li and Meng, 2013)
✓ Well managed residential(Li and Meng, 2013)
✓ Landscape construction(Xu and Wang, 2013)

Table 2c: List of live ability element for "functional facilities

Construct 3: Functional Facilities and Services
✓ Shopping facilities (Xu and Wang, 2013)
✓ Schools and lifelong education (Xu and Wang, 2013; Unit's, 2013)
✓ Public facilities and services (Xu and Wang, 2013)
✓ Private and public healthcare (Xu and Wang, 2013)
✓ Public transportation(MHRC, 2007)
✓ Traffic facilities and management (Li and Meng, 2013; MHRC, 2007; Lee and Chi, 2010)
✓ Airport and connectivity to land and other areas (Unit's, 2013; MHRC, 2007)
✓ Household maintenance and repair (MHRC, 2007)
✓ Leisure facilities (Li and Meng, 2013; MHRC, 2007)
✓ Sport facilities (Khantong)Green Community (Li and Meng, 2013)

Table 2d: List of live ability element for "safety environment"

Construct 4: Safety Environment
✓ Protection against crimes (Xu and Wang, 2013)
✓ Emergency rescue (Xu and Wang, 2013)
✓ Housing and residential maintenance (Xu and Wang, 2013)
✓ Protection against civil conflict and unrest (Unit's, 2013)
✓ Protection from infectious diseases (MHRC, 2007)
✓ Protection against natural disasters (Li and Meng, 2013)
✓ Availability of integrated security systems (Li and Meng, 2013)

✓ Traffic safety (Li and Meng, 2013)
✓ Protection against fire (Collinson, 1998)
✓ Emergency escape guideline (Collinson, 1998)

Table 2e: List of live ability element for "resources sustainability"

Construct 5: Resources Sustainability
✓ Shopping facilities (Xu and Wang, 2013; Li and Meng, 2013)
✓ Schools and lifelong education (Xu and Wang, 2013; Li and Meng, 2013; MHRC, 2007)
✓ Public facilities and services (Xu and Wang, 2013; Lee, 2010)
✓ Freshwater (Xu and Wang, 2013; Li and Meng, 2013; Lee, 2010; MHRC, 2007)
✓ Labourer #
✓ Agricultural resources #
✓ Electricity (Xu and Wang, 2013; MHRC, 2007)
✓ Domestic gas (Xu and Wang, 2013; Li and Meng, 2013)
✓ Consumer goods(MHRC, 2007)
✓ Fresh foods (Lee, 2010)
✓ Natural assets/resources(Unit's, 2013)
✓ Energy/fuel #

Table 2f: List of live ability element for and communication system"

Construct 6: Information and Communication System
✓ Protection against crimes (Xu and Wang, 2013; Wei and Jiali, 2012)
✓ Emergency rescue (Xu and Wang, 2013; Li and Meng, 2013)
✓ Housing and residential maintenance (Xu and Wang, 2013)
✓ Mobile cellular coverage (Hearn and Foth, 2005)
✓ Mail (MHRC, 2007)
✓ Mass media (MHRC, 2007)
✓ Cable television (Wei and Jiali, 2012)
✓ Fixed telephone line (Xu and Wang, 2013; MHRC, 2007)
✓ Internet network (Hearn and Foth, 2005)
✓ Radio broadcasting (Hearn and Foth, 2005)
✓ Networking and computer hardware (Hearn and Foth, 2005; Hanafizadeh et al., 2009)
✓ Software technology application (e.g. e-banking) (Hearn and Foth, 2005; Hanafizadeh et al., 2009)
✓ Residential community network (Hearn and Foth, 2005; Hanafizadeh et al., 2009)

Table 2g: List of live ability element for "economic sustainability"

Construct 7: Economic Sustainability
✓ Human capital quality (Petrakos et al., 2007; Artelaris et al., 2006) High technology, innovation and R and D (Petrakos et al., 2007; Artelaris et al., 2006)
✓ Openness to trade (Petrakos et al., 2007; Artelaris et al., 2006)
✓ Good infrastructure (Petrakos et al., 2007)
✓ Significant investment (Petrakos et al., 2007; Artelaris et al., 2006)
✓ Rich natural resources (Petrakos et al., 2007; Radelet et al., 1997)
✓ Economic policies (Petrakos et al., 2007; Artelaris et al., 2006)
✓ Population size and growth (Petrakos et al., 2007; Artelaris et al., 2006; Radelet et al., 1997)
✓ Socio-cultural support (Petrakos et al., 2007; Artelaris et al., 2006)

Table 2h: List of live ability element for "governance policies"

Construct 8: Governance Policies
✓ Consensus orientation (Sheng, 2010; Fritsche et al., 2015; Graham et al., 2003)
✓ Accountability to public and stakeholders (Sheng, 2010; Fritsche et al., 2015; Graham et al., 2003)
✓ Responsiveness of service to stakeholders (Sheng, 2010; Fritsche et al., 2015; Kaufmann et al., 2010)
✓ Accessibility and transparency of information (Sheng, 2010)
✓ Effectiveness and efficiency of resources usage (Sheng, 2010; Fritsche et al., 2015)
✓ Equity and inclusiveness of society members (Sheng, 2010; Fritsche et al., 2015)
✓ Enforcement of laws (Sheng, 2010)
✓ Political stability and absence of violence (Kaufmann et al., 2010)
✓ Corruption combat (Fritsche et al., 2015; Kaufmann et al., 2010)
✓ Stakeholder participations (Sheng, 2010)

The quality of the sets of questions developed has been ascertained using Cronbach Alpha method and the value obtained for each construct is between 0.917 to 0.962 (see Table 3 and Table 4).

2.2. Data collection and analysis

The questionnaires are manually administered to respondents representing the categories of people who would potentially be living on a future mega float and as such, for example, offshore engineers are one of the priority groups. The data has been processed using SPSS (Statistical Package for Social Science) software.

Table 3: Result of reliability test for resources sustainability

Reliability Statistics	
Cronbach's Alpha	N of Items
0.917	9

Table 4: Result of reliability test for safety environment

Reliability Statistics	
Cronbach's Alpha	N of Items
0.962	10

Normality test on each construct has been performed using the Kolmogorov-Smirnov and the Shapiro-Wilk Test. The returned Sig. values as presented in Table 5 are below 0.05, signifying that the constructs are of non-normal distributions.

Some analysis on the live ability factors proposed has been carried out. Descriptive analysis is utilized to determine the relevance of the factors which could be indicated by the means, standard deviations and variance values obtained for each construct. Analysis of variance approach is employed to check whether there has been difference in perception between groups of respondents. Correlation analysis is applied to indicate the degree of connectedness between the proposed factors.

Table 5: Result of normality test

	Kolgomorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Social Environment	0.170	165	0		165	0
Physical Environment	0.208	165	0		165	0
Functional Facilities & Services	0.171	165	0		165	0
Safety Environment	0.251	165	0		165	0
Resources Sustainability	0.187	165	0		165	0
Information & Communication System	0.177	165	0		165	0
Economic Sustainability	0.158	165	0		165	0
Governance Policies	0.180	165	0		165	0

a Lilliefors Significance Correction

3. Result

Over 165 respondents participated in the survey. By gender 80.60% of the respondent are male, 57.00% are between age of 21 to 40, 69.70% are Malay ethnic, 55.20% are from urban area, 52.10% are single, 70.30% possess tertiary education, 50.30% employed as other category, 53.90% are related to marine industry and 95.80% have the experience of staying away from home.

The descriptive statistical analysis produced results as summarized in Table 6. Mean values for all constructs are between 4.33 and 4.56, signifying that all respondents agree with the live ability elements proposed. The lowest mean value is for Construct 3; functional facilities and services (4.33). The highest mean values is for Construct 4; safety environment (4.56). The mean values for other constructs are 4.33 for social environment (Construct 1), 4.43 for physical environment (Construct 2), 4.47 for resources sustainability (Construct 5), 4.38 for information and communication system (Construct 6), 4.38 for economic sustainability (Construct 7), and 4.43 for governance policies (Construct 8).

The corresponding standard deviations and variances are small where standard deviations are between 0.60 to 0.71 and variances are between 0.36 to 0.51, indicating a strong consistency of the proposed elements. The smallest standard deviation is for resources sustainability (0.60) while the largest is for functional facilities and services (0.71). The smallest variance is for resources sustainability (0.36) while the largest variance is for functional facilities and services (0.51).

An analysis of variance has been performed using the chi-square method to check the possible difference of opinion between different groups of respondents on the eight constructs proposed. The condition of the null hypothesis, H_0, is developed as such there is no difference opinion among the respondents. This shall be accepted when the asymp. sig. values produced are greater than 0.05. The chi-square analysis on age is divided into 20 and below, 21 - 40, 41 - 60 and 60 and above while analysis on employment is composed of professional and non-professional category. The result of the analysis on age, employment category and relation to offshore/marine industries are summarized in Table 7 respectively.

Table 6: Respondent's perception on liveability

		Social Environment	Physical Environment	Functional Facilities &	Safety Environment	Resources Sustainability	Information & Communication	Economic Sustainability	Governance Policies
N	Valid	165	165	165	165	165	165	165	165
	Missing	0	0	0	0	0	0	0	0
Mean		4.3320	4.4303	4.3361	4.5552	4.4653	4.3830	4.3825	4.4285
Std. Deviation		0.69962	0.70152	0.71054	0.66410	0.60156	0.66467	0.61600	0.62565
Variance		0.490	0.492	0.505	0.441	0.362	0.442	0.379	0.391

Table 7: Chi-square analysis for age, employment category and offshore industries

	Age			Employment Category			Offshore/Marine Industries		
	Value	df	Asymp. Sig. (2-sided)	Value	df	Asymp. Sig. (2-sided)	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	282.748a	272	0.314	145.333a	136	0.276	136.490a	136	0.472
Likelihood Ratio	277.185	272	0.402	201.342	136	0	188.185	136	0.002
Linear-by-Linear Association	0.623	1	0.43	0.817	1	0.366	1.477	1	0.224
N of Valid Cases	165			165			165		
Note	a 410 cells (99.8%) have expected count less than 5. The minimum expected count is .14.			a 272 cells (99.3%) have expected count less than 5. The minimum expected count is .50.			a 272 cells (99.3%) have expected count less than 5. The minimum expected count is .46.		

Is clearly shown that the recorded asymp. sig. values are above 0.05, indicating that HO is accepted. This means there is no significant difference in opinion between age, employment category and relation to offshore/marine industries to the eight constructs proposed. The asymp. sig. values for age demographics is 0.31, the asymp. sig. values for employment category is 0.28 and the asymp. sig. for relation to offshore/marine industry is 0.47.

Table 8: Correlation analysis

		Social Environment	Physical Environment	Functional Facilities & Services	Safety Environment	Resources Sustainability	Information & Communication System	Economic Sustainability	Governance Policies
Social Environment	Pearson Correlation	1	.795**	.747**	.715**	.648**	.578**	.605**	.618**
	Sig. (2-tailed)		0	0	0	0	0	0	0
	N	165	165	165	165	165	165	165	165
Physical Environment	Pearson Correlation	.795**	1	.813**	.750**	.663**	.590**	.652**	.679**
	Sig. (2-tailed)	0		0	0	0	0	0	0
	N	165	165	165	165	165	165	165	165
Functional Facilities & Services	Pearson Correlation	.747**	.813**	1	.758**	.745**	.717**	.707**	.682**
	Sig. (2-tailed)	0	0		0	0	0	0	0
	N	165	165	165	165	165	165	165	165
Safety Environment	Pearson Correlation	.715**	.750**	.758**	1	.886**	.782**	.790**	.778**
	Sig. (2-tailed)	0	0	0		0	0	0	0
	N	165	165	165	165	165	165	165	165
Resources Sustainability	Pearson Correlation	.648**	.663**	.745**	.886**	1	.793**	.746**	.761**
	Sig. (2-tailed)	0	0	0	0		0	0	0
	N	165	165	165	165	165	165	165	165
Information & Communication System	Pearson Correlation	.578**	.590**	.717**	.782**	.793**	1	.807**	.804**
	Sig. (2-tailed)	0	0	0	0	0		0	0
	N	165	165	165	165	165	165	165	165
Economic Sustainability	Pearson Correlation	.605**	.652**	.707**	.790**	.746**	.807**	1	.853**
	Sig. (2-tailed)	0	0	0	0	0	0		0
	N	165	165	165	165	165	165	165	165
Governance Policies	Pearson Correlation	.618**	.679**	.682**	.778**	.761**	.804**	.853**	1
	Sig. (2-tailed)	0	0	0	0	0	0	0	
	N	165	165	165	165	165	165	165	165

** Correlation is significant at the 0.01 level (2-tailed).

Table 8 presents the correlations between the eight constructs proposed. The recorded Pearson's r^2 - values are between 0.58 and 0.89, indicating correlations between the constructs as referred to Guilford (Guilford, 1956). The r^2 - values below 0.2 indicates an almost negligible relationship, r^2 - values between 0.2 to 0.4 indicate low correlation, r^2 - values between 0.4 to 0.7 indicate moderate correlation, r^2 - values between 0.7 to 0.9 indicate high correlation, and r^2 - values above 0.9 indicates very high correlation. Correlation with r^2 - values greater than 0.70 (Guilford, 1956) has been taken as acceptable and hence a total of nineteen pair of constructs of the proposed liability factors have high correlations as summarized in Table 9.

A total fourteen pairs of constructs are within 0.7 to 0.8. The r^2 for social environment with physical environment is 0.80. The r^2 for safety environment with economic sustainability is 0.79. The r^2 for resources sustainability with information and communication system is 0.79. r^2 for social environment with functional facilities and services is 0.75. The r^2 for social environment with safety environment is 0.72. The r^2 for physical environment with safety environment is 0.75. The r^2 for functional facilities and services with safety environment is 0.76. r^2 functional facilities and services and resources sustainability is 0.75. The r^2 for functional facilities and services with information and communication system is 0.72. The r^2 for functional facilities and services with economic sustainability is 0.71. The r^2 for safety environment with information and communication system is 0.78. The r^2 for safety environment with governance policies is 0.78. The r^2 for resources sustainability with economic sustainability is 0.75. The r^2 for resources sustainability with governance policies is 0.76.

Table 9: Summary of correlation analysis

S/N	Constructs	r^2
1	Safety Environment Vs. Resources Sustainability	0.886
2	Economic Sustainability Vs. Governance Policies	0.853
3	Physical Environment Vs. Functional Facilities & Services	0.813
4	Information & Communication System Vs. Economic Sustainability	0.807
5	Information & Communication System Vs. Governance Policies	0.804
6	Social Environment Vs. Physical Environment	0.795
7	Resourcees Sustainability Vs. Information & Communication System	0.793
8	Safety Environment Vs. Economic Sustainability	0.790
9	Safety Environment Vs. Informationa & Communication	0.782
10	Safety Environment Vs. Governance Policies	0.778
11	Resources Sustainability Vs. Governance Policies	0.761
12	Functional Facilities & Services Vs. Safety Environment	0.758
13	Physical Environment Vs. Safety Environment	0.750
14	Social Environment Vs. Functional Facilities & Services	0.747
15	Functional Facilities & Services Vs. Resources Sustainability	0.745
16	Resources Sustainability Vs. Economic Sustainability	0.746
17	Functional Facilities & Services Vs. Information & Communication System	0.717
18	Social Environment Vs. Safety Environment	0.715
19	Functional Facilities & Services Vs. Economic Sustainability	0.707

A total five pairs of constructs are within 0.8 to 0.9. The r^2 for physical environment with functional facilities and services is 0.81. The r^2 safety environment with resources sustainability is 0.89. The r^2 for information and communication system with economic sustainability is 0.81. The r^2 for information and communication system with governance policies is 0.80. The r^2 for economic sustainability with governance policies is 0.85.

4. Discussion

The results from descriptive statistical analysis indicate that the respondents put emphasis on the eight live ability factors proposed for the long term habitable offshore mega floats which are social environment, physical environment, functional facilities and services, safety environment, resources sustainability, information and communication system, economic sustainability, and governance policies. The chi-square test results further show that the views of respondents are alike or undivided. They have similar opinions on factors that define live ability of a long term habitable offshore mega float. The yound and the old, the professionals and the nonprofessionals and the marine related and the non-marine related are sharing the same opinion. Furthermore, they ranked nineteen pairs of live ability factors as correlated and of the nineteen pairs 5 are highly correlated.

Overall, the findings suggest that potential habitants of the long term habitable offshore mega floats expect similar facilities and services that they and their loves one are used to currently. They would like to maintain the same culture and environment that surround their current life (social environment, physical environment and safety environment elements). They would like to maintain their current lifestyle as much as possible and would not easily forego the live ability comfort that they are enjoying on land (functional facilities and services, information and communication system and governance policies elements). They prefer to maintain the status quo on matters important to their wealth, career and economic comfort and life sustainability including those for the future of their children (resources sustainability and economic sustainability elements).

Specific results from the correlation studies, and based on minimum r^2 of 0.7, safety environment element is found to be correlated to 7 other live ability elements with an average r^2 value of 0.78 (refer to Table 9). It can be seen as the most influential. In other words providing other elements will probably not providing full impact if safety environmental is not part of the package? The second most influential live ability element is functional facilities and services with average r^2 of 0.75. It packages itself with 6 other elements. Third most influential are resources sustainability element, economic sustainability element and information and communication system with an average r^2 of 0.78. Each package itself with 6 other live ability elements.

The least correlated live ability elements are social environment element and physical environment element. Each is packaged to only 3 other elements. It safely indicates that, when spaces and resources are limited, these two elements could be foregone. However, safety related items shall not be foregone. For social and environment element, for example, safety related items as have been included in the construct that are not to be foregone include communal works and community connectedness. Similarly, noise control, air pollution control and residential connectedness are safety related and must not be excluded. These will be in addition to all safety items listed under safety environment construct which itself is not an exhaustive list.

Therefore, in practical sense, the findings suggest that priorities in the design of a live ability complying mega float for long term habitation starts with safety environment on all aspects, physical or nonphysical inclusive of safety against the risk of systems' engineering and technical failures, safety against risk of threat from terrorism and piracy and safety against risk of common robbery. Escape during an emergency is one design area to pay attention to. Second design priority is providing sufficient physical public infrastructure for housing and accommodation, business and commercial, sports and leisure and transportation which are safe and well sustained. Third design priority is providing space for economic resources, self-sufficiency and sustainability, including areas for industrial activities and commercial activities as well as reserve spaces for activity, and hence, population expansion. Fourth design priority for a live able advanced mega float is the allocation of sufficient space for Information and Communication Technology and broadcasting systems. Key spaces are for buildings for management and operations and transmission systems. Actual amount of live ability complying spaces for safety, physical infrastructure, economic and wealth sustaining units and ICT and broadcasting facilities could be estimated based on benchmark values provided for land based.

5. Conclusion

Fundamental elements such as sustainability and live ability are important aspect in the design of mega floats for long term habitation. In planning and, as such, conceptual designing they must be given emphasis (Zakaria, 2012). It influences the type and quantity of facilities to be provided on the mega floats. Statistically, the study found that there are eight liability factors not to be missed which are social environment, physical environment, functional facilities and services, safety environment, resources sustainability, information and communication system, economic sustainability and governance. It also founds that all these factors a correlated to each other. Based on r2 value safety environment factor is the most important for it strongly correlate itself to six other live ability factors. Functional facilities and resources factor is the second most important and the third are resources sustainability factor, economic sustainability factor and information and communication factor. The least important factors are the social environment factor and the physical environment factor. An interesting extension to this study would be on transforming the information into design data. The live ability factors must be translated and broken down into physical entities that will later be given technical descriptions and specifications such that their space and volume requirement could be ascertained.

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