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Dietetics Practice in the Scope of Disease Prevention in Community Settings: A School-based Obesity Prevention Program (SOPP)

Elham Abbas Aljaaly, Nahlaa Abdulwahab Khalifa

Abstract— The active method of disease prevention is seen as the most affordable and sustainable action to deal with risks of non-communicable diseases such as obesity. This eight-week project aimed to pilot the feasibility and acceptability of a school-based programme, which is proposed to prevent and modify overweight status and possible related risk factors among student girls "at the intermediate level" in Jeddah city. The programme was conducted through comprehensible approach targeting physical environment and school policies (nutritional/exercise/behavioural approach). The programme was designed to cultivate the personal and environmental awareness in schools for girls. This was applied by promoting healthy eating and physical activity through policies, physical education, healthier options for school canteens, and the creation of school health teams. The prevention programme was applied on 68 students (who agreed to participate) from grades 7th, 8th and 9th. A pre and post assessment questionnaire was employed on 66 students. The questionnaires were designed to obtain information on students' knowledge about health, nutrition and physical activity. Survey questions included information about nutrients, food consumption patterns, food intake and lifestyle. Physical education included training sessions for new opportunities for physical activities to be performed during school or after school hours. A running competition "to enhance students' performance for physical activities" was also conducted during the school visit. A visit to the school canteen was conducted to check, observe, record and assess all available food/beverage items and meals. The assessment method was a subjective method for the type of food/beverages if high in saturated fat, salt and sugar (HFSS) or non-HFSS. The school canteen administrators were encouraged to provide healthy food/beverage items and a sample healthy canteen was provided for implementation. Two healthy options were introduced to the school canteen. A follow up for students' preferences for the introduced options and the purchasing power were assessed. Thirty-eight percent of young girls (n=26) were not participating in any form of physical activities inside or outside school. Skipping breakfast was stated by 42% (n=28) of students with no daily consumption (19%, n=13) for fruit/vegetables. Significant changes were noticed in students' (n=66) overall responses to the pre and post questions (P value=.001). All students had participated in the conducted running competition sessions and reported satisfaction and enjoyment about the sessions. No absence was reported by the research team for attending physical education and activity sessions throughout the delivered programme. The purchasing power of the introduced healthy options of "Salad and oatmeal" was increased to 18% in 8 weeks at the school canteen, and slightly affected the purchase for other less healthy options. The piloted programme indorsed better health and nutrition knowledge, healthy eating and lifestyle attitude, which could help young girls to obtain sustainable changes. It is expected that the outcomes of the programme will be a corner stone for futuristic national study that will assist policy makers and participants to build a knowledgeable health promotion scenario and make sure that school students have access to healthy foods, physical exercise and healthy lifestyle.

Keywords: *Adolescents, Diet, Exercise, behaviours, Overweight/obesity, Prevention-intervention programme, Saudi Arabia, Schoolgirls.*

Introduction

It is well established that risk factors such as unhealthy diet and lifestyle behaviours are known to increase the risk of obesity and related diseases. Most of these factors are related to poor knowledge, attitude and behaviours; thus the active method of prevention is seen as the most affordable and sustainable action to deal with the risk of obesity [1]. Evidence confirmed that prevention programs those are school-based with limited resources could support students to improve their eating patterns, enhance their performance for physical activity, which help them reach their ideal body weights. This will authorize schools to turn out to be an integral part of the competition against the obesity prevalent. This requires quick action [2].

Adolescents' females in Saudi Arabia adapted unhealthy eating behaviours and habits for different reasons such as taste and convenience. Mostly they consume fast foods, particularly burgers and carbonated beverages at "least once a week" [3], [4] Saudi adolescents consume less milk and skip breakfast in the morning. They also, sleep for long time during vacation, and do not exercise regularly [5], [6]. Food related behaviour and food consumption is a major cause for concern as anecdotal evidence suggests over-consumption of food in all age groups. The cultural context of food consumption has not been fully examined and this forms an important basis for any health interventions and nutrition guideline formulation for any

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population group. The focus of the present study is therefore to manage exposure risk factors of obesity with a view to targeted prevention-intervention pointed at both primary and secondary prevention of modifiable risk factors for obesity.
The consequences of overweight and obesity include increased risk of other diseases such as cardiovascular, stroke, cancers and diabetes mellitus. There has been an increase in the incidence of this health problem and related diseases in children as young as 7 years old. A study in Kuwait showed that average body mass index (BMI) values among children aging 6 to 13 years consistently above the 90th percentile in each age group category indicating obesity prevalence above 45% [7]. In Saudi Arabia, overweight and obesity is prevalent among quarter of population at Saudi schools for girls who age 13 to 18 years old [8]. Similar results (22%, n=68) were found among the participants of the present study [9].

It has been evidenced that adolescents and young adults develop similar health benefits from physical activity. Sedentary activities such as sitting down at school breaks for eating or talking to friends is prevalent among 41% of Saudi students [10]. A previous national study noticed that there is a positive association between intelligence quotient of adolescent students with good health status and physical activity. Similarly, there was an inverse correlation between physical activity and body mass index [11]. Physical activity at Saudi schools for girls and physical education are used to be excluded at public schools and allowable for around one to two hours per week in self-governing schools. However, is not compulsory.

Saudi students (63%) preferred to have physical education classes at school [10]. Physical education in female Saudi public schools is included in some courses and not in a separate course in the curriculum. However, in private schools it is delivered to students as a separate course [12]. Early health education program besides healthy school environment can enhance learning and improve outcomes. Education and curriculum should include balanced and holistic range of objectives, and contain different types of education. Therefore, it was recommended that in order to achieve goals, we need to increase attention to the humanities and social sciences in the curriculum [13].

Traditionally, school health department that serve girls in public schools is Saudi Arabia have been fundamental and supportive to students' health by providing different immunizations and vaccines. A conducting for some regular screening and health assessment programs for some diseases and conditions e.g. screening program for anaemia in schools for girls was also one of the school health practices [12]. They also supported and provided some nutrition programs such as Dates & Milk programme [14]. However, no opportunities for physical activity (PA) and physical education (PE) programs were provided to present (in both intra and extra-curricular form). This because PA & PE were influenced by national policies that used to band PA & PE in schools for girls [10]. However, "in July 2017" the government introduced a reform that it works toward its Saudi Vision 2030, to allow girls at public schools to participate in physical education starting in the academic year 2017-2018. The reform did not specify what kinds of activities to be included in the classes, but stated that all activities will comply with the "rules of sharia" [15]. Establishing physical education classes across all public schools for girls is a big challenge for the Saudi Ministry of Education (MoE). There is a need to equip schools for sports facilities and provide large areas for practicing outdoor activities. Most schools have large areas but were underutilized (based on national rules) to provide opportunities to practice physical activity for female children and adolescents [12]. Although Saudi universities did not previously trained female PE teachers, postgraduate diplomas in PE "that is specified for teachers" was approved by MoE to be established urgently in the academic year 2017-2018. The Education Ministry held workshop to discuss physical education at girls' schools [16]. A committee from the MoE decided for the design and implementation of the Diploma of Physical Education to be launched in universities. The Institute of Educational Graduate Studies at King Abdulaziz University and according to the initiation of the Minister of Education has recently formed a committee that include a number of faculty members those are specialized in education, food and nutrition, clinical nutrition, physical education and other professionals to design and implement the Diploma of Physical Education that will be presented by the university. This higher diploma in PE is to be structured as didactic programs and for 3 semesters: A one whole year for theoretical and practical parts and the last whole semester to be a fieldwork-based training program. Teachers can save a practical (fieldwork) placement in one of the schools at any level (elementary, intermediate or high). A well-planned supervision approach will be applied for the fieldwork period by universities who provide these programs [17].

Looking at the Saudi literature concerning canteens' content, an online document "in Arabic language" that is belong to school affair agency and public school health administration indicated in its part one in section four that food allowed in school canteens are characterised as full fat, low fat, fortified and flavoured milk. The same document reported that biscuits with whole grain and refined grain with dates and sesame are available in canteens. Other available food items are nuts and fresh fruits, cheese, peanut butter, boiled egg and jam sandwiches. Fresh juice (100%), canned juices at least 30%, hot beverages and small water bottles were also available. In part two of the document, some instructions about the way that food/beverage items should be presented in canteens included sandwiches, which should be warped in plastic, raw materials should be stored in refrigerators, beverages should not be placed in glass bottles, sold sandwiches and fresh juices should be fresh and food should be made based on instructions for preservation and consumption. The third part of document included food/beverages items those are not permitted in school canteen e.g. candies, chocolates, chips, soft beverages, canned juice beverages (less than 30% juice), meat and organs (such as liver & kidneys) and falafel (which could be refereed to its fat content as it is always served as fried) [18]. A sixty-seven percent of meals and snack options accessed by schoolgirls "at high & intermediate level" in Jeddah city were HFSS [19]. Moreover, "Competitive Foods" such as the one sold or served outside of school meals such as vending machines are also of

high risk for student's health and they are out of control of school polices [12].

In practice, dietitians in community-based programs are knowledgeable and possess skills in several critical areas. These include utilizes of national and international legislative structures and procedures intricate in the improvement of community strategy and regulations that impact and communicate to nutrition and health facilities, knows and uses an epidemiologic methodology to evaluate health and nutrition problems and styles in the public and functions as a multidisciplinary and interdisciplinary team members.

The role of a registered Dietitian -Nutritionist in prevention for individuals at risk for developing obesity is important to prevent and control weight gain, related complications and further progression. This could start with primary prevention when screening students at high risk for overweight or obesity [9]. Then, application of changing diet and lifestyle behaviours can take place. The second level of prevention could include medical nutrition therapy or interventions to reach the best healthy weight. These two levels if applied, complications of obesity would be prevented. Therefore as part of implementing the role and practice of the dietitian in the area of disease prevention in a community setting, faculty staff and dietetics senior students participated in conducting this study. This is in order for students to be trained in comprehensively practice dietetics in disease-prevention. The programme allowed students to apply the dietetics practice in different scopes which included research conduct, assessment of nutrition status (anthropometrics, dietary, laboratory and physical) [9], education and counselling for at risk for or overweight and obesity. Therefore, skills to be applied by faculty members and gained by students to develop a model that focus on a multi-disciplinary methodology for preventative and integrated care set in for obesity in Saudi schools for girls was one of the objectives of this study. **The project aimed** for co-design and piloting of a prevention programme in one intermediate school for girls in Jeddah city. This is supported by the agreement of Saudi Ministry of Education, the Research Ethics Committee at the Faculty for Medical Applied Science at King Abdulaziz University, the principal teacher of the piloted school, students and their parents. The programme is aimed to target all schools in Jeddah and the whole country of Saudi Arabia. This study is part of a study that concerns a pilot project used community-based approaches to address physical environment (food access at school canteens and opportunities for physical education and activity), as an affecting factor that could impact weight management and control for school girls. The other part was to pilot an individualized intervention programme for girls who are diagnosed as overweight/obese [9]. The study helps dietetics students to understand political and ethical considerations within and across organizations and their impact on agency planning, policy, and decision making needs of individuals. It is the view of the project team that this project will provide a solid basis for future larger studies that help in comparisons, provide reliable data for the National Health Survey and contribute to nutrition and health policy for the people of Saudi Arabia. It is also envisaged that outcomes of the future national project would contribute to the formulation of national nutrition guidelines, nutrition education, health promotional materials and information for the general public.

Material and Methods

A school-based obesity prevention programme at personal and environmental levels in schools for girls was designed and conducted by promoting physical education, healthy eating, increasing physical activity through policies, physical education (extra-curricular activities), improved school catering/food service and activity options, and the creation of school health teams. Increased awareness among teachers and school administrators about risk factors and underlying causes of obesity resulting from the project's healthy lifestyle messages was applied. A total sample of 68 female students, their age ranged from 13 to 15 years were recruited (if agreed to participate in the study). The school and participants were recruited with agreement from Ministry of Education, school administration, parents and students.

Research Hypothesis: A preventive school-based programme to create a healthier physical environment including a physical education & physical activity and a healthy school canteen programme will enhance weight control, change lifestyle and behaviours of schoolgirls at intermediate level.

A Designed Health and Nutrition Educational Programme

A sample piloting physical educational programme that is health and nutrition related was introduced to all students in the school. The programme included information on how to determine the healthy nutrients that are suitable for their age and live a healthy lifestyle. Methods to help in performing enough physical activities and eating right were also emphasized. This is in order to prevent/control nutrition-related diseases. Moreover, advices on following planned special diets (by health professional), avoiding un-prescribed dieting practices, unhealthy and unbalanced (FAD) diets was applied. The impact of media on adolescents' eating choices was also described in the programme. Lessons and advices to limit the screen and computer time to ≤ 2 hours/day (the cut-off point of screen time, [12] was also comprised. Nutrition and activity instructions were also considered. The nutrition and physical education programme was delivered to students in the activity times on weekly basis through continues lectures for a period of eight weeks.

A pre and post-tests were used to evaluate the students' knowledge about nutrition, health and their applications. The questions were about nutrition and health information e.g.

"food groups, macro & micro nutrients, healthy and nutritious snacks and healthy food choices. A quick survey questionnaire was also applied and completed by students before delivering the programme. It included students' responses about some eating behaviours, participation in physical activities at school and outside school such as recreational activity and indoor or outdoor activities "performed after school, at home, or away from home". Survey questions also included surveys about sedentary behaviours or activities that provide very low energy e.g. television watching or playing on computer (screen and computer time), reading or doing homework. Students were also asked to response to surveys about dieting practices and attempts to alter or control their weight. A previously validated questionnaire was adapted and modified with permission from the main author to be used in this study [12].

The delivered educational programme included training sessions for students about new opportunities for physical activities to be performed during school hours (breaks such as recreational breaks) or after school at fitness centers and outdoor areas. The research team has conducted a running competition (marathon) sessions for the attended students during the school visits. This was to enhance their performance of physical activities. Incentives were introduced to winners and for those saved first places in the competition. Other activities were encouraged and guided by the research team and/or the involved trained teachers. These activities were performed during the school day. This included using the stairs, walking or running with friends at break times. The programme was applied in the presence of teachers who are assigned for students' extra-curricular activities and school health. This was in order to update and promote their knowledge and experience and to be aware of the delivered information to students. This is in order to continue the programme for sustainability.

School Canteen

The research team visited the school canteen and checked (observed & recorded) and assessed all food and beverage items. The assessed food items were classified "subjectively" to healthy or less healthy options based on its content of fats, sugars & salt. A sample of a healthy canteen was provided to the head teacher and the school canteen administrators. The canteen administrators were advised to implement the sample healthy canteen in the school. In addition, two healthy recipes (oats porridge & packed green salad) were provided to the school canteen to be introduced to students. Recipes were provided. The two introduced items were recommended to replace items that are less healthy.

Ethical Considerations

Approval from King Abdulaziz University's Ethical Committee and the Ministry of Education (MoE), Local Research Ethics Committee were required prior to commencement of fieldwork. Although no invasive procedures were involved in conducting this study, individual written consent was sought prior to inclusion in the programme. Written consent was requested from each participant for the recruitment to the School-based Obesity Prevention Program (SOPP). All participants were told that they could withdraw their consent at any time.

Results

The prevention programme including the healthy canteen, physical education and activity was delivered to students in one academic school for girls. The programme duration was eight weeks and was delivered in the academic year 2015-2016. The programme was applied on 68 students at the intermediate level of the school.

In order to apply the physical education programme, the school administrators had to cut major amounts of time from science, reading and mathematics lessons. However, most schoolteachers were not happy to use their lessons time for physical education and activities. Based on student's response to the survey questionnaire prior to the conduct of the programme, students (38%, n=26) reported no engagement in any type of physical activities inside or outside school. The rest of students were performing different types (mild, moderate and vigorous) and patterns of physical activity outside school. Activities included mild, moderate or vigorous activities e.g. walking, shopping, swimming, cycling and dancing. Some students were joining fitness centers, however, the rest did not afford the high prices for fitness centers. Dieting practices was reported by 61% (n= 41) of participants and mostly was not prescribed by a health professional. Skipping breakfast was indicated by 42% (n=28) of students. Daily consumption for fruit/vegetables was not practiced by (19%, n=13).

Based on the pre and post-test for information on nutrition and health, significant changes were noticed in students' (n=66) overall responses to the pre and post questions (*P value=.001*). (**Table 1)**

Table 1: The difference in overall results for the marked pre and post-tests that were answered by 66 students (only 2 students did not agree to complete the questionnaires).

		Mean	Number of student	SD	t	df	P value
Information on nutrition and health	Pre	9.6667	66	2.22111	-10.387-	65	**.001**
	Post	14.0606	66	2.73371			

***P Value is significant at <0.05**

Involvement in all of the programmed physical activities was performed by all students. Students were mostly satisfied about running competition sessions and reported enjoyment about this sessions. Altogether students were interested to attend sessions for physical education and activity. However, during programme delivery, some students were not confident when first been asked to be involved in running competitions arranged by the research team. But, when provided repeated opportunities for practice that was guided by the research team, they developed some skills and confidence that promoted their engagement in different physical activities and the marathon competition. Physical education programme that was structured and applied by the research team (who were qualified to deliver its theory & training parts) has provided students with better experiences that build up their skills and confidence participation in different physical activity.

The subjective assessment for the food and beverages items to healthy and less healthy options showed that available items were more likely to be considered as less healthy options and about 70% of items could be classified (based on its contents) to high in saturated fats, sugars and salt. This includes items like croissants, donuts, Pizza and pastries, full cream cheese sandwiches, biscuits, potato chips, different kinds of chocolates, drinks with different flavours and tea with milk & sugar. The research team had provided recipes for the introduced two items, the oats porridge and the packed green salad. They also followed up about students' consumption to both items and assessed the purchasing power of the items. The purchasing power of the introduced two healthier options was increased to 18% in 8 weeks. However, it did not significantly affect the purchasing power for the other less healthy options.

Discussion

The study is part of a project that aimed for co-design and piloting of a prevention-intervention programme in one intermediate school for girls in Jeddah city [9]. The school was previously screened for overweight status (using national and international reference data). Results showed that 32.4% (n= 22 out of 68) of students were overweight or obese [9]. The intervention programme that was applied for four weeks "on the overweight and obese individuals", resulted in significant changes (p value = 0.009) in standards for BMI for the intervention group, compared to the non-intervention group. Other post intervention results presented significant changes in levels for random blood glucose and values for hand grip with P values of 0.048 and 0.027, respectively. The applied prevention programme (presented in this study) aimed to create a healthier physical environment, where food can be accessed at the same school. The programme targeted the school canteen by applying a healthy school canteen and introduces healthier options to replace less healthy ones. The programme also conducted sessions in nutrition and health, physical education & activity, which resulted in significant changes and improvements in knowledge and practices related to nutrition, health and behavior. In addition, the ways in which physical activity has been effectively integrated into the school environment and the students' achievement in the performed PA and the running competition could confirm the possibility for applying the PE and PA in schools for girls. These results confirmed the feasibility of the programme and the high probability for its application in other schools. Therefore, the whole project including prevention and intervention parts could be considered for application in other schools and in different areas of Saudi Arabia. "To our knowledge" there is a lack of significant previous national research on dietetics practice specific to obesity management at community level. Therefore, application of this programme confirms the role of registered dietitians in practicing the profession at community settings. It also enhances the need to train and encourage dietetics students to perform such practice, which could enhance the prevention of different nutrition-related diseases. The programme can also be applied as joint activities and conducted by health professionals in different areas (e.g. education, nutrition & dietetics, physiotherapy and medicine). The combined prevention and intervention programs would be appreciated as one of the projects within the framework of the Saudi national nutrition and health care. It is been recommended that delivering for health & education programs should provide a national plan focuses on tackling health and education inequalities [20]. Therefore, the recent Saudi governmental reform to establish PA & PE in schools for girls was one of the important area to consider, which will facilitates equalities with boys in health as well as in education. Moreover, lessons should be learned from other countries that are providing physical education classes and from the national experience of including PA and PE in schools for boys. For example: In the best-possible scenario, where physical education classes are likely to provide only 10-20 minutes of vigorous- or moderate-intensity physical activity per session and this cannot be the only source to achieve the recommended PA "of the at least 60 minutes per day" of vigorous- or moderate-intensity physical activity for children and adolescents [2]. Therefore, using different approaches to meet the required time for PA should be considered. Other approaches to promote physical activity in young population need to be systematically subjugated to enhance physical activity opportunities and prevent obesity. These include the cooperation of family, community and macro-systems that could have an impact on children performance for PA. Both educators and policy makers should be fully aware of the health benefit of PA & PE.

Conclusion, Recommendations & implications

Screening programs leading to designing and delivering programs for obesity control is vital. Targeting the school physical environment by implementing prevention programs with the help and cooperation of students and school administration will enhance applicability and the effectiveness of the delivered programs. Education elements included school administration by assessing the school canteen and intervening it by advices in replacing some food and beverages those are less healthy by healthier choices. Recipes and method of preparations were provided and monitoring and evaluation of students' consumption to this food were applied. Percentage of

purchased items was also observed. Classes in education and recommendations for healthy eating and lifestyle were also conducted to students and teachers those involved with school activities. However, programs should include other elements such as cookery classes, combining healthy eating guidelines and evaluating of nutrition and value of food items. Encouraging school and students to use simple resources at school such as stairs, large available areas, and easy access for safe walking and cycling in schools and homes or around them. Project supervision by experienced professional in nutrition, physical education and activities is needed to sustain the achieved results. Although this project required to improve girls' diet, physical activity and other behaviours, and the limited timescale for the pilot study for 8 weeks, a trusting and believing relationships between the program's team and the school administrators and students was built. More confidence and trust in applying the programme and get benefit out of it will be obtained when the programme applied for longer period, supervised and followed up by professionals. This will reduce students' isolation from others. It will also improve self-efficacy and sustainability of health and wellbeing. In order to apply this programme in more schools or at a national level, the following actions need to be taken:

Decision making power should not only obtain from the project team but should be at community, school health and Ministry of Education level.
Recruiting and training of teachers those are specialized in nutrition, physical education and activities is required.
Programs should not only focus on application of the programme but also on sustainability of these programs.
There is a need "to nationally" unify the nutrition & dietetics practice in the scope of obesity management and control. Nutrition policies and procedures in preventing and treating obesity at clinical and community level need to be standardized for all health sectors in the Kingdom of Saudi Arabia.
The guidance of the professional body "the Saudi Dietetic Association" to the practice of dietetics in Saudi Arabia is essential. This will assist in informing, protecting, representing and supporting all practitioners in the field of dietetics to work within an ethical framework. It will also express the nutrition and dietetic process in the dietetic practice & disease management, particularly for nutrition-related diseases.
Future research and programs require application of the prevention programme in different schools including public school and schools for boys. This is in order to facilitate comparison of results from different schools
More objective data should be used to measure feasibility and validity of the used materials in the programme. E.g. the evaluation of the type of food/beverage items available at the school canteen, the measure of the PA performance and the pre and post answers to each question and not to the overall questions.
Social implications: The study introduced a pilot prevention programme to control overweight status with some significant results, which could be applied in schools for girls in Saudi Arabia.

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A Screening Program for Overweight Status among Schoolgirls in Saudi Arabia: A Proposed Co-Design Project to Tackle the Problem

Elham A. Aljaaly

Abstract**—**The paper realizes the importance of communicating with schools to conduct nutritional screening, assessment and intervention programs for obesity and related risk factors to tackle the problem at earlier stage. The screening program was conducted by dietetics' students "under supervision" as part of their practice and community services to apply some assessment method for nutritional status. Two intermediate schools for girls in Jeddah city were involved in the screening stage, followed by a full nutritional assessment and implementation of a designed intervention program at one of the schools. At screening stage, interview questionnaires for diet histories and anthropometric measurements used to screen overweight status and related food patterns. National and international references data used for assessment and comparison. Following screening approach, a designed comprehensive nutritional assessment and intervention program was piloted at one of the screened schools for overweight status. For screening stage: the overall prevalence of overweight girls is 61% (n = 81 out of 133) of the population, 73% (n = 91) of girls were centrally obese. Almost 3/4 of all students reported no participations in any type of physical activities/exercises. Dietary behaviors included non-consumption of breakfast (83%) and low intake of fruit and vegetables (38%). For intervention stage, the present report concentrates on data concerning post intervention changes in Body Mass Index (BMI) and Waist Circumference (WC). By the 30 days of intervention there were significant changes in values for BMI according to Saudi growth chart (p value = 0.009) with no changes among the control group. No statistically significant difference in the mean WC of the group. Study's results suggest that approaching young girls through schools to screen, assess and intervene overweight status and risk factors is vital. Although the non-random selection of only two schools for screening the prevalence of overweight status among school girls prevent the generalizability of the study findings to wider population, previous studies used random selection of schools and large sample sizes showed a high prevalence of overweight status among Saudi students. Therefore, designing and piloting of an intervention program for implementation at a national level is useful to tackle the problem.

Keywords**—**Screening program, nutritional assessment, overweight status, intervention programs, diet histories, anthropometry, and dietetic students.

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Protective Effect of *Cinnamomum zeylanicum* Bark Extract against Doxorubicin Induced Cardiotoxicity: A Preliminary Study

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***Abstract*—**Introduction: Doxorubicin is widely used in the treatment of solid organ tumors and haematological malignancies; but the dose dependent cardiotoxicity due to free radical formation compromises its clinical utility. Therapeutic strategies which enhance cellular endogenous defense systems have been identified as promising approaches to combat oxidative stress-associated conditions. *Cinnamomum zeylanicum* (Ceylon cinnamon) has a number antioxidant compounds, which can effectively scavenge reactive oxygen including superoxide anions, hydroxyl radicals and as well as other free radicals. Therefore, the objective of the study was to elucidate the most effective dose of *Cinnamomum* bark extract which ameliorates doxorubicin induced cardiotoxicity.

Materials and methods: Wistar rats were divided into seven groups of 10 animals in each. Group 1: normal control (distilled water, orally, for 14 days, 10 mL/kg saline, ip, after 16 hours fast on the 11th day); Group 2: doxorubicin control (distilled water, orally, for 14 days, 18 mg/kg doxorubicin, ip, after 16 hour fast on the 11th day); Groups 3-7: five doses of freeze dried aqueous bark extracts (0.125, 0.25, 0.5, 1.0, 2.0g/kg, orally, daily for 14 days, 18 mg/kg doxorubicin, ip, after 16 hour fast on the 11th day). Animals were sacrificed on the 15th day and blood was collected for the estimation of cardiac troponin I (cTnI), AST and LDH concentrations and myocardial tissues were collected for histopathological assessment of myocardial damage and irreversible changes were graded by developing a score.

Results: cTnI concentration of groups 1-7 were 0, 161.9, 128.6, 95.9, 38, 19.41 & 12.36 pg/mL showing significant differences ($p<0.05$) between group 2 and groups 4-7. In groups 1-7, serum AST concentration were 26.82, 68.1, 37.18, 36.23, 26.8, 26.62 & 22.43U/L and LDH concentrations were 1166.13, 2428.84, 1658.35, 1474.34, 1277.58, 1110.21 & 974.40U/L and a significant difference ($p<0.05$) was observed between group 2 and groups 3-7.

Maximum score for myocardial necrosis was observed in group 2. Parallel to the increase of the dosage of plant extract, a gradual reduction of the score for myocardial necrosis was observed in groups 3-7. Reversible histological changes such as vacuolation, congestion were observed in group 2 and all plant treated groups. Haemorrhages, inflammatory cell infiltrations and interstitial oedema were observed in group 2, but absent in groups treated with higher doses of the plant extract.

Discussion & Conclusion: According to the in vitro antioxidant assays performed, *Cinnamomum zeylanicum* (Ceylon cinnamon) bark possesses high amounts of polyphenolic substances and high antioxidant activity. The present study showed that *Cinnamomum zeylanicum* extract at 2.0g/kg possesses the most significant cardioprotective effect against doxorubicin induced cardiotoxicity. It can be postulated that pretreatment with *Cinnamomum* bark extract may replenish the cardiomyocytes with antioxidants that are needed for the defense against oxidative stress induced by doxorubicin.

***Keywords*—**Cardioprotection, *Cinnamomum zeylanicum*, doxorubicin, free radicals.

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Transcriptomic Analysis of *Acanthamoeba castellanii* Virulence Alteration by Epigenetic DNA Methylation

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Abstract**—**Background. *Acanthamoeba* is a genus of amoebae which lives as a free-living in nature or as human pathogen that causes severe brain and eye infections. Virulence potential of *Acanthamoeba* is not constant and can change with growth conditions. DNA methylation, an epigenetic process which adds methyl groups to DNA, is used by eukaryotic cells, including several human parasites to control their gene expression. We used qPCR, siRNA gene silencing and RNA sequencing (RNA-Seq) to study DNA-methyltransferase gene family (*dnmt*) in order to indicate the possibility of its involvement in programming *Acanthamoeba* virulence potential. Methods. A virulence-attenuated *Acanthamoeba* isolate (designation: ATCC; original isolate: ATCC 50492) was subjected to mouse passages to restore its pathogenicity; a virulence-reactivated isolate (designation: AC/5) was generated. Several established factors associated with *Acanthamoeba* virulence phenotype were examined to confirm the succession of reactivation process. Differential gene expression of *dnmt* between ATCC and AC/5 isolates was performed by qPCR. Silencing on *dnmt* gene expression in AC/5 isolate was achieved by siRNA duplex. Total RNAs extracted from ATCC, AC/5 and siRNA-treated (designation: si-146) were subjected to RNA-Seq for comparative transcriptomic analysis in order to identify the genome-wide effect of *dnmt* in regulating *Acanthamoeba* gene expression. qPCR was performed to validate the RNA-Seq results. Results. Physiological and cytophatic assays demonstrated an increased in virulence potential of AC/5 isolate after mouse passages. *dnmt* gene expression was significantly higher in AC/5 compared to ATCC isolate ($p \leq 0.01$) by qPCR. si-146 duplex reduced *dnmt* gene expression in AC/5 isolate by 30%. Comparative transcriptome analysis identified the differentially expressed genes, with 3768 genes in AC/5 vs ATCC isolate; 2102 genes in si-146 vs AC/5 isolate and 3422 genes in si-146 vs ATCC isolate, respectively [fold-change of ≥ 2 or ≤ 0.5, *p*-value adjusted (padj) < 0.05]. Of these, 840 and 1262 genes were upregulated and downregulated, respectively, in si-146 vs AC/5 isolate. Eukaryotic orthologous group (KOG) assignments revealed a higher percentage of downregulated gene expression in si-146 compared to AC/5 isolate, were related to posttranslational modification, signal transduction and energy production. Gene Ontology (GO) terms for those downregulated genes shown were associated with transport activity, oxidation-reduction process and metabolic process. Among these downregulated genes were putative genes encoded for heat shock proteins, transporters, ubiquitin related proteins, proteins for vesicular trafficking (small GTPases) and oxidoreductases. Functional analysis of similar predicted proteins had been described in other parasitic protozoa for their survival and pathogenicity. Decreased expression of these genes in si146-treated isolate may account in part for *Acanthamoeba* reduced pathogenicity. qPCR on 6 selected genes upregulated in AC/5 compared to ATCC isolate corroborated the RNA sequencing findings, indicating a good concordance between these two analyses. Conclusion. To the best of our knowledge, this study represents the first genome-wide analysis of DNA methylation and its effects on gene expression in *Acanthamoeba spp*. The present data indicate that DNA methylation has substantial effect on global gene expression, allowing further dissection of the genome-wide effects of DNA-methyltransferase gene in regulating *Acanthamoeba* pathogenicity.

Keywords**—***Acanthamoeba*, DNA methylation, RNA sequencing, Virulence.

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Role of Natural Products in Drug Discovery of Anti-Biotic and Anti-Cancer Agents

Sunil Kumar

Abstract**—**For many years, small organic molecules derived naturally from microbes and plants have delivered a number of expedient therapeutic drug agents. The search for naturally occurring lead compounds has continued in recent years as well, with the constituents of marine flora and fauna along with those of telluric microorganisms and plants being investigated for their anti-bacterial and anti-cancer activities. It has been observed that such promising lead molecules incline to promptly generate substantial attention among scientists like synthetic organic chemists and biologists. Subsequently, the availability of a given precious natural product sample may be enriched, and it may be possible to determine a preliminary idea of structure-activity relationships to develop synthetic analogues. For instance, anti-tumor drug topotecan is a synthetic chemical compound similar in chemical structure to camptothecin which is found in extracts of *Camptotheca acuminate.* Similarly, researchers at AstraZeneca discovered anti-biotic pyrrolamide through a fragment-based lead generation approach from kibdelomycin, which is isolated from *Staphylococcus aureuss.*

Keywords**—**Anticancer, antibiotic, lead molecule, natural product, synthetic analogues.

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Exploring Research Trends and Topics in Intervention on Metabolic Syndrome Using Network Analysis

Lee Soo-Kyoung, Kim Young-Su

***Abstract*—**This study established a network related to metabolic syndrome intervention by conducting a social network analysis of titles, keywords, and abstracts, and it identified emerging topics of research. It visualized an interconnection between critical keywords and investigated their frequency of appearance to construe the trends in metabolic syndrome intervention measures used in studies conducted over 38 years (1979–2017). It examined a collection of keywords from 8,285 studies using text rank analyzer, NetMiner 4.0. The analysis revealed 5 groups of newly emerging keywords in the research. By examining the relationship between keywords with reference to their betweeness centrality, the following clusters were identified. Thus if new researchers refer to existing trends to establish the subject of their study and the direction of the development of future research on metabolic syndrome intervention can be predicted.

***Keywords*—**Intervention, Metabolic syndrome, Network analysis, Research, Trend.

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Impact of a Home-Based Health Intervention on Older Adults at Risk of Chronic Diseases: A Study Protocol

Elaine Wong Yee-Sing

Abstract**—**Older adults are at high risk of chronic health conditions in Singapore. A closer examination at all facets of their aging process has revealed that they may not be necessary aging well. This demands for an increasing healthcare services brought to their home environment due to limited mobility and in the interest of time management. The home environment is an ideal setting to implement self-directed health promoting activities at their convenience and enable family's support and motivation. This research protocol aims to explore their healthcare concerns; and creation of age appropriate interventions targeted to improve their chronic disease biomarkers. Convenience sampling of 130 families residing in private housing within five major districts in Singapore will be selected to participate in the health intervention. Statistical Package for Social Science 25 will be used to examine the pre and post screening results of their lipid, glycaemia and anthropometric outcomes. Using focus interviews, data results will be translated and transcribed to investigate on enablers, barriers and improvement on these services. Both qualitative and quantitative research outcomes are crucial to examine the impact of these services for these older adults living in private housing as they are not exposed to government subsidized community health programs. It is hypothesized that provision of relevant yet engaging health programs at their homes may mitigate the rising burden of chronic health conditions and result in successful aging outcomes among older Singaporeans.

Keywords**—**Chronic disease, health program, older adults, residential homes.

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Acclimation of *in vitro*-Propagated Apple Plantlets as Affected by Light Intensity

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***Abstract*—**Environmental control of *in vitro*-propagated apple plantlets is required for successful acclimation to *ex vitro* due to its low survival rate. This study aimed to determine the proper lighting condition for *ex vitro* acclimation of the apple plantlets in plant factories. *In vitro*-propagated M9 apple plantlets treated with pre-acclimatization for 1 week were exposed to following light treatments for additional 6 weeks; 60 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (A), 100 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (B), 140 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (C), 180 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (D), 60 $\mu mol \cdot m^{-2} \cdot s^{-1} \rightarrow$ 100 $\mu mol \cdot m^{-2} \cdot s^{-1}$ at 2 weeks (E) or 4 weeks (F), 60 $\mu mol \cdot m^{-2} \cdot s^{-1} \rightarrow$ 100 $\mu mol \cdot m^{-2} \cdot s^{-1}$ at 2 weeks $\rightarrow$ 140 $\mu mol \cdot m^{-2} \cdot s^{-1}$ at 4 weeks (G) and 60 $\mu mol \cdot m^{-2} \cdot s^{-1} \rightarrow$ 140 $\mu mol \cdot m^{-2} \cdot s^{-1}$ at 4 weeks (H). Shoot height, total leaf area, soil-plant analysis development (SPAD) value, root length, fresh and dry weights of shoots and roots were measured every 2 weeks after transplanting. In addition, photosynthetic rate was measured at 5 weeks after transplanting. At 6 weeks after transplanting, shoot height of B was significantly higher than the other treatments. SPAD value, total leaf area and root length of B and F were relatively higher than the other treatments. Root fresh weights of B, D, F and G were relatively higher than those in the other treatments. D induced the highest value in shoot fresh weight probably due to stem hardening but it also resulted in shoot damage in the early stage of acclimation. Photosynthetic rate at 5 weeks after the transplanting was significantly increased as the light intensity increased. These results suggest that 100 $\mu mol \cdot m^{-2} \cdot s^{-1}$ for 6 weeks (B) or gradual increased treatment from 60 $\mu mol \cdot m^{-2} \cdot s^{-1}$ to 140 $\mu mol \cdot m^{-2} \cdot s^{-1}$ at 2 weeks interval (F) were the proper lighting conditions for successful acclimation of *in vitro*-propagated apple plantlets.

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***Keywords*—**Acclimation, *In vitro*-propagated apple plantlets, Light intensity, Plant factory.

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Enhancement of Biomass and Bioactive Compounds in Kale Subjected to UV-A LED Lights

Jin-Hui Lee, Myung-Min Oh

***Abstract*—**The application of temporary abiotic stresses before crop harvest is a potential strategy to enhance phytochemical content. The objective of this study was to determine the effect of various UV-A LED lights on the growth and content of bioactive compounds in kale (*Brassica oleracea* var. *acephala*). Fourteen-day-old kale seedlings were cultivated in a plant factory with artificial lighting (air temperature of 20℃, relative humidity of 60%, photosynthesis photon flux density (PPFD) of 125 $\mu mol \cdot m^{-2} \cdot s^{-1}$) for 3 weeks. Kale plants were irradiated by four types of UV-A LEDs (peak wavelength; 365, 375, 385, and 395 nm) with 30 W/m^2 for 7 days. As a result, image chlorophyll fluorescence (Fv/Fm) value of kale leaves was lower as the UV-A LEDs peak wavelength was shorter. Fresh and dry weights of shoots and roots of kale plants were significantly higher in the plants under UV-A than the control at 7 days of treatment. In particular, the growth was significantly increased with a longer peak wavelength of the UV-A LEDs. The results of leaf area and specific leaf weight showed a similar pattern with those of growth characteristics. Chlorophyll content was highest in kale leaves subjected to UV-A LEDs with the peak wavelength of 395 nm at 3 days of treatment compared with the control. Total phenolic contents of UV-A LEDs with the peak wavelength of 395 nm at 5 and 6 days of treatment were 44% and 47% higher than those of the control, respectively. Antioxidant capacity showed almost the same pattern as the results of total phenol content. The activity of phenylalanine ammonia-lyase was approximately 11% and 8% higher in the UV-A LEDs with the peak wavelength of 395 nm compared to the control at 5 and 6 days of treatment, respectively. Our results imply that the UV-A LEDs with relative longer peak wavelength were effective to improve growth as well as the content of bioactive compounds of kale plants.

***Keywords*—**Bioactive compounds, Growth, Kale, UV-A LEDs.

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Weak Electric Fields Enhance Growth and Nutritional Quality of Kale

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***Abstract*—**Generally, plants growing on the earth are under the influence of natural electric fields and may even require exposure of the electric field to survive. Electric signals have been observed within plants and seem to play an important role on various metabolic processes, but their role is not fully understood. In this study, we attempted to explore response of plants under external electric fields in kale *(Brassica oleracea* var. *acephala*). The plants were hydroponically grown for 28 days in a plant factory. Electric currents at 10, 50 and 100 mA were supplied to nutrient solution for 3 weeks. Additionally, some of plants were cultivated in a Faraday cage to remove the natural electric field. Kale plants exposed to electric fields had higher fresh weight than the control and plants in Faraday cage. Absence of electric field caused a significant decrease in shoot dry weight and root growth. Leaf area also showed a similar response with shoot fresh weight. Supplying weak electric stimulation enhanced nutritional quality including total phenolic content and antioxidant capacity. This work provides basic information on the effects of electric fields on plants and is a meaningful attempt for developing a new economical technology to increase crop productivity and quality by applying an electric field.

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***Keywords*—**Electroculture, electric signal, faraday cage.

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Preparation of Nb Silicide-Based Alloy Powder by HDH Reaction

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Abstract—The Nb silicide-based alloy has excellent high temperature strength and relatively lower density than the Ni-based superalloy; therefore, it has been receiving a lot of attention for the next generation high temperature material. To enhance the high temperature creep property and oxidation resistance, Si was added to the Nb-based alloy, resulting in a multi-phase microstructure with metal solid solution and silicide phase. Since the silicide phase has a low machinability due to its brittle nature, it is necessary to fabricate components using the powder metallurgy. However, powder manufacturing techniques for the alloys have not yet been developed. In this study, we tried to fabricate Nb-based alloy powder by the hydrogenation-dehydrogenation reaction. The Nb-based alloy ingot was prepared by vacuum arc melting and it was annealed in the hydrogen atmosphere for the hydrogenation. After annealing, the hydrogen concentration was increased from 0.004wt% to 1.22wt% and Nb metal phase was transformed to Nb hydride phase. The alloy after hydrogenation could be easily pulverized into powder by ball milling due to its brittleness. For dehydrogenation, the alloy powders were annealed in the vacuum atmosphere. After vacuum annealing, the hydrogen concentration was decreased to 0.003wt% and Nb hydride phase was transformed back to Nb metal phase.

Keywords—Nb alloy, Nb metal and silicide composite, powder, hydrogenation-dehydrogenation reaction.

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Investigation of the Corrosion Inhibition Mechanism of *Tagetes erecta* Extract for Mild Steel in Nitric Acid: Gravimetric Studies

Selvam Noyel Victoria, Kavita Yadav, Manivannan Ramachandran

***Abstract*—**The extract of *Tagetes erecta* (marigold flower) was used as a green corrosion inhibitor for mild steel (MS) in nitric acid medium. The weight loss measurements were performed to understand the inhibition mechanism. The effect of temperature on the behaviour of mild steel corrosion without and with inhibitor was studied. The temperature studies revealed that the activation energy increased from 12 kJ/mol to 28.8 kJ/mol with the addition of 500 ppm inhibitor concentration. The thermodynamic analysis and the adsorption isotherm studies revealed that the molecules of inhibitor show physical adsorption on the surface of mild steel. Based on weight loss measurements, adsorption of the inhibitor on the surface of mild steel follows Langmuir isotherm.

Keywords*—Tagetes erecta*, corrosion, adsorption, inhibitor.

I. Introduction

MILD steel (MS) is the most common form of steel because of its properties that are acceptable for many applications particularly in food, petroleum, chemical, and electrochemical industries. Nitric acid is widely used in acid pickling, acid cleaning, acid descaling and oil well acidizing. Destruction of a material due to chemical reaction with its surrounding environment is known as corrosion. Corrosion can spread across a large area corroding the surface, more or less uniformly to form a pit or crack. Corrosion occurs on exposed surfaces since it is a controlled diffusion process. Industries suffer economic loss due to corrosion of metallic parts as if occurred by the aggressiveness of acids [1]. There are many ways to prevent corrosion, for example, appropriate material selection, and application of coating. Use of corrosion inhibitor is one of the ways to inhibit the deterioration of the material in which the solution is transported. Many organic compounds have been studied as corrosion inhibitors for controlled rate of corrosion [2]. The plant extracts are the abundant phytochemical constituents which possess good potential as non-toxic, renewable sources and are of low cost. Corrosion inhibitive effect by the plant extracts have been reported for acidic medium. Steroids, sugars, gallic acid, tannic acid, flavanoids, etc. are the basic components of extracts [3]. The marigold flower extract, i.e. *Tagetes erecta* extract (TEE), is proposed as a suitable green corrosion inhibitor. The TEE has not been used as an inhibitor for mild steel corrosion in nitric acid medium. In this present study, TEE is used as an inhibitor for mild steel corrosion. Weight loss measurement, potentiodynamic polarization, and electrochemical impedance spectroscopy measurements were carried out understand the corrosion inhibition mechanism. The inhibition efficiency of *Tagetes erecta* was claimed to be due to its main component Lutein [4]. *Tagetes erecta* is a rich source of Lutein, which belongs to the carotenoid family, namely to xanthophylls. Thus, Lutein was the major component for the interpretation of the experimental data.

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II. Materials and Method

A. Specimen Preparation

In this work, mild steel of density 7.83 g/cm^3 was used for corrosion studies. It was mechanically cut into coupon to make a specimen of 1.25 cm radius (r) and 1 cm height (h). Metal specimen was polished with various grades emery paper (silicon carbide paper) and rinsed with acetone followed by air drying, prior to its use in experiments.

B. Extract Preparation

First, flowers of *Tagetes erecta* (Marigold) were taken and were dried between 50 and 60 °C for a period of 2 h. The dried petals were powdered. Aqueous methanol (40%) was used as solvent for reflux. 40 g powder was refluxed using 400 ml (40%) aqueous methanol at a temperature of 55-60 °C for a period of 2 h. The refluxed solution was left undisturbed for 24 h. The solution was then filtered using Whatman filter paper (No. 1). The concentration of the extract was determined using standard drying procedure.

C. Weight Loss Measurements

In these experiments, the mild steel specimen was rinsed with acetone, dried and weighed before and after its immersion in the nitric acid medium. The weight loss of the coupon is obtained by the weight difference of the coupon before and after the immersion in nitric acid medium for a specified time. This weight loss is then converted into corrosion rate. Weight loss analysis is widely used for corrosion detection as it gives high degree of accuracy, when performed in a procedural manner. Effect of inhibitor concentration was studied at constant acid concentration of 0.25 M. The duration of these weight loss experiments was 10 min. The temperature study was done for 5 min with 0.25 M acid and 500 ppm inhibitor concentration. At least three experimental runs for each case were performed to give an average weight loss. This weight loss was reported along with the standard deviation. The observed weight loss was used to calculate the corrosion rate (CR) using (1) [5]:

$$CR = \frac{87.6 \times w}{\rho \times a \times t} \quad (1)$$

where w is the weight loss (mg), ρ is the density of MS (7.83 g/cm^3), a is the area of MS specimen (cm^2), and t is the exposure time (h). The inhibition efficiency (IE) in % was calculated using (2) [6]:

$$IE(\%) = \left(\frac{w_o - w_i}{w_o} \right) \times 100 \quad (2)$$

where w_o and w_i is the weight loss of MS specimen in absence and in presence of inhibitor, respectively.

III. Results and Discussion

A. Effect of Nitric Acid Concentration

Fig. 1 (A) shows the average CR of mild steel in various concentration of nitric acid. It is seen that the corrosion rate increases with HNO_3 concentration for a constant immersion period of 10 min. The CR increases from ~165 mmpy at 0.25 M to ~765 mmpy at 1.5 M. As the concentration of the nitric acid increases, dissolution of metal surface also increases. In this analysis, the CR increases with HNO_3 concentration due to increased H^+ concentration and hence increased rate of chemical reaction as in (3) [7], [8]:

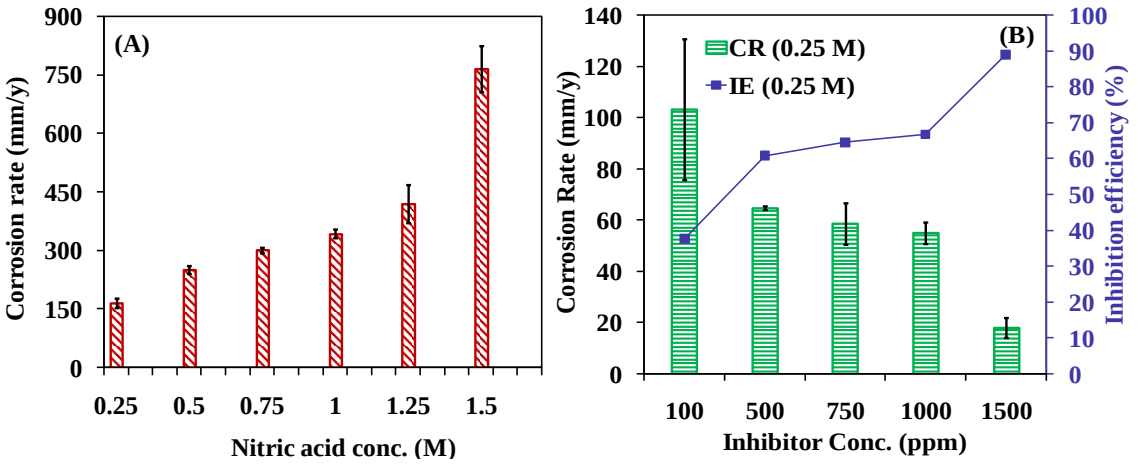

Fig. 1 (A) Effect of nitric acid concentration on CR. **(B)** Effect of inhibitor concentration with MS coupons immersed in 0.25 M HNO_3 on CR and IE

$$Fe + 4HNO_3 \rightarrow Fe(NO_3)_2 + 2H_2O + 2NO_2 \quad (3)$$

B. Effect of Inhibitor Concentration

Fig. 1 (B) shows the CR and IE of MS coupons immersed in 0.25 M HNO_3 with different concentration of inhibitor. Corrosion inhibition efficiency increases with increase in the inhibitor concentration. Maximum inhibition efficiency of 89% was obtained at 1500 ppm. The increasing trend is obtained due to increase in the adsorption of the inhibitor molecules onto the metal surface which helps in protecting it from corrosion.

C. Effect of Temperature

Fig. 2 shows the temperature effect on CR and IE of mild steel specimen in 0.25 M HNO_3 with and without 500 ppm inhibitor. The temperature effect and the thermodynamic activation parameters of the mild steel corrosion in nitric acid medium was carried out using weight loss measurements in the temperature range from 303 to 343 K. The inhibitor concentration of 500 ppm was selected for this study. It revealed that there is increase in the CR with increase in the temperature for both the solutions. However, the solution containing inhibitor has lower CR than the solution without inhibitor. Increased CR may be due to increased rate of chemical reaction between the metal surface and the medium with increasing temperature [9].

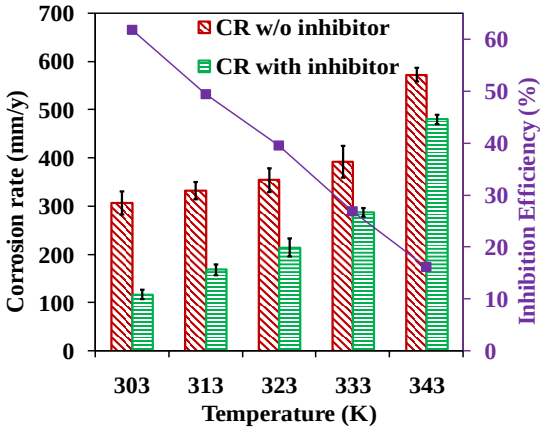

Fig. 2 Effect of temperature on CR and IE of MS in 0.25 M HNO_3 with and without 500 ppm inhibitor

The activation energy plays a major role in understanding the mechanism of inhibition and is given by Arrhenius equation (4) [10]:

$$\log(CR) = \log A - \frac{E_a}{2.303RT} \quad (4)$$

where, effective activation energy (E_a), pre-exponential factor (A), and R is the universal gas constant and T is the absolute temperature. E_a and A were calculated from the plot of logarithm of CR versus $1/T$, which is shown in Fig. 3. Addition of inhibitor increases the activation energy from 12 kJ/ mol to 28.85 kJ/ mol which could be described by the increased energy barrier of the corrosion reaction [11]. An

E_a value less than 40 kJ/mol represents the physical adsorption [10].

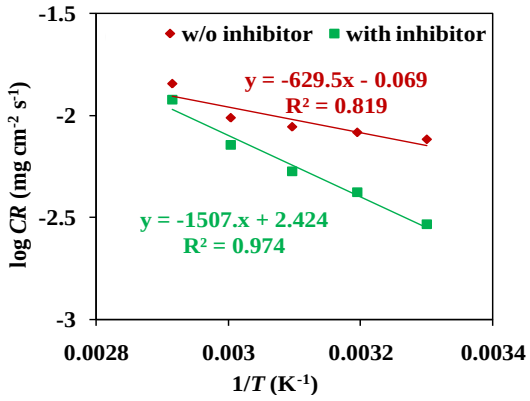

Fig. 3 Arrhenius plot for MS in 0.25 M HNO_3 with and without 500 ppm inhibitor concentration

However, E_a is not a reliable parameter to arrive at a conclusion about the nature of the adsorption phenomenon since some activation energy is needed for the removal of the adsorbed water molecules as the competitive adsorption takes place due to the water molecules [12].

Enthalpy (ΔH_{act}) and entropy (ΔS_{act}) of activation were calculated using transition state equation as shown in (5) [10]:

$$\log\left(\frac{CR}{T}\right) = \log\left(\frac{R}{Nh}\right) + \frac{\Delta S_{act}}{2.303R} - \frac{\Delta H_{act}}{2.303RT} \quad (5)$$

where, N is the Avogadro's number (6.02252×10^{23} mol^{-1}), h is the Planck's constant (6.626176×10^{-34} J-s), R is the universal gas constant. Fig. 4 shows a plot between log (CR/T) and $1/T$, which gives a straight line with ($-\Delta H_{act}$ /2.303R) as slope and [log (R/Nh) + (ΔS_{act} /2.303R)] as intercept. ΔH_{act} and ΔS_{act} values were calculated and presented in Table I. The enthalpy (ΔH_{act}) was found to be positive which reflects the endothermic nature of the MS dissolution. The increase in ΔH_{act} with addition of inhibitor reflects that the energy for dissolution increases which causes a drop in inhibition efficiency [10]. The negative value of entropy (ΔS_{act}) reflects the controlled corrosion process by activation complex [10]. The entropy (ΔS_{act}) increases in presence of inhibitor which reveals that there is an increase in disordering when moved to the activated complex from the reactant. This is the driving force for the adsorbed inhibitor molecules on the surface of mild steel [13]. The adsorbed inhibitor molecules hinder the liberation of hydrogen ions resulting increased disorderliness [10].

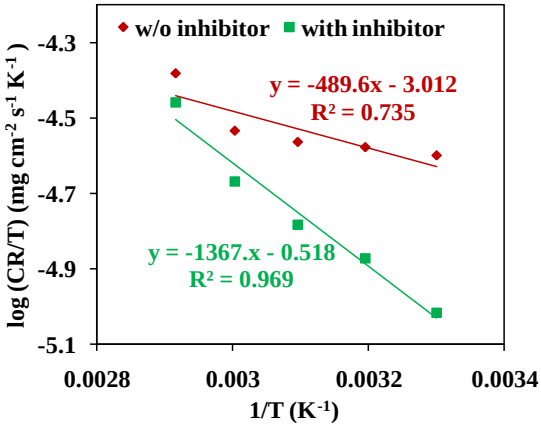

Fig. 4 Plots of log (CR/T) versus $1/T$ for MS in 0.25 M HNO_3 with 500 ppm inhibitor concentration

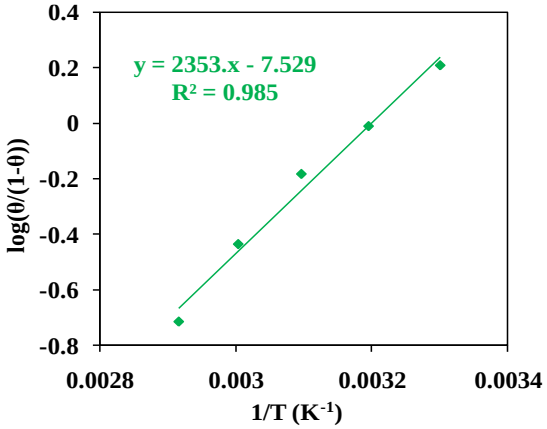

Fig. 5 Plot of log(θ/(1- θ)) vs. $1/T$ for MS in 0.25 M HNO_3 with 500 ppm inhibitor concentration

Under constant pressure conditions, the heat of adsorption of the process (Q_{ads}) is considered to be the same as the enthalpy of adsorption ΔH_{ads} [10]. The Q_{ads} can be calculated from (6) [10].

$$\log\left(\frac{\theta}{1-\theta}\right) = \log A + \log C - \frac{Q_{ads}}{2.303RT} \quad (6)$$

where, θ is the surface coverage, A is a constant and C is the concentration of the inhibitor. The value of Q_{ads} at constant inhibitor concentration was calculated using above equation [14]. A plot between log(θ/(1- θ)) and $1/T$ is constructed, as shown in Fig. 5 using θ values obtained by the weight loss experiments of temperature study (range 303 K to 343 K) in presence of 500 ppm extract. $-\Delta H_{ads}/2.303R$ is the slope for the obtained straight line. ΔH_{ads} was calculated to be -45 kJ/ mol. The negative value of ΔH_{ads} represents exothermic process of inhibitor adsorption on MS specimen. An absolute ΔH_{ads} value below 41.86 kJ/mol and above 100 kJ/mol is considered to be physisorption and chemisorption, respectively [15]. Therefore, ΔH_{ads} calculated as -45 kJ/ mol is less than 41.86 kJ/ mol. Hence, the inhibition of corrosion using TEE on MS can be considered as physical adsorption [10], [15].

TABLE I
ACTIVATION PARAMETERS FOR MS IN 0.25 M HNO_3 WITHOUT AND WITH 500 PPM INHIBITOR

Solution	E_a (kJ/mol)	ΔH_{act} (kJ/mol)	ΔS_{act} (J/mol.K)
Uninhibited	12.05	9.374	-255.07
Inhibited	28.85	26.174	-200.4

D.Adsorption Isotherm

The inhibitor molecules adsorb on the surface of metal due to the water molecules get desorbed at the surface [5]. The weight loss and electrochemical measurements show that the inhibitor molecules get adsorb on the surface of the mild steel resulting in minimized corrosion. The surface coverage of the molecules during the adsorption process is calculated from the inhibition efficiency. The surface coverage was calculated by dividing IE% by 100. The surface coverage is used to investigate the type of adsorption using Langmuir and Temkin isotherm. Langmuir adsorption isotherm can be expressed by the following equation (7)

[10]:

$$\frac{C}{\theta} = \frac{1}{k_{ads}} + C \qquad (7)$$

where C is concentration of the inhibitor, θ *is* the surface coverage and k_{ads} is the equilibrium constant for adsorption desorption process. The equilibrium constant (k_{ads}) value was calculated from the reciprocal of isotherm line intercept. Fig. 6 (A) shows the plot between C/θ and C which yields a straight line with coefficient of correlation and slope.

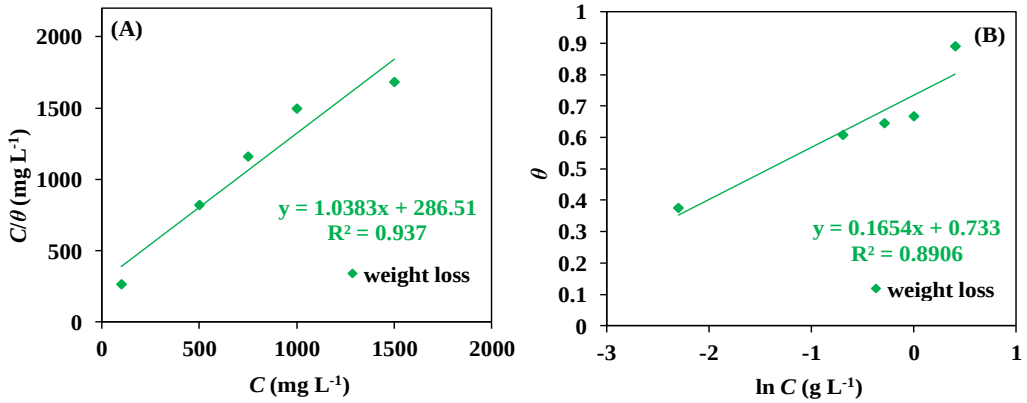

Fig. 6 Adsorption isotherm for MS in 0.25 M HNO_3 without and with various inhibitor concentrations. (A) Langmuir isotherm (B) Temkin isotherm

The Temkin isotherm can be expressed using (8) [10]:

$$\theta = \frac{-\ln k_{ads}}{2a} - \frac{\ln C}{2a} \qquad (8)$$

where, k_{ads} is the adsorption equilibrium constant and a is the attractive parameter. Fig. 6 (B) shows the plot between θ and ln$C$ which yields a straight line with correlation coefficient and slope.

The adsorption standard free energy (ΔG^0_{ads}) of inhibitor on the metal surface can be calculated using (9) [10]:

$$\Delta G^0_{ads} = -RT \ln(k_{ads} \times \rho_w) \qquad (9)$$

where R is the universal gas constant, T is the absolute temperature in K, ρ_w is the density of water in g/L. The values of k_{ads} and ΔG^0_{ads} for both Langmuir and Temkin adsorption isotherms are tabulated in Table II. The ΔG^0_{ads} value was found to be negative which indicates that there is a spontaneous adsorption on the surface of mild steel due to the inhibitor molecule. Thus, indicating a strong interaction between metal surface and inhibitor molecules is formed. ΔG^0_{ads} value is calculated for Langmuir adsorption isotherm ranges between –19.1 to –28.2 kJ/ mol. The ΔG^0_{ads} value calculated for Temkin adsorption isotherm ranges between –14.9 to –17.6 kJ/ mol. The threshold value of ΔG^0_{ads} between both chemical and physical adsorption process is considered to be –40 kJ/ mol. ΔG^0_{ads} value up to –20 kJ/ mol is considered to be physisorption and is considered as chemisorption if the value is more negative than –40 kJ/ mol [10], [16], [17]. The data for this present system obey the Langmuir isotherm to higher percentage, hence for the present system ΔG^0_{ads} values are closer to –20 kJ/ mol which can be considered as physical adsorption.

TABLE II
LANGMUIR AND TEMKIN ISOTHERM PARAMETERS FOR MS IN 0.25 M HNO_3 WITHOUT AND WITH 500 PPM INHIBITOR

Isotherm		Weight loss
Langmuir	k_{ads} (L g^{-1})	3.49
	ΔG^0 (kJ mol^{-1})	-20.5
Temkin	k_{ads} (L g^{-1})	0.48
	ΔG^0 (kJ mol^{-1})	-15.5

IV. CONCLUSION

The present study shows that the *Tagetes erecta* (Marigold flower) extract was found as an efficient corrosion inhibitor for mild steel in 0.25 M HNO_3. The weight loss measurement studies showed that without inhibitor, the mild steel corrosion rate increases with addition of nitric acid and the addition of inhibitor reduces the mild steel corrosion rate in the nitric acid medium. Inhibition efficiency increases with the addition of inhibitor concentration. In weight loss measurement, the maximum IE was found to be 89% obtained at 1500 ppm of inhibitor concentration. In the presence of 500 ppm inhibitor, IE decreases with rise in temperature but increases the activation energy from 12 kJ/ mol to 28.85 kJ/ mol with the addition of inhibitor which could be described by the increased energy barrier of the corrosion reaction. Heat of adsorption (ΔH_{ads}) was obtained to be –45 kJ/ mol which is considered as physical adsorption since the value obtained is less than 41.86 kJ/ mol. Langmuir and Temkin adsorption isotherms yielded the value of ΔG^0_{ads} ranging from -14.9 to -28.2 kJ/ mol. Thermodynamic studies showed the endothermic nature of the solution process indicating that with rise in temperature, the inhibition efficiencies decreases.

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Improved Estimation Strategies of Sensitive Characteristics Using Scrambled Response Techniques in Successive Sampling

S. Suman, G. N. Singh

Abstract**—**This research work is an effort to analyse the consequences of scrambled response technique to estimate the current population mean in two-occasion successive sampling when characteristic of interest is sensitive in nature. The generalized estimation procedures have been proposed using sensitive auxiliary variables under additive and multiplicative scramble models. The properties of resultant estimators have been deeply examined. Simulation as well as empirical studies are carried out to evaluate the performances of the proposed estimators with respect to other competent estimators. The results of our studies suggest that the proposed estimation procedures are highly effective under the presence of non-response situation. The result of this study also suggests that additive scrambled response model is better choice in the perspective of cost of the survey and privacy of the respondents.

Keywords**—**Scrambled response, sensitive characteristic, successive sampling, optimum replacement strategy.

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Model of a Black Hole That Deforms a Surface of Simultaneity

Leticia Corral Bustamante[1]

***Abstract*—** In this work, it is presented a model of a compact astrophysical object that deforms a surface of simultaneity, such as the one described in Einstein´s theory of special relativity. The object is compressed until it is within its Schwarzschild radius and becomes a singularity. This was calculated in general relativity by means of the Einstein field equation, evaluating the geometry of space-time and the distribution of energy and mass.

The exact solutions obtained for the Einstein field equation allow us to corroborate the equilibrium between the space-time geometry with the Ricci tensor, the Ricci scalar, the metric tensor, and the Einstein cosmological constant with respect to the distribution of matter and energy given by the energy-impulse tensor and to obtain the simultaneity surface where an astrophysical object lies such as a black hole that deforms it.

From the study of the physical properties of the black hole, theories that describe the behavior of the hole in close analogy with the laws of thermodynamics are highlighted. These laws relate the mass with energy and temperature, as well as evaporation time and surface gravity; and, the area with entropy, for a black hole with mass and without charge or angular momentum, whose results are in agreement with those of other authors

This study allows us to contribute to the state of art of the modeling and simulation of compact astrophysical objects by deforming space-time in accordance with the theory of general relativity and thermodynamic laws.

***Keywords*—**Black hole, Einstein field equation, Mass and energy distribution, Schwarzschild radius, Simultaneity surface, Space-time geometry, Thermodynamics properties.

I. INTRODUCTION

IN the present work, a black hole [1]- [2] is modeled that deforms a simultaneity surface [3] as it compresses until it enters its Schwarzschild radius [4]-[6] and becomes a singularity [7]-[15].

In this case, the space-time produced by the black hole is just the size of the Schwarzschild radius (hereafter r_s), which is indicative of horizon presence, similar to Laplace's black holes [16]; light crosses the horizon only from the outside inwards [17]. What happens within the horizon is eternally disconnected from the outside, which is why it does not influence the rest of the Universe.

For this, exact solutions of the Einstein field equation [18] were obtained both for the geometry of space-time, and for the distribution of mass and energy. From the results obtained, it is concluded that the resulting space-time has symmetric properties around the mass that produces singularity [14]-[15] and the external region of a black hole with mass M and radio equal to r_s is modeled [19]-[22] through the postulated metric.

We model events that only occur at a given moment and in a certain spatial plane, where a compact astrophysical object that is present produces deformations on the surface of simultaneity as it is compressed [3], [13]. Far from the astrophysical object, space-time becomes flat [19]-[20]. The solution describes the space-time in the region around the astrophysical object that, upon reaching the stable state, prints a fixed curvature. The light emitted from both the surface and any interior point of the black hole [1]-[2], [23]-[24] with radius r_s, cannot reach the critical radius and is trapped forever.

Thus, we study the physical properties of the final state, independent of the time of the black hole (Kerr 2009) without electromagnetic field in its surroundings [23], for the resulting static space-time, such as: mass, radius, relationship between the increments of the mass and area, surface gravity, temperature, evaporation time, entropy and the area of the event horizon, obtaining results that agree with those of other authors [3], [25]-[26]. The nomenclature used in the modeling is described in Table I.

TABLE I
NOMENCLATURE USED IN MODELING AND THERMODYNAMIC PROPERTIES OF A COMPACT ASTROPHYSICAL OBJECT

Symbol	Quantity	Value and/or units
A	Area of the event horizon of the black hole with mass and without charge nor angular momentum	cm^2
c	Speed of light	3×10^{10} cm·s^{-1}
C, _$C1$, _$C2$	Constants to be determined	
C_{ijij}, $i=1,2,3,$ $j=2,3,4$	Weyl tensor nonzero components	dimensionless
G	Newton's universal gravitation constant	6.67×10^{-8} dyne·cm^2·g^{-2}
g_{ii}, $i=1,2,3,4$	Metric tensor nonzero components	dimensionless
G_{ii}, $i=1,2,3,4$	Einstein tensor nonzero components	dimensionless
h	Planck constant	6.62606896×10^{-27} erg·s
k	Boltzmann constant	1.3806488×10^{-16} erg·K^{-1}
M	Mass of the black hole	g

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$M_{f_{BH}}$	Final mass of the black hole	g
r	Radial spatial coordinate,	cm
R	Ricci scalar	dimensionless
$R_{ii},\ i=1,2,3,4$	Ricci tensor nonzero components	dimensionless
$R_{ijij},\ i=2,3,$ $j=3,4$	Riemann tensor nonzero components	dimensionless
r_s	Schwarzschild radius	cm
S	Entropy of the black hole	J·K^{-1}
t	Temporal coordinate	s
T	Temperature	K
$T_{ii},\ i=1,2,3,4$	Energy-momentum tensor nonzero components	dimensionless
$u(r),\ v(r)$	Functions of the proposed metric to be determined	dimensionless
t_{evap}	Evaporation time of the black hole	years
Λ	Einstein's cosmological constant	
κ	Surface gravity of the black hole,	cm^2·s^{-1}
ϕ	Spatial coordinate, angular coordinate	rad, deg
θ	Spatial coordinate, angular coordinate	rad, deg

II. Modelling

This section describes the model performed to predict a simultaneity surface deformed by a "massive" (in this context) astrophysical object, such as a black hole [1], [3]. Prior to the presentation of the metric proposed here, we started from the basis of demonstrating that said metric is reduced as a special case to the Lorentzian metric corresponding to a flat space-time. Thus, the metric corresponding to a spherical curvature is proposed as [19]- [21]

$$ds^2 = -e^{u(r)^2}dt^2 + e^{v(r)^2}dr^2 - r^2\left(d\theta^2 + \sin^2(\theta)d\phi^2\right) \tag{1}$$

One of the solutions obtained from the Einstein tensor, G_{ii}, for (1), is

$$u(r) = \sqrt{\ln\left(\frac{2(-\_C1 + \_C2r)}{r}\right)}$$
$$v(r) = \sqrt{\ln\left(-\frac{1}{2}\frac{\left(\frac{2\_C2}{r} - \frac{2(-\_C1+\_C2r)}{r^2}\right)r^2}{-\_C1+\_C2r} - 1\right)} \tag{2}$$

Introducing the solution G_{ii}, (2), in the original metric (1), this becomes the metric

$$g_{1,1} = -\frac{2(-\_C1+\_C2r)}{r}$$
$$g_{2,2} = -\frac{1}{2}\frac{\left(\frac{2\_C2}{r} - \frac{2(-\_C1+\_C2r)}{r^2}\right)r^2}{-\_C1+\_C2r} - 1 \tag{3}$$
$$g_{3,3} = -r^2,\ -r^2\sin(\theta)^2.$$

From this metric (3), the nonzero components of the Ricci, Einstein, Riemann and Weyl tensors are obtained, in addition to the Ricci scalar. With the metric tensor, the Ricci tensor, the Ricci scalar as well as the Einstein cosmological constant, Λ, we calculate the energy-impulse tensor through Einstein's field equation [18], namely

$$R_{ii} - \frac{1}{2}Rg_{i,j} + \Lambda g_{i,j} = -8\pi G T_{ii} \tag{4}$$

The stress–energy tensor, stress–energy–momentum tensor or energy–impulse tensor, is a tensor quantity in physics that describes the density and flux of energy and momentum in space-time. It is an attribute of matter, radiation, and nongravitational force fields, is the source of the gravitational field in the Einstein field equations of GR [18].

The determination of the geometry of the space-time or term of the left side of (4), was performed with the Ricci tensor, (5), Ricci scalar, (6), and the metric tensor, (3), multiplied by the cosmological constant. The Ricci tensor is

$$R_{11} = -\frac{1}{re^{v^2}}\left(e^{u^2}\begin{pmatrix} ru'^2 + ruu'' + ru^2u'' \\ -uu'rvv' + 2uu' \end{pmatrix}\right)$$
$$R_{22} = \frac{1}{r}\left(ru'^2 + ruu'' + ru^2u'^2 - uu'rvv' - 2vv'\right)$$
$$R_{33} = \left(-vv'r + e^{v^2} + uu' + 1\right)/e^{v^2} \tag{5}$$
$$R_{44} = \frac{1}{e^{v^2}}\begin{pmatrix} -uu'r + uu'r\cos(\theta)^2 + vv'r - \\ vv'r\cos(\theta)^2 + e^{v^2}\cos(\theta)^2 - \\ e^{v^2} - 1 + \cos(\theta)^2 \end{pmatrix}$$

whereas the Ricci scalar is given by

$$R = \frac{1}{r^2e^{v^2}}\left(2\begin{pmatrix} r^2uu'' + r^2u^2u'^2 - r^2uu'vv' + \\ 2uu'r - 2vv'r + e^{v^2} + r^2u'^2 + 1 \end{pmatrix}\right) \tag{6}$$

Thus, the energy-moment tensor when there is matter in the universe is given by the system of nonlinear differential equations

$$T_{11} = \frac{1}{4}\frac{e^{u^2}vv'}{re^{v^2}\pi G} - \frac{1}{8}\frac{e^{u^2}}{r^2\pi G} - \frac{1}{8r^2e^{v^2}\pi G} + \frac{1}{8}\frac{\Lambda e^{u^2}}{\pi G}$$

$$T_{22} = \frac{1}{4}\frac{uu'}{r\pi G} + \frac{1}{8}\frac{e^{v^2}}{r^2\pi G} + \frac{1}{8r^2\pi G} - \frac{1}{8}\frac{\Lambda e^{v^2}}{\pi G} \quad (7)$$

$$T_{33} = \frac{1}{8}\frac{rvv'}{e^{v^2}\pi G} - \frac{1}{8}\frac{ruu'}{e^{v^2}\pi G} - \frac{1}{8}\frac{r^2uu''}{e^{v^2}\pi G} - \frac{1}{8}\frac{r^2u^2u'^2}{e^{v^2}\pi G} + \frac{1}{8}\frac{r^2uu'vv'}{e^{v^2}\pi G} - \frac{1}{8}\frac{r^2u'^2}{e^{v^2}\pi G} + \frac{1}{8}\frac{\Lambda r^2}{\pi G}$$

$$T_{33} = T_{44}$$

The solutions of (7) are

$$e^{v^2} = \frac{2ruu'+1}{\Lambda r^2 - 1}, \quad v' = -\frac{uu'}{v},$$

$$u'' = \frac{\Lambda r + ru'^2 - r^3u'^2\Lambda + 2uu' + 2ru^2u'^2 - 2r^3u^2u'^2\Lambda}{r^3u\Lambda - ru} \quad (8)$$

& where $\{[u \neq 0, v \neq 0, \quad 2ruu'+1 \neq 0]\}$

With the condition

$$2ruu'+1 \neq 0 \quad (9)$$

Solving the ordinary differential equation (9), as $2ruu'+1 = C$, we get $u(r)$ given by

$$u(r) = \pm\sqrt{-\ln(r) + C\ln(r) + \_C1} \quad (10)$$

Further, $v(r)$ and the constants

$$v(r) = \sqrt{\ln\left(\frac{C}{\Lambda r^2 - 1}\right)}, \quad C = \frac{3\Lambda r^2 - 1}{\Lambda r^2 - 1}, \quad (11)$$

$$\_C1 = -(C-1)\ln(r)$$

Then, the only solution is

$$u(r) = \pm\sqrt{-\ln(r) + \frac{(3\Lambda r^2 - 1)\ln(r)}{\Lambda r^2 - 1} - \left(\frac{3\Lambda r^2 - 1}{\Lambda r^2 - 1} - 1\right)\ln(r)} \quad (12)$$

$$v(r) = \sqrt{\ln\left(\frac{3\Lambda r^2 - 1}{(\Lambda r^2 - 1)^2}\right)}$$

Using the solution with the positive sign of the roots of $u(r)$ and introducing it into the metric tensor (1), we can test if it is an exact solution to the Einstein field equation. Now the metric tensor becomes (the covariant metric nonzero components)

$$g_{1,1} = -e^{-\ln(r) + \frac{(3\Lambda r^2 - 1)\ln(r)}{\Lambda r^2 - 1} - \left(\frac{3\Lambda r^2 - 1}{\Lambda r^2 - 1} - 1\right)\ln(r)},$$

$$g_{2,2} = \frac{3\Lambda r^2 - 1}{(\Lambda r^2 - 1)^2}, \quad g_{3,3} = -r^2, \quad g_{4,4} - r^2\sin(\theta)^2. \quad (13)$$

And the tensor of GR, from this metric, are: the Einstein tensor nonzero components, the Riemann tensor nonzero components, Ricci tensor nonzero components, Ricci scalar and Weyl tensor nonzero components, given by (14)-(18), respectively, are

$$G_{11} = \frac{\Lambda(9\Lambda^2 r^4 - 2\Lambda r^2 - 3)}{(3\Lambda r^2 - 1)^2},$$

$$G_{22} = \frac{(1 + \Lambda r^2)\Lambda}{(\Lambda r^2 - 1)^2},$$

$$G_{33} = \frac{\Lambda r^2(3\Lambda^2 r^4 - 2\Lambda r^2 - 1)}{(3\Lambda r^2 - 1)^2} \quad (14)$$

$$G_{44} = \frac{\sin(\theta)^2\Lambda r^2(3\Lambda^2 r^4 - 2\Lambda r^2 - 1)}{(3\Lambda r^2 - 1)^2}$$

$$R_{2323} = \frac{\Lambda r^2(3\Lambda r^2 + 1)}{(3\Lambda r^2 - 1)(\Lambda r^2 - 1)}$$

$$R_{2424} = \frac{\Lambda r^2(3\Lambda r^2 + 1)\sin(\theta)^2}{(3\Lambda r^2 - 1)(\Lambda r^2 - 1)} \quad (15)$$

$$R_{3434} = -\frac{r^4\sin(\theta)^2\Lambda(\Lambda r^2 + 1)}{3\Lambda r^2 - 1}$$

$$R_{22} = \frac{2\Lambda(3\Lambda r^2 + 1)}{(3\Lambda r^2 - 1)(\Lambda r^2 - 1)}$$

$$R_{33} = -\frac{2\Lambda r^2(3\Lambda^2 r^4 - 1)}{(3\Lambda r^2 - 1)^2} \quad (16)$$

$$R_{44} = -\frac{2\Lambda r^2\sin(\theta)^2(3\Lambda^2 r^4 - 1)}{(3\Lambda r^2 - 1)^2}$$

$$R = \frac{2\Lambda(9\Lambda^2 r^4 - 2\Lambda r^2 - 3)}{(3\Lambda r^2 - 1)^2} \quad (17)$$

$$C_{1212} = \frac{4}{3}\frac{\Lambda^2 r^2}{(3\Lambda r^2 - 1)(\Lambda r^2 - 1)^2}$$

$$C_{1313} = \frac{2}{3}\frac{\Lambda^2 r^4}{(3\Lambda r^2 - 1)^2}$$

$$C_{1414} = \frac{2}{3}\frac{\Lambda^2 r^4\sin(\theta)^2}{(3\Lambda r^2 - 1)^2}$$

$$C_{2323} = -\frac{2}{3}\frac{\Lambda^2 r^4}{(3\Lambda r^2 - 1)(\Lambda r^2 - 1)^2}$$

$$C_{2424} = -\frac{2}{3}\frac{\Lambda^2 r^4 \sin(\theta)^2}{\left(3\Lambda r^2 - 1\right)\left(\Lambda r^2 - 1\right)^2} \qquad (18)$$
$$C_{3434} = -\frac{4}{3}\frac{\Lambda^2 r^6 \sin(\theta)^2}{\left(3\Lambda r^2 - 1\right)^2}$$

Equation (12) is an exact solution to the Einstein field equation, since it fully satisfies all the nonzero components of said tensor, as well as all components of the Ricci tensor. Another exact solution is given by

$$u = \_C1, \quad v = \pm\sqrt{I\pi} \qquad (19)$$

Thus, (14)-(18) represent an exact solution to the Einstein field equation with present matter, which allows us to argue the presence of a massive astrophysical object that is compressed increasing the deformation of the simultaneity surface (see Fig. 1 in section III).

In his 1915 paper, Einstein deduced the mathematical formula that relates the geometry of space-time (terms on the left side of (20), with the distribution of matter and energy (term on the right side of (20)), as

$$R_{ii} - \frac{1}{2}Rg_{i,j} + \Lambda g_{i,j} = \frac{8\pi G T_{ii}}{c^4} \qquad (20)$$

Therefore, the left side of the Einstein field equation (Eq. (20)) represents the geometry of space-time which in this case is

$$\begin{aligned}
stG_{11} &= -\frac{1}{re^{v^2}}\left(e^{u^2}\begin{pmatrix} r(u'') + ruu'' + ru^2u'^2 \\ -ruu'vv' + 2uu' \end{pmatrix}\right) \\
&+ \frac{e^{u^2}}{r^2e^{v^2}}\begin{pmatrix} r^2uu'' + r^2u^2u'^2 - r^2uu'vv' + 2ruu' \\ -2vv'r + e^{v^2} + r^2u'^2 + 1 \end{pmatrix} \\
&- \Lambda e^{u^2} \\
stG_{22} &= \frac{1}{r}\left(ru'^2 + ruu'' + ru^2u'^2 - ruu'vv' - 2vv'\right) \\
&- \frac{1}{r^2}\begin{pmatrix} r^2uu'' + r^2u^2u'^2 - r^2uu'vv' + 2ruu' \\ -2vv'r + e^{v^2} + r^2u'^2 + 1 \end{pmatrix} + \Lambda e^{v^2} \\
stG_{33} &= -\frac{-vv'r + e^{v^2} + ruu' + 1}{e^{v^2}} + \\
&\frac{1}{e^{v^2}}\begin{pmatrix} r^2uu'' + r^2u^2u'^2 - r^2uu'vv' + 2ruu' \\ -2vv'r + e^{v^2} + r^2u'^2 + 1 \end{pmatrix} - \Lambda r^2
\end{aligned} \qquad (21)$$

The solutions of (21) are given by (8) and (22)

$$\begin{aligned}
u' &= \frac{1}{2}\frac{-e^{v^2} - 1 + \Lambda r^2 e^{v^2}}{ur}, \\
u' &= -\frac{1}{2}\frac{e^{v^2} + 1 - \Lambda r^2 e^{v^2}}{ur}, \\
v' &= \frac{1}{2}\frac{e^{v^2} + 1 - \Lambda r^2 e^{v^2}}{vr} \quad \text{\& where } [u \neq 0, \quad v \neq 0]
\end{aligned} \qquad (22)$$

whereas the right side of (20) corresponding to the distribution of matter and energy that with the proposed metric (1), is represented by the nonzero components of the energy-impulse tensor as

$$\begin{aligned}
T_{11} &= -\frac{1}{8}\frac{1}{\pi G r e^{v^2}}\left(e^{u^2}\begin{pmatrix} ru'^2 + ruu'' + ru^2u'^2 \\ -ruu'vv' + 2uu' \end{pmatrix}c^4\right) \\
&+ \frac{1}{8}\frac{e^{u^2}c^4}{\pi G r^2 e^{v^2}}\begin{pmatrix} r^2u^2u'^2 + r^2uu'' - r^2uu'vv' + \\ 2ruu' - 2vv'r + e^{v^2} + r^2u'^2 + 1 \end{pmatrix} \\
&- \frac{1}{8}\frac{\Lambda e^{u^2}c^4}{\pi G} \\
T_{22} &= \frac{1}{8}\frac{c^4}{\pi G r}\left(ru'^2 + ruu'' + ru^2u'^2 - ruu'vv' - 2vv'\right) \\
&- \frac{1}{8}\frac{c^4}{\pi G r^2}\begin{pmatrix} r^2uu'' + r^2u^2u'^2 - r^2uu'vv' + 2ruu' \\ -2vv'r + e^{v^2} + r^2u'^2 + 1 \end{pmatrix} \\
&+ \frac{1}{8}\frac{\Lambda e^{v^2}c^4}{\pi G} \\
T_{33} &= -\frac{1}{8}\frac{\left(-vv'r + e^{v^2} + ruu' + 1\right)c^4}{\pi G e^{v^2}} \\
&+ \frac{1}{8}\frac{1}{\pi G e^{v^2}}\left(\begin{pmatrix} r^2uu'' + r^2u^2u'^2 - r^2uu'vv' + 2ruu' \\ -2vv'r + e^{v^2} + r^2u'^2 + 1 \end{pmatrix}c^4\right) \\
&- \frac{1}{8}\frac{\Lambda r^2 c^4}{\pi G} \\
T_{33} &= T_{44}
\end{aligned} \qquad (23)$$

The solutions of the differential equation system of the tensor T, (23), are the same as those obtained for the geometry of space-time (21), that is, (8), as expected.

The solution to the equation: $u' = \frac{1}{2}\frac{-e^{v^2} - 1 + \Lambda r^2 e^{v^2}}{ur}$ of (22), is given by

$$\_\xi = \frac{r}{-e^{v^2} - 1 + \Lambda r^2 e^{v^2}}, \quad \_\eta = 0 \qquad (24)$$

where v is

$$v(r)=\sqrt{-\ln\left(\frac{1}{3}\frac{r^3\Lambda-3r}{r}\right)} \tag{25}$$

In Fig. 2 of section III we can see the graph of this solution. of (22), we have that one of the equations is $v'=\frac{1}{2}\frac{e^{v^2}+1-\Lambda r^2 e^{v^2}}{vr}$ & where $[u\neq 0,\ v\neq 0]$, where the solution has been plotted in Fig. 3 of section III, and is represented by the expressions

$$\begin{aligned} &\_\xi=0,\quad \_\eta=\frac{3}{\sqrt{-\ln\left(\frac{1}{3}\frac{r^3\Lambda-3r}{r}\right)}\left(\Lambda r^3-3r\right)}\\ &\_\xi=0,\\ &\_\eta=\frac{-\frac{9r^2}{\left(r^3\Lambda-3r\right)^2}+\frac{9\Lambda r^4}{\left(r^3\Lambda-3r\right)^2}-\frac{3r}{r^3\Lambda-3r}}{r\sqrt{-\ln\left(\frac{1}{3}\frac{r^3\Lambda-3r}{r}\right)}\left(-\frac{3r}{r^3\Lambda-3r}-1+\frac{3\Lambda r^3}{r^3\Lambda-3r}\right)} \end{aligned} \tag{26}$$

Actually, both expressions are the same solution according to their graphs and come from

$$\_\xi=0,\quad \_\eta=\frac{e^{v^2}}{rv} \tag{27}$$

and

$$\_\xi=0,\quad \_\eta=\frac{-e^{2v^2}+\Lambda r^2 e^{2v^2}-e^{v^2}}{rv\left(-e^{v^2}-1+\Lambda r^2 e^{v^2}\right)} \tag{28}$$

where $v(r)$ is given by (25).

Equations (26) were obtained with (25). The solutions on the right side of the Einstein field equation, (20), corresponding to the distribution of mass and energy, through the energy-momentum tensor, (23), are the (8) and (22). For (22), $u(r)$ it is

$$u(r)=\pm\sqrt{\ln\left(-\frac{2}{3}\frac{\_C2r^3\Lambda-3\_C2r-\_C1}{r}\right)} \tag{29}$$

which corresponds to the solution of one of the equations of (8) namely

$$u''=\frac{\Lambda r+ru'^2-r^3u'^2\Lambda+2uu'+2ru^2u'^2-2r^3u^2u'^2\Lambda}{r^3u\Lambda-ru}$$

Computing symmetries for this equation, the following solutions are obtained

$$\begin{aligned} &\left[0,\frac{1}{u}\right],\ \left[0,\frac{e^{-u^2}}{ru}\right],\ \left[0,\frac{\left(-3+r^2\Lambda\right)e^{-u^2}}{u}\right],\\ &\left[\frac{1}{-1+r^2\Lambda},-\frac{1}{2ru\left(-1+r^2\Lambda\right)}\right],\\ &\left[\frac{r\left(-3+r^2\Lambda\right)}{\left(-1+r^2\Lambda\right)},\frac{1}{u\left(-1+r^2\Lambda\right)}\right],\\ &\left[\frac{r^2\left(9-6r^2\Lambda+r^4\Lambda^2\right)}{-1+r^2},\frac{r^3\Lambda\left(-3+r^2\Lambda\right)}{u\left(-1+r^2\Lambda\right)}\right],\\ &\left[\frac{e^{u^2}r}{-1+r^2\Lambda},-\frac{1}{2}\frac{e^{u^2}}{u\left(-1+r^2\Lambda\right)}\right],\\ &\left[\frac{e^{u^2}r^2\left(-3+r^2\Lambda\right)}{-1+r^2\Lambda},\frac{r^3\Lambda e^{u^2}}{u\left(-1+r^2\Lambda\right)}\right] \end{aligned} \tag{30}$$

whereas for the equation $v'=-\frac{u'u}{v}$ of the (8), $v(r)$ it is

$$v(r)=\pm\sqrt{-\ln\left(\frac{1}{3}\frac{-3r+\Lambda r^3+3\_C1}{r}\right)} \tag{31}$$

Using the three equations of the (8), the value of the constants is obtained as

$$\_C1=0,\quad \_C3=-1/3 \tag{32}$$

The solutions of the energy-momentum tensor (distribution of matter and energy in space-time according to the proposed metric), (29) and (31), are graphed and shown in Fig. 4 and Fig. 5 of section III. These are graphs of the density of the components of the energy-impulse tensor of (23). Other solutions of the (8) are given in Fig. 6 of the same section.

III. Results and Discussions

In this section, we present the simulations of the modeling section. Fig. 1 shows the geometry of the space-time given by (14), (16) and (18) by the Einstein, Ricci and Weyl tensors (Fig. 1 a)-c)) obtained with the metric of (13) graphed in Fig. 1 d).

In Fig. 2, the geometry of the space-time given by the solution for $u(r)$ of (22) is shown, whereas in Fig. 3 we can observe the said geometry given by the solution of $v(r)$ in (26).

In Fig. 4, the solutions of the energy-momentum tensor given by (29) and (31) were plotted. Fig. 5 shows graphs of the density of the components of the energy-impulse tensor given by (23). Other solutions of (8) are given in Fig. 6. These solutions of the energy-impulse tensor allow us to appreciate

surfaces of simultaneity deformed by a massive astrophysical object that, passing from the Schwarzschild radius, reaches the singularity, such as the case of a black hole. Fig. 7 a)-d) shows the curvature of space-time by means of the graph of the components of the energy-impulse tensor of (23), and their solutions given by (28) and (29), related as the curvature exerted by the amount of matter present.

Here, we also discuss the results obtained from the study of the physical properties of the compact astrophysical object, such as a black hole, which deforms the surface of simultaneity (defined as a two-dimensional surface by [3]) when compressed until it is within its Schwarzschild radius and becomes a singularity [11], [13]-[15].

From the study of the physical properties of the final state, independent of time, of the black hole [23] without surrounding electromagnetic field, for the resulting static space-time, such as i. mass of the black hole calculated with the components of the energy-stress tensor: T_{11}, T_{22} and T_{33} in function of the radius and the cosmologic constant, ii. radius of the black hole according to the determination of its mass, iii. relationship between the increases of the mass and the area of the black hole, iv. the surface gravity of the black hole, κ, v. the temperature T of the black hole of mass M, without charge or angular moment [19]-[22], vi. the time it would take the black hole to evaporate completely, t_{evap} [24], vii. entropy, S [27]-[30] and viii. the area of the event horizon, A, the results obtained in this section are discussed. Equations (33)-(41) were taken from [3].

From the results obtained for these physical properties, the following can be argued, respectively.

Considering the event horizon area for a black hole with no charge nor angular momentum [3], [19]-[22],as

$$A = 16\pi \frac{G^2 M^2}{c^4} \tag{33}$$

The final mass of the hole must be greater than or equal to

$$M_{f_{BH}} = \frac{c^2}{G}\sqrt{\frac{A}{16\pi}} \tag{34}$$

Matching mass for the three components of the energy-impulse tensor, both calculating the area by (33), as well as by calculating the area taking into account the Schwarzschild radius, (35) and (36), respectively

$$A = 4\pi r_s^2 \tag{35}$$

$$r_s = \frac{2GM}{c^2} \tag{36}$$

Which satisfies the mathematical theorem on black holes formulated in 1972 by Stephen Hawking [3], according to which, the area of the horizon of a black hole can never decrease [31]: it can increase or remain constant as consequence of some physical process. In Table II this theorem is verified with the calculations made in this work. We were also able to verify that when the radius of the black hole decreases, the area of the event horizon increases, as expected. The relation between the increases of the mass and the area of the black hole, were calculated with the relation

$$\Delta M = \frac{\kappa}{8\pi G}\Delta A \tag{37}$$

where the surface gravity [25]-[26] is given by

$$\kappa = \frac{c^4}{4GM} \tag{38}$$

which corresponds to the surface gravity or gravitational acceleration produced by the black hole without charge nor angular momentum [19]-[22] in the right place of its horizon.

As the mass of the black hole decreases, its temperature increases and the radiation becomes more intense. It is also noted that the mass decreases more and more rapidly, until the black hole evaporates completely [24] in a true explosion (see Table II).

The approximate time it would take a black hole to completely evaporate was calculated with the expression

$$t_{evap} = 10^{-17} M^3 \tag{39}$$

The time in which a black hole of the mass of a Sun would evaporate, according to (39), it is of the order of 10^{73}, which is an absurdity if we compare it with the age of the Universe of $\approx 13.82\times10^9$ years. In this case, the black hole resulting from the proposed metric has an evaporation time of the order of 10^{69}, which is also in direct contradiction with the age of the universe. On the contrary, a mass of 1×10^{11} kg, it takes to evaporate around 317,097,920 years, which is consistent with the age of the universe and could be a primordial black hole that was completely evaporating today [3]. Thus, it is concluded that the Hawking effect is totally insignificant for the massive black holes [3], [32]. The time it takes to evaporate the black hole studied is 7.41×10^{69} s or 2.35×10^{62} years (see Table II).

The temperature T of a black hole of mass M, without charge nor angular moment [3], [13], [19]-[22], is

$$T = \frac{hc^3}{16\pi^2 GMk} = \frac{10^{23}}{M} \tag{40}$$

T in Kelvin and M in kilograms. Therefore, as the Hawking effect for this black hole is totally insignificant, this is indicative that it is a black hole with enough mass (of the order of 10^{29} kg)

so that its evaporation time is frankly greater than the age of the universe, therefore, has a mass that oscillates between the mass of the Earth and the Sun. In comparison, a small black hole could be of the order of one hundred million tons (1×10^{11} kg), if it existed, the Hawking effect on it would be significant [3].

On the other hand, the entropy of the black hole [25]-[30], [33]-[34] is given by the expression that contains the Planck constant, given the quantum effect produced (since its temperatures oscillate in a range greater than absolute zero), as

$$S = \frac{\pi c^3 k}{2hG} A \tag{41}$$

where the area A is the area of the event horizon of (33). The last entropy obtained for the black hole in Table II is of the order of 10^{58} erg K^{-1}, which is indicative that there are quantum effects due to its temperature exceeding absolute zero, as expected.

According to the second law of thermodynamics, evaporation [24], [26] and disappearance of the black hole, brings as a consequence that its area and, therefore, its entropy decreases, although the radiation produced has a very high entropy, in such a way that the total entropy increases.

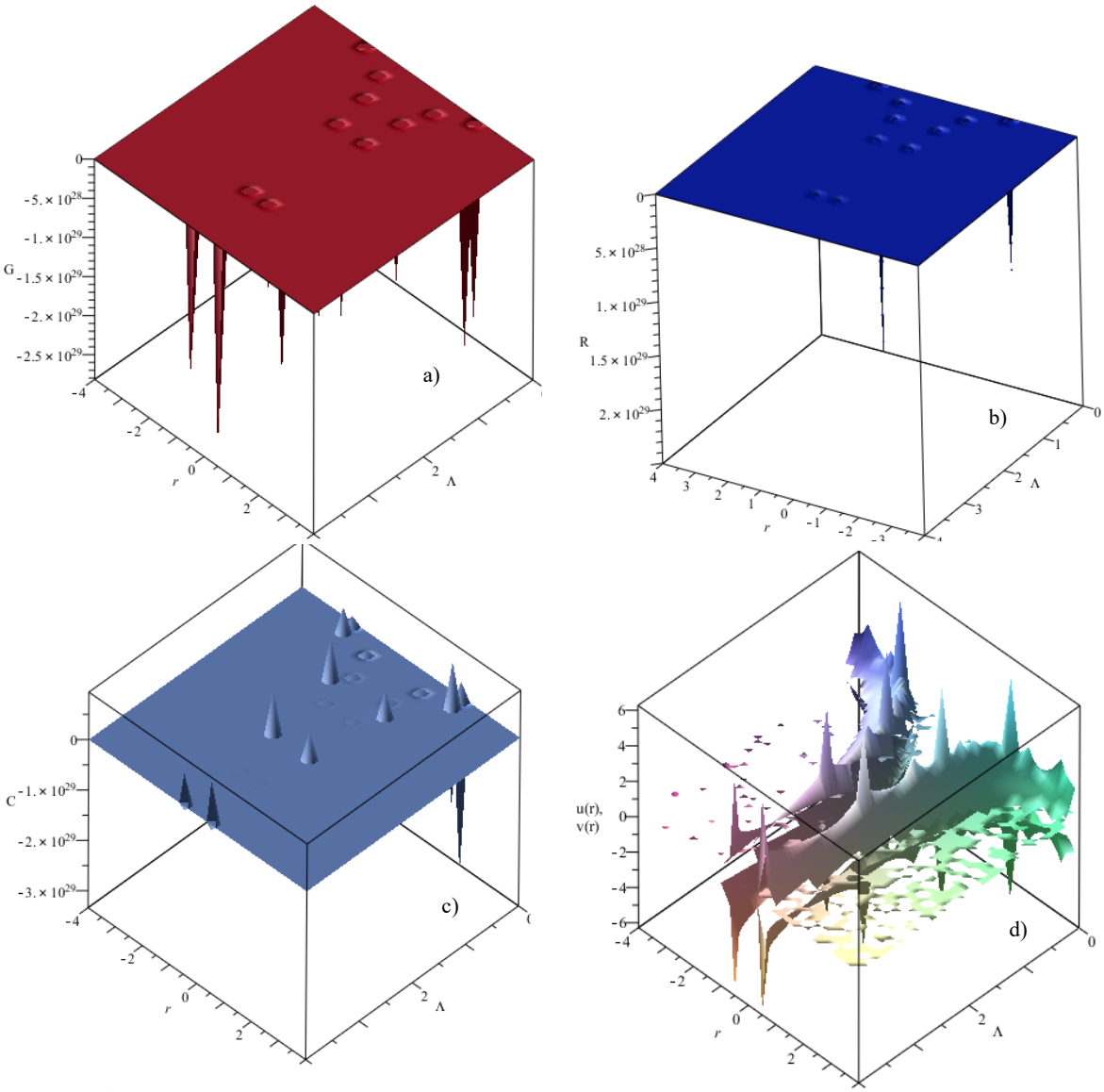


Fig. 1 Simultaneity surfaces around a massive astrophysical object that allow to see the compression of said object until it is within its Schwarzschild radius and become a singularity, obtained from the tensors of: a) Einstein, b) Ricci and c) Weyl with: d) solutions $u(r)$ and $v(r)$ introduced in the metric of (13)

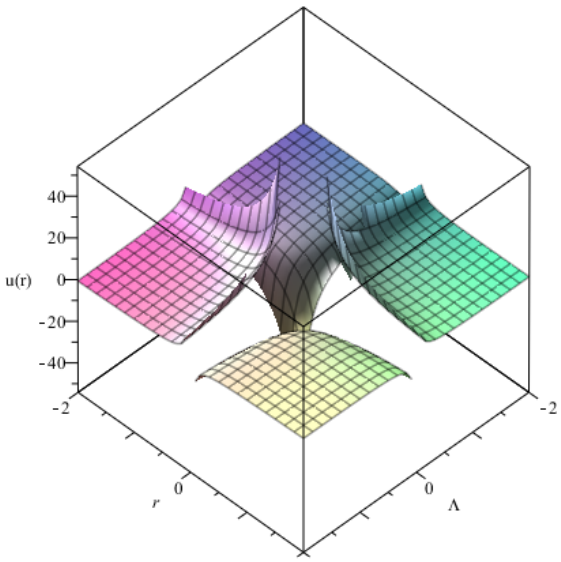


Fig. 2 Geometry of space-time given by (22) as a solution to (21).

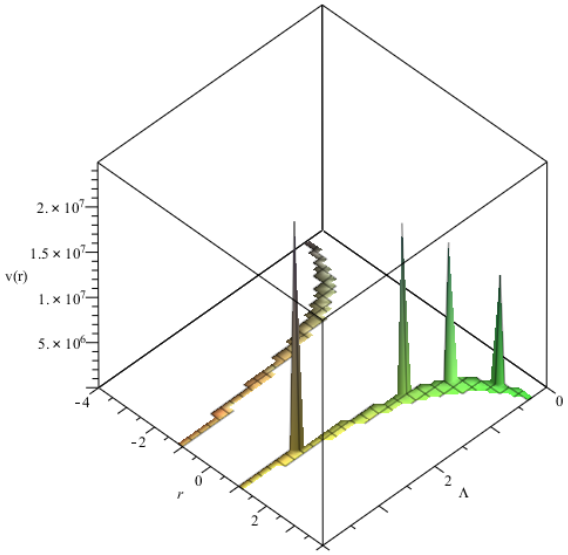
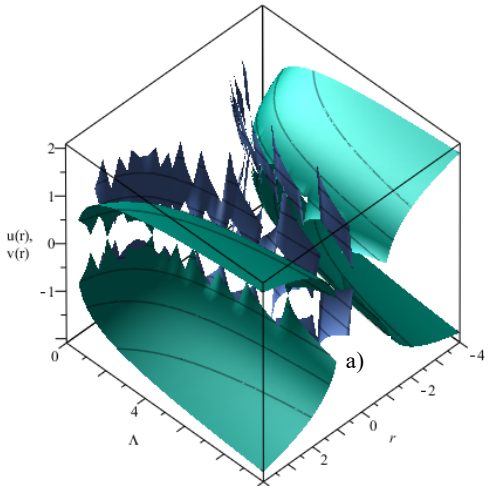


Fig. 3 Geometry of space-time given by (26)



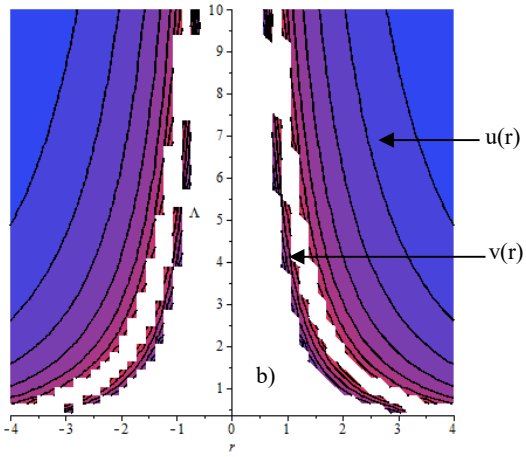


Fig. 4 Energy-impulse tensor solutions given by (30) and (32).

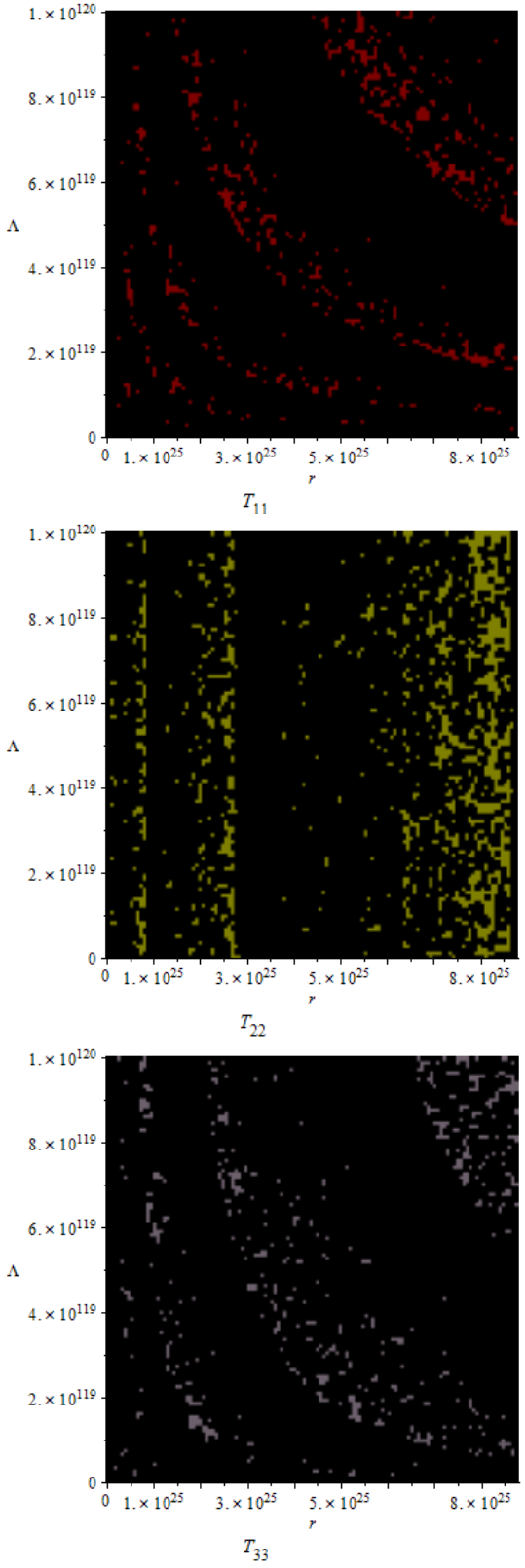


Fig. 5 Density graphs of the energy-impulse tensor nonzero components of the (23). Distribution of matter and energy in space-time according to the metric of (1).

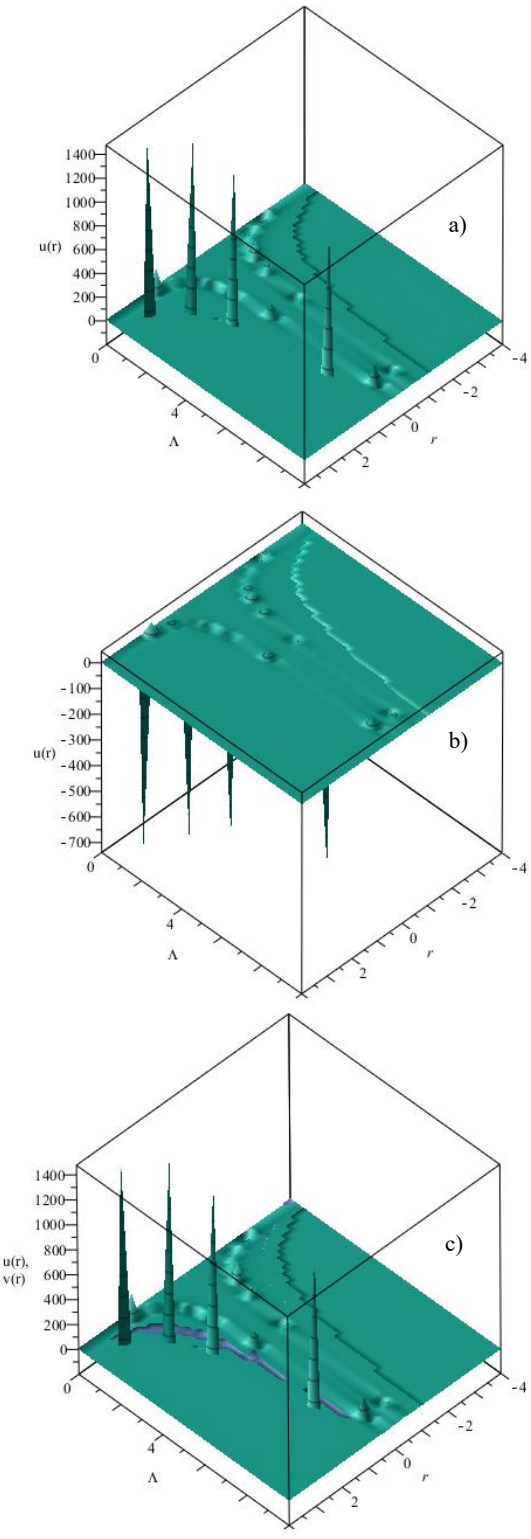


Fig. 6 Solutions of the energy-stress tensor showing surfaces of simultaneity deformed by a black hole: a) and b) with (31) and c) with (26) and (31).

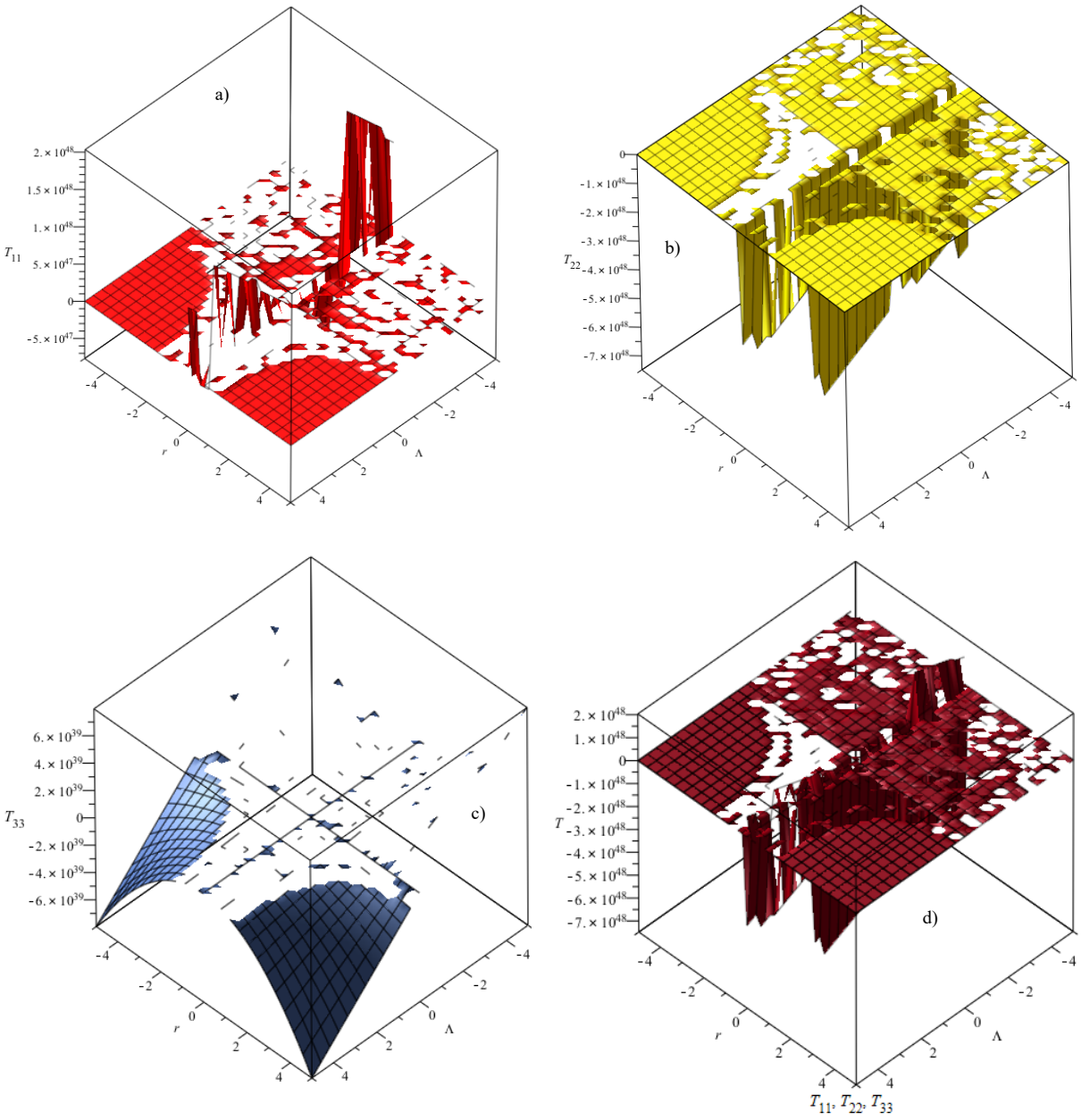


Fig. 7 Graphs of the energy-impulse tensor, and their solutions for nonzero components: a) T_{11}, b) T_{22}, c) T_{33} and d) graph of all the components: T_{11}, T_{22} and $T_{33} = T_{44}$.

TABLE II
PROPERTIES OF THE BLACK HOLE THAT DEFORMS THE SURFACE OF SIMULTANEITY

Tensor	Radius, r (cm)	Mass, M (g)	Schwarzschild radius, r_s (cm)	A_{EH} (cm^2)	Superficial gravity, κ, (cm^2 s^{-1})
T11	1.2E+12	3.22E-73	4.77E-101	2.86E-200	9.42E+120
	300000	3.97E+20	5.891E-08	4.361E-14	7.64E+27
	0.88897	9.05E+31	13415.45	2261627379	3.35E+16
T22	1.2E+12	-4.83E-73	-7.16E-101	6.45E-200	-6.28E+120
	300000	8.61E+19	1.284E-08	2.05E-15	3.53E+28
	0.88897	-1.71E+31	-2527.78	80295283.75	1.78E+17
T33	300000	-4.35E-62	-6.45E-90	5.221E-178	6.98E+109
	0.88897	-5.36E+31	-7951.38	794503873.9	5.66E+16

Tensor	ΔM (g)	Temperature, T (K)	Entropy, S (erg K^{-1})	Evaporation time, t_{evap} (s)
T11		3.10E+98	3.80E-151	3.34E-244
	3.97E+20	251654.63	5.78E+35	6.27E+35
	9.05E+31	1.10E-06	2.99E+58	7.41E+69
T22		2.07E+98	8.54E-151	1.13E-243
	8.61E+19	1161764.02	2.71E+34	6.38E+33
	1.71E+31	5.86E-06	1.06E+57	4.96E+67
T33		2.30E+87	6.92E-129	8.22E-211
	5.36E+31	1.86E-06	1.05E+58	1.54E+69

IV. CONCLUSION

From the results obtained from the physical properties of the black hole, we can conclude that, as the mass of the black hole decreases, its temperature increases. The time it takes the black hole to evaporate turns out to be much larger than the age of the universe, so the Hawking effect is totally insignificant for this hole that reaches a mass of the order of 10^{29} kg. During the evaporation phase of the hole, both the entropy and the area of the event horizon decrease, but the total entropy increases because the radiation produced has a very high entropy, as expected, results that agree with those of other authors. From the model and the physical properties studied, it is concluded that it is corroborated that a compact astrophysical object deforms a surface of simultaneity through the fulfillment of thermodynamic laws unified to the physics of the black holes.

The GR model presented here contains the metric that we are currently using to model and analyze the shadow of the black hole event horizon of the Milky Way that the Event Horizon Telescope (EHT) will obtain, which represents one of the biggest current projects from the international collaboration: Atacama Large Millimeter/Sub millimeter Array (ALMA), the Global mm-VLBI Array (GMVA) and the EHT whose objective is precisely to get images from the black hole's event horizon's shadow at the center of the Milky Way.

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Fine-Scale Modeling the Influencing Factors of Multi-Time Dimensions of Transit Ridership at Station Level: The Study of Guangzhou City

Dijiang Lyu, Shaoying Li, Zhangzhi Tan, Zhifeng Wu, Feng Gao

***Abstract*—**Nowadays, China is experiencing rapidly urban rail transit expansions in the world. The purpose of this study is to finely model factors influencing transit ridership at multi-time dimensions within transit stations' pedestrian catchment area (PCA) in Guangzhou, China. This study was based on multi-sources spatial data, including smart card data, high spatial resolution images, points of interest (POIs), real-estate online data and building height data. Eight multiple linear regression models using backward stepwise method and Geographic Information System (GIS) were created at station-level. According to Chinese code for classification of urban land use and planning standards of development land, residential land-use were divided into three categories: first-level (e.g. villa), second-level (e.g. community) and third-level (e.g. urban villages). Finally,it concluded that: (1) four factors (CBD dummy, number of feeder bus route, number of entrance or exit and the years of station operation) were proved to be positive correlated with transit ridership, but the area of green land-use and water land-use negative correlated instead. (2) The area of education land-use, the second-level and third-level residential land-use were found to be highly connected to the average value of morning peak boarding and evening peak alighting ridership. But the area of commercial land-use and the average height of buildings, were significantly positive associated with the average value of morning peak alighting and evening peak boarding ridership. (3) The area of the second-level residential land-use was rarely correlated with ridership in other regression models. Because private car ownership is still large in Guangzhou now, and some residents living in the community around the stations go to work by transit at peak time, but others are much more willing to drive their own car at non-peak time. The area of the third-level residential land-use, like urban villages, was highly positive correlated with ridership in all models, indicating that residents who live in the third-level residential land-use are the main passenger source of the Guangzhou Metro. (4) The diversity of land-use was found to have a significant impact on the passenger flow on the weekend, but was non-related to weekday. The findings can be useful for station planning, management and policymaking.

***Keywords*—**Fine-scale modeling, Guangzhou city, multi-time dimensions, multi-sources spatial data, transit ridership.

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Interior designing suggestions and guidelines for dementia patients in Taiwan for their wellbeing

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Abstract

The claim for elderly care center has increased enormously with the world demographic revolution as the number of senior citizens increased in the 21st century. As per the world progress into contemporaneousness, a large number of people are engaged in daily routine to bring about the senior citizens to lose the care that they in fact need. New design suggestions have been made on the basis of available guidelines and two case studies in Taiwan. Interior design can provide positive and sensory stimulation through memory stimulation, and by creating a friendly and comfortable environment for demented older people, which can reduce patient anxiety and reduce stress on caregivers. This report pursues to reveal the better design of an elderly care center with a new tactic in direction to offer better service for demented elderly people which could upraise their living standard.

Keywords: day care center, dementia patients, interior designing, older adults.

Introduction

Dementia, including Alzheimer's disease (AD), is a group of symptoms which upsets memory, orientation, reasoning, knowledge, control, wisdom capacity, linguistic, and judging approach up to significant level. It is a syndrome in which cognitive functions are hampered. The intensity of dementia increases with age [1], [2]. The indications linked to dementia can be implied in three stages as illustrated in figure 1. Because of an aging society, Taiwan is fronting the encounters with large numbers of individuals with dementia. Dementia is a prolonged and progressive ailment, and unfortunately, incidence surges with the aging population hovering consequential economic and social difficulties. As indicated by the Department of Statistics, Ministry of the Interior in

Taiwan, till 2008, there were 2,402,220 people in the age group of above 65 years, which was 10.43% of the Taiwanese population. This is due to decline in birth rate and incline in life expectancy. The Council for Economic Planning and Development estimations indicate that the number of older people in Taiwan will touch 20.69 percent of the total population by 2027. Therefore, Taiwan is going to see the encounters of an aging society and large numbers of persons with dementia concurrently [3]. According to WHO, in next 25 years, disease burden of dementia will increase more than 76%.

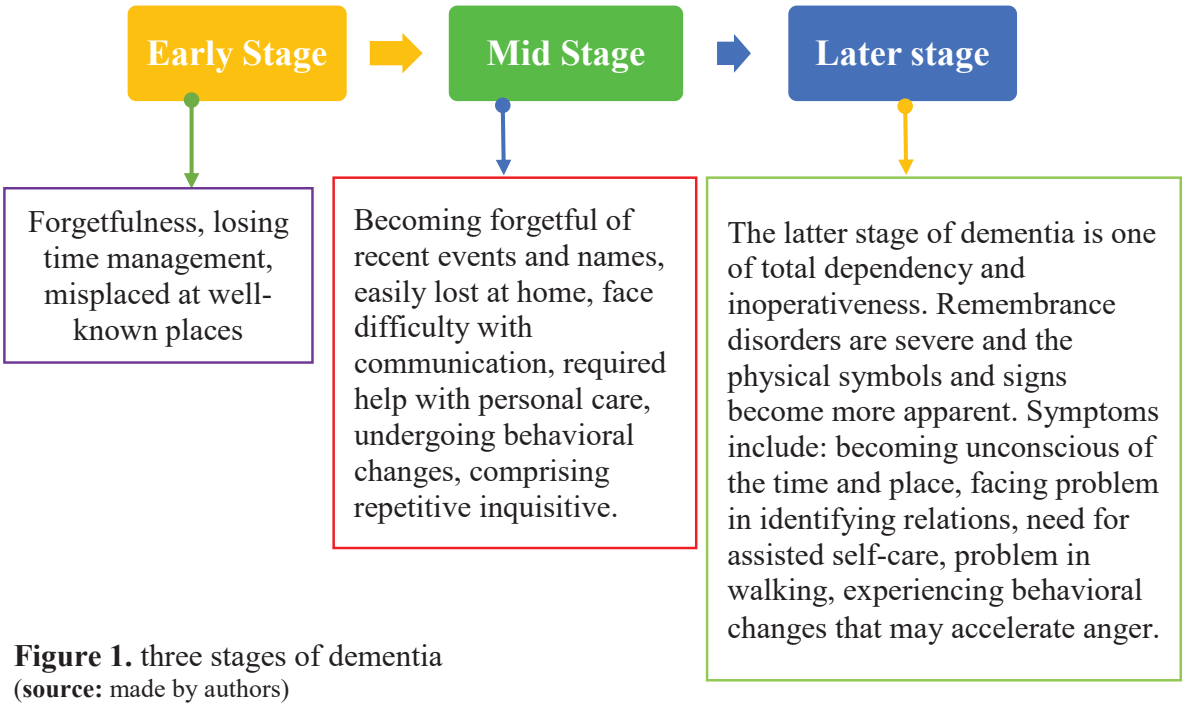


Figure 1. three stages of dementia
(**source:** made by authors)

The health and societal care amenities of dementia in Taiwan are primarily controlled under health and social welfare legislation comprising: Physically and Mentally Disabled Citizens Protection Act, Mental Health Act, Nursing Personnel Act, Senior Citizens Welfare Act, etc. Since 2007, Taiwan administration has considered numerous guidelines and plans, counting collaborated with non-government organizations (NGO) to create national dementia and social supporting centers. A dementia MultiCare service network has been developed to establish dementia care resources including “School of Wisdom”. In addition, the government has proposed to support the setup of daycare centers and home-based care units in order to overcome the difficulties of their establishment, responding to the increase in aged and dementia population, to decrease the impact

of dementia on society and families. A Framework for Prevention and Care was developed which has composition of the National policy strategy and has referred to many other sources including the dementia: a public health priority policy WHO in 2012, the "Kyoto Declaration" by the Alzheimer Disease International (ADI) in 2004, dementia policies and planning developed in other countries, and considered the development and present practice of the Taiwan healthcare system. The program policy also fulfills the impression of "prevention is better than cure." This policy approach of dementia summaries main resolutions and contents which shields the advancement of public perception of dementia anticipation and care. Whole public care networks, treatment, and care services, developing human resources for better care capability. Establishing cross-department co-operation and integration of resources encouraging dementia-related researches and international cooperation, and guarding mortal privileges [4], [5]. This paper will discuss how to improve demented people's life on the basis of available guidelines and two case studies in Taiwan.

Research methodology

Research work is based on the review of available guidelines and case studies done by authors at Banqiao Haishan Public Care Center and Tucheng Public Care Center, Taiwan.

I. General Guidelines:

For elderly and dementia suffering people live at home or in institutions, special facilities need to contact and understand the condition of the patient in many ways. The following types of ideas and suggestions can be used as a reference:

Security system: The central magnetic or sensor door lock system facilitates the monitoring of all doorways and clearly provides access records. It can be accessed by pressing the button on the front door; however, when leaving, either the front door or the back door must be equipped with a security card. In an emergency situation (such as a fire alarm, power failure, etc.), all door locks will be opened immediately for evacuation.

CCTV: All doorways, lifts and rest gardens, installation of closed-circuit television to ensure the safety of dementia patients in the above-mentioned places. Closed-circuit television is also required in the quiet room for clinical observation.

Windows: There are restrictions on the opening of windows, which will not hinder the circulation of air, and it will prevent the mentally retarded patients from climbing out of the window. The location of the window to avoid facing the line of movement, so as not to reflect light through the floor, causing glare, so that the elderly cannot see clearly and fall. Windows can also be fitted with mosquito nets to prevent mosquitoes and reduce sunlight exposure, but the light must be sufficient to avoid falling easily.

Curtains: Use a combination of standard fireproof and dust-proof fabrics, simpler than the original pattern, with a home atmosphere.

Floor: Absorbs sound effects, paved with cushions to reduce the damage caused by tripping, non-slip surface, and wide paving, minimizing the connection points to prevent patients with mental retardation tripping, no wax surface, reducing daylight refraction, simple pattern design, avoid confusion with the sight of demented patients. Of course, because the elderly have poor eyesight, minimize the placement of small objects on the ground to avoid falling. There is a handrail device along the wall along the line to give elderly patients temporary support during walking.

Seat: There are handrails of modest size. It is more comfortable to sit in them. In addition, it is also convenient for the elderly to stand and sit down. The height and breadth are designed specifically for the elderly in Taiwan. The fabric is completely moisture-proof, breathable, mold-proof, mold-proof, and strong anti-fouling. Round edge design, no sharp corners, to protect the skin from scratches or scratches, and use soft and contrasting color series to increase the ease of home atmosphere.

Table: A round table or petal type table designed for people with dementia to sit at the table, reducing the need for wearing a safety suit. A table for four, suitable for group meetings. Or you can combine them into larger tables for larger events. The surface material is a fireproof panel (Formica veneer) that is easy to clean. The design is stable and not easy to fall over. Round edge design, no sharp corners is more secure.

Door design: Two-way door lock system should be made, for example: in case of emergency, patients with mental retardation trip in the bathroom. The width of each door in the room must reach 85 cm or more, which is at least wheelchair accessible. Avoid the installation of large glass

doors (including windows or mirrors) because the resulting images can easily confuse the elderly's judgment of the environment.

Bedroom: The elderly should have their own room, with light and well-ventilated windows. It is best to go outside to the court.

Bathing toilets: As far as possible, individuals are allowed to use larger bathroom facilities in the bedroom or next door. They can accommodate caregivers to assist the elderly in toileting and bathing. There must be a light in the toilet in the evening to make it easier for the elderly to get up at night and get to see the toilet door and go to the toilet. At the same time, the position of the door and bed of the toilet should be noted. Bathroom faucet water can be easily controlled. Generally, the bathtub is too low. The elderly and caregivers are inconvenient to use and cause injury. Therefore, it is still better to use a sitting bathing method. It is necessary to purchase an appropriate bath seat and a shower head that is convenient to use. There should be non-slip equipment on the floor of the bathroom, and there should be handrails beside the toilet and bathtub.

Quiet Room: Provides a peaceful and peaceful space for dementia patients who need to be short-lived or occasionally evacuated. The interior decoration and all furniture are all soft and non-friable materials to prevent self-injury or injury to people with mental retardation. Closed-circuit television is provided to ensure the safety of demented patients indoors [6].

II. Guidelines provided by The Ministry of the Interior, Taiwan

In order to facilitate the creation of space design for the elderly deprived people, the Institute of Architecture has provided the guidelines for elderly dementia suffering people.

First, the entrance space simulation map and precautions

Luminaires should provide sufficient lighting and should have a progressive light sensor, Nostalgic photos, providing memory stimulation, creating a home feeling. Bright, highly convenient handrails. Planting plants provide olfactory stimulation and borderline reminders. The storage space provides wheelchair accommodation. The seating area can provide a safe wearing area. Entrance material should be different and will not cause glare and reflection, Install the spring, or make it easier for the user to apply force, and open the door's assistive device. You can place

photos, etc. to provide the uniqueness of the door. Infrared sensors alert caregivers. Use a long, easy-to-use door handle. The color of the switch must be different from the wall, and the old style. Open cabinets are easy to see and use. Some cabinets can use security locks.

Figure 2. Old age dementia living space simulation maps (**source:** Institute of Architecture, Ministry of the Interior, Taiwan)

Second, the living room space simulation and precautions

Set the line board so that users can feel the traditional home form. Set up enough lights and add lighting sensors near the windows, a large area of windows to allow sunlight to enter. Make sure that the color of the door can be opened differently, and the handle should be set in the traditional form with a height of about 75-85 cm. Place personal items so that users can feel at home. Fish farming can help users create different focus and feel of the creator. There are differences in the colors of the floor, walls, and doors, Personal photos stimulate memory, so that users can feel the feelings of home. The clock and calendar can be used for easy reading. The form of curtains should be easy to use, will not cover excessive light, and should not have too many patterns, Door handles

should be provided with long and obvious handles, Cabinet items should be set to be easy to read and understand. The TV should allow the user to be clearly visible. The remote control buttons are large and easy to understand, Planting and planting provide elderly individuals with different stimuli and regional tips.

Third, restaurant and kitchen space simulation map and notes

With traditional lighting, and set in the center of space, with emergency lighting. A penetrating closet allows users to read the contents inside and avoid reflections. Install the spring, or to facilitate the user to easily apply force and open the door assistive device. The drawer has a logo icon and text so that the user can read it easily. A good lighting system avoids shadows. The line board allows users to feel the traditional home form. Make sure the mirror can be easily removed. The color of the switch and socket is different from the color of the wall, and the height is appropriate, Let the user easily see the toilet's presence from the bed, Use a free-standing toilet, Two single beds for easy use by carers [7].

III. Case study in Taiwan, New Taipei City - authors have done two cases of old age daycare in New Taipei city

Case study 1-Banqiao Haishan Public Care Center: The study area is located in Banqiao District, which is the area with the highest number of elderly people in New Taipei City. Medical resources and public transportation systems can reach within 10 minutes by car. The nearby medical resources are abundant. Public transport availability is high. In terms of manpower allocation, there are eight staff members, including social workers, caregivers and caregivers, plus a chauffeur's driver. However, there is no small-scale and multi-function service, and no services are provided for elderly people to bathe. Services include health management like blood pressure records, self-help group meals, health promotor such as group sports activities: art and craft, music, gymnastics, reality-oriented.

Figure 3. location of Banqiao Haishan Public Care Center (**source:** taken by authors during case study in Taiwan)

Figure 4. Illustration of floors of Banqiao Haishan Public Care Center (a) ground floor; (b) first floor (**source:** made by authors during case
study in Taiwan)

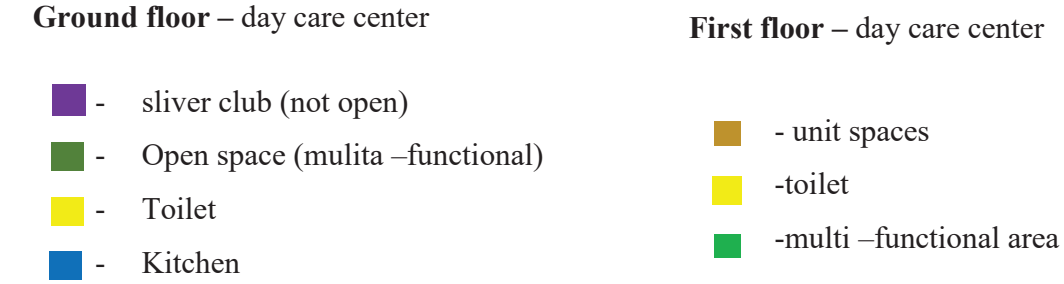


Figure 5. Photo descriptions of the current status of Banqiao Haishan Public Care Center: (a) Open event space; (b) Closed compartment; (c) strip indicating the direction of toilets; (d) strip indicating the direction of elevators (**source:** taken by authors during case study in Taiwan)

Discussion -Through interviews, it is understood that there is some problem in the center like the factors of the environment, elderly persons who use wheelchairs even can't take care of the assistive devices because the subject's accessibility space is very low. Friendly, moving line and toilet space are also not enough. If you use two pods, it will cause the movement line and the toilet

to get stuck. Therefore, for both, elderly people who are healthy and who suffers from dementia, rubber strips on the ground are suggested so that they can easily identify the space.

Builder group is H1 Anyang Church was changed to H1 community daycare. In the process of transfer, the building structure remains unchanged. The difficulty in this transition is that the original partition wall cannot be removed, and it will affect the damage to the building structure. This will cause a lot of space for the unused units on the follow-up, and space can only be removed when used. The two large space activities of the partition wall are used, and the rest are not used so that the space cannot be fully utilized.

Problems occurred in the dementia patients

Common issues- The building is very old and has old pipelines and wall cancer seepage.

Regional issues- 1. Proximity to schools, traffic, and bus stops are nor convenient.

2. In the vicinity of the market, rats often appear because of mouse holes in the pipeline.

3. There is no parking lot in the vicinity, and many temporary parking lots cause loud noises and affect the psychology of elderly people, leading to distractions and difficulty in focusing on their activities.

4. Humidity is heavy.

Space is not properly coordinated with the service content

The lack of space for building fire protection zones.

Case study 2- New Taipei City, Tucheng Public Public Care Center - Day Care Center & Yinfa Club

The longest living is near Banqiao District. The traffic is within 30 minutes. About 85% of the elders are transported from the center to the Sunshine Center. This is convenient for the family members and allows the elders and the center staff to have More interactive opportunities, there are three vehicles to pick up and drop every day. The pick-up and drop-off staff is a driver and two staff in the center. The pick-up and drop-off will be at 7:00 in the morning and the return of the elderly at 5:00 in the evening. The first floor is the Rizhao Center and has service desk. The Rizhao Center has access control and fire doors. After entering the door, there is a buffer space. After entering the second door, it is the Rizhao Center. The stairs leading to the first floor are very spacious and non-slip design. The disadvantage is that there is no elevator. After inquiring, it was

found that the layout of the original Anyang Church is not possible to increase the space of the hall, thus difficult to manage for demented elders.

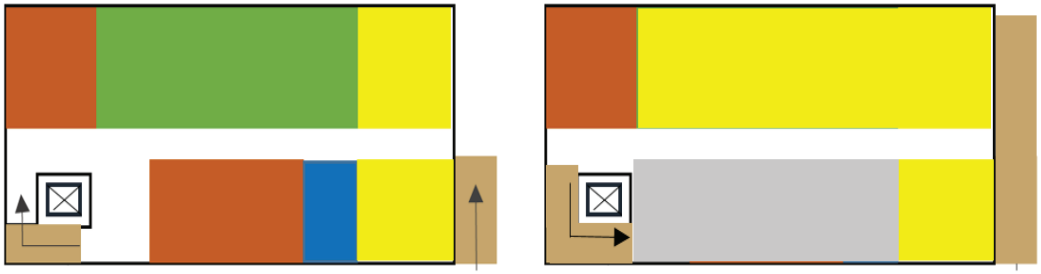
The interior space of the Rizhao Center is an open event space that can be separated by pull curtains. In addition, there are two small homes, which are the size of the accommodation space of the former Anyang Church. They usually use open activities or lunch breaks and are more incompetent. The elderly will be concentrated in small homes close to the toilet. There is a kitchen on the first floor and on the second floor. The Open-bar design is adopted. There are edible lands outdoors, but the stone trails have not yet been completed and muddy. It is inconvenient for the elderly to move. Silver Club is situated on the second floor, which opens up half of the space as a saloon and leisure area. On the day of the interview, nurses from Yadong Hospital happen to provide health check services; there is a screening room that can show movies, sing KTV and other nearby community residents. For fun, it also doubles as a meeting place for staff members; and a silver hair activity room with fitness facilities. The corridors are equipped with many of the elders' finished products, planned for the nostalgic area and works appreciation area.

There is a single-layer handrail in the hallway, and the floor is a non-slip material. The director said that he often updates and maintains the situation. There is non-slip sandpaper on the second floor of the stairs, barrier-free toilets on both floors. There are plenty of separate toilets for men and women. The building was completed about 22 years ago. There are a total of 10 staff members, including 1 director, 4 care workers, 1 social worker, 1 medical care worker, 1 driver, 1 case manager, and 1 business supervisor. There are also volunteers to assist. There are approximately 30 seniors in the Sunshine Center and they belong to a mixed type sunshine center. There are many clients suffering from dementia, hypertension, and diabetes. The elderly aged in the center are all over the age of 85 and most of them are female elders.

The public care center is an integrated service center that provides services such as visits, co-education services, and telephone visits with social care based services; there is no small-scale machine service. The First floor is sunshine center, offers two meals and snacks, and cognitive classes, cooking, group sports activities, small family time, rehabilitation training, and art creation. The Second floor is a silver club, which is mainly open to community elders. It regularly organizes

group courses (such as language classes, mobile phone classes) and Yadong Hospital's health promotion to attract the elderly to enter; there are group health and fitness facilities, newspapers, etc. for the community elders. Every two months, there are two disaster drill tests. First-floor evacuation is about 3 minutes, and second-floor evacuation is about 6 minutes.

Figure 6. location of New Taipei City, Tucheng Public Public Care Center (**source:** taken by authors during case study in Taiwan)



(a) (b)

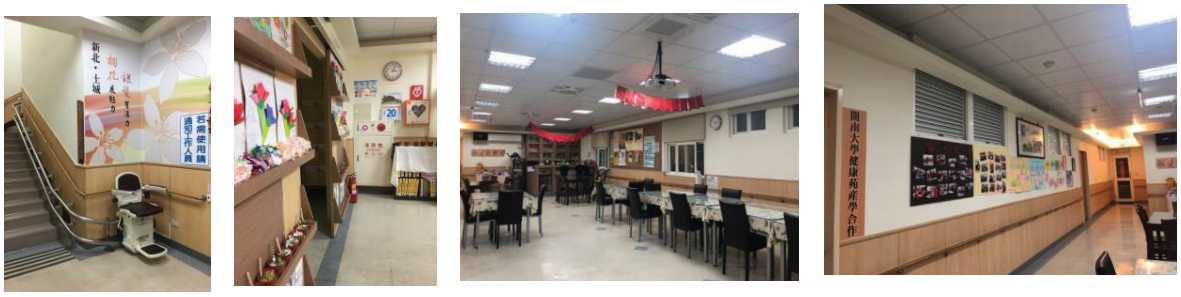
Figure 7. Illustration of floors of New Taipei City, Tucheng Public Public Care Center (a) first floor; (b) second floor (**source:** made by authors during case study in Taiwan)

First floor – day care center

- Unit spaces
- Open space (mulita –functional)
- Toilet
- Kitchen
- stair

Second floor – day care center

- unit spaces
- toilet
- multi –functional area
- stair



(a) (b) (c) (d)

Figure 8. Photo descriptions: (a) stair; (b) leaving the door and disguising the door as a buffer for bookcases; (c) Open Space; (d) Event Area of New Taipei City, Tucheng Public Public Care Center (**source:** taken by authors during case study in Taiwan)

Problems occurred in the dementia patients

Common issues- The building is very old, leading to old pipelines and wall cancer seepage.

Regional issues-

1. Because it is located inside the park, the time of schooling nearby schools is such that the population entering and exiting is more complicated. There will be loud noises from children and it is more likely to affect the activities of the demented elderly.

2. The area is more susceptible to flooding, so there are currently water gates to prevent water from flooding into the center.

3. In the park, it is secretive. Therefore, many elderly people do not know about it, and it is not easy to find this center. Therefore, the openness and closeness of elderly people are not enough.

Due to architectu0ral space limitations, both internal and external elevators cannot be installed. Therefore, no elevators can be used at present, and only barrier-free climbers are currently available.

Suggested guidelines

Interior design can provide positive and sensory stimulation through memory stimulation by using three-dimensional pictures of their childhood.

Creating a friendly and comfortable environment for demented older people, which can minimize patient apprehension and reduce strain on caregivers.

Conclusion

In conclusion, the design guidelines can provide a comfortable stay for memory affected people. This paper delivers a contented scheme of aging care center with a novel methodology to afford the better amenity by analyzing their necessities and appropriate accomplishments that may possibly upraise life expectancy. Interior design was proposed on the basis of provided guidelines and case studies in New Taipei City by present authors. This design can be used as newly developed dementia specific guidelines.

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The Impact of Fire Resilience on Cities

Fanny Guay

***Abstract*—** Building resilience, sustainable buildings, urbanization, climate change, resilient cities, are just a few examples of where the focus of research has been in the last few years. It is obvious that there is a need to rethink how we are building our cities and how we are renovating our existing buildings. However, the question remaining is how can we assure that we are building sustainable yet resilient cities? There are many aspect one can touch upon when discussing resilience in cities, but after the event of Grenfell in June 2017, it has become clear that fire resilience must be a priority.

We define resilience as an holistic approach including communities, society and systems, focusing not only on resisting the effects of a disaster, but also how it will cope and recover from it. Cities are an example of such a system, where components such as buildings have an important role to play. A building on fire will have an impact on the community, the economy, the environment, and so the entire system. Therefore, we believe that fire and resilience go hand in hand when we discuss building resilient cities.

This article aims at discussing the current state of the concept of fire resilience and suggest actions to support the built of more fire resilient buildings. Using the case of Grenfell and the fire safety regulations in the UK, we will briefly compare the fire regulations in other European countries, more precisely France, Germany and Denmark, to underline the difference and make some suggestions to increase fire resilience via regulation. For this research, we will also include other types of resilience such as technological resilience, discussing the structure of buildings itself, as well as community resilience, considering the role of communities in building resilience.

Our findings demonstrate that to increase fire resilience, amending existing regulations might be necessary, for example, how we performed reaction to fire tests and how we classify building products. However, as we are looking at national regulations, we are only able to make general suggestions for improvement. Another finding of this research is that the capacity of the community to recover and adapt after a fire is also an essential factor. Fundamentally, fire resilience, technological resilience and community resilience are closely connected. Building resilient cities is not only about sustainable buildings or energy efficiency, it is about assuring that all the aspects of resilience are included when building or renovating buildings. We must ask ourselves questions as: who are the users of this building? Where is the building located? What are the components of the building, how was it designed and which construction products have been used?

If we want to have resilient cities, we must answer these basic questions and assure that basic factors such as fire resilience, are included in our assessment.

***Keywords*—**Buildings, cities, fire, resilience.

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I. Introduction

Fire has caused many damages throughout the years and is probably one of the oldest type of disaster known of mankind. The London fires in 1212 and 1666, the Chicago fire in 1871, Tokyo in 1923, Texas city in 1947 are just a few examples. Unfortunately, we have not yet managed to eradicate this type of disaster and we keep adding events to the list. One of the most recent tragic incident in Europe happened at the Grenfell Tower in June 2017, where 72 persons lost their lives [1].

After the incident, several questions were raised about the safety of the building and the materials used to refurbish it. As we are now approaching the "one year anniversary" of the disaster, some questions have been answered but little has been done to assure that such event would not happen again. The results of the preliminary enquiry have showed that the design of the building itself, with only one staircase as escape route and without the presence of sprinklers had an important impact. Another factor was the materials used for the refurbishment which was proven more combustible than the results of the fire resistance tests performed. As buildings are at the center of our cities, it is therefore of the outmost importance to assure that they are safe to be in. And there can't be resilient cities without resilient buildings.

For this article, we will start by explaining the concepts of resilience and fire resilience. Using the case of the Grenfell Tower, we will study France, Germany and Denmark's national fire regulations for testing facades of high-rise buildings. We are focusing on high-rise buildings for this paper, first because it is not possible to review all fire regulations for all types of building in this article. It is also relevant to look at high-rise building since the increasing rate of urbanization is creating the need for more of this type of buildings in cities [2].

We will then discuss fire regulations and resilient cities, touching upon technological and community resilience. Finally, we will have a closer look at the link between fire resilience and resilient cities.

II. The Concept of Resilience

The concept of resilience is now well known for those who are working within domains where the term is used. However, we find that even if the concept is often mentioned, few know how it can be defined. This can easily be explained by the fact that the term "resilience" has been used in different discipline such as engineering, psychology and disaster risk management. Since the UN Hyogo Framework for Action adopted the term

resilience in its aims within global disaster risk reduction in 2005 [3], the concept has gained momentum in many different areas and disciplines such as safety engineering, sociology, governance, emergency preparedness and urban development. We like to use the definition of the UNISDR as it can be applied to all these disciplines: "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" [4].

III. The concept of fire resilience

Looking for a clear definition of fire resilience can become a lengthy process. We found that there is no clear definition of this concept. Instead we found several references to fire resistance, which is an engineering term defined as the ability to withstand the effect of a fire [5]. Referring to buildings, this definition of fire resistance is relevant, however, what is not included in this definition is how the fire in a building will affect the people using the building, the environment, the economy and the communities around it.

Fire resilience is also a terminology present in the environmental domain, as fires cause damages to the environment, for example through air pollution or forest fires. Defined by Holling, ecological resilience can be defined two different ways; first by measuring resilience through the resistance to disturbance and how fast one can return to equilibrium, which is most often referred as engineering resilience. Second, by measuring resilience through the amount of disturbance a system can absorb before it changes its structure, which Holling refers to as ecological resilience [6].

The effects of fire can also be observed on the economy. A good example of such impact are the forest fires in California. Estimates for insured losses from wildfires in Northern California, owing to damages to business and residential properties and business disruption, were between $8 billion and $10.5 billion [7].

Finally, fire as an impact of the communities. A fire destroying private houses, an apartment building, a school, a hospital, or a shopping center will affect people living and/or using the building. Children, residents or patients would have to be relocated, and there could be trauma related effects as well.

Therefore, even without a clear definition of fire resilience, we can link the concept to existing resilience domains. Fire resilience is more than regulations or technological resilience. Fire has also an impact on the economy, the environment and communities. In the next section, we will shortly present three different fire regulations for façade of high-rise buildings to demonstrate the impact fire regulation might have on fire resilience and how different the fire regulations are from country to country.

IV. France

The main test for fire spread on facades in France is called LEPIR II. This test is made on a test rig build specifically for façade tests (see figure 1) [8].

This test is particular because it includes four openings, is clearly representing two stories of a building, and the rig is closed from all sides. This is a full-scale test and one of the "most complete of all current façade fire spread test methods" [9].

Fig. 1:LEPIR II test rig

The performance criteria are: non-propagation of the fire to the second level and no fire leap to the second level through the facade or the floor. For any integrated systems, there is also a temperature criteria which must not exceed 180°C at the façade / floor junction, no rise in temperatures above 180 °C measured on the unexposed side of the floor at 50 mm away from the facade for the first 30 minutes of the test [10].

The length of the test varies depending of the type of system tested, but most current is 60 minutes, where the fire is extinguished after thirty minutes and the remaining time is used to observe that there will not be secondary inflammation of the test specimen [10].

This test is interesting to mention because even though it is considered a complete test, it is mainly use nationally and rarely used as a compared methodology, unlike the UK test method BS8414 or the German test DIN 4120-20. There could elements in this test that could results closer to how a façade system would behave under a fire. We will now have a closer look in the German test.

V. Germany

In Germany, the test that can be comparable to LEPIR II and SP105 can be found in DIN 4102-20. This test is a medium scale test, but there are of course other tests available such as the technical regulation A 2.2.1.5 which is a full-scale test for ETICS systems.

DIN 4102-20 has a test specimen that is L-shaped, at least 5,5 m high and can use either a burner or a crib for the fire load (see figure2) [11].

Fig. 2:DIN 4120-20 test rig

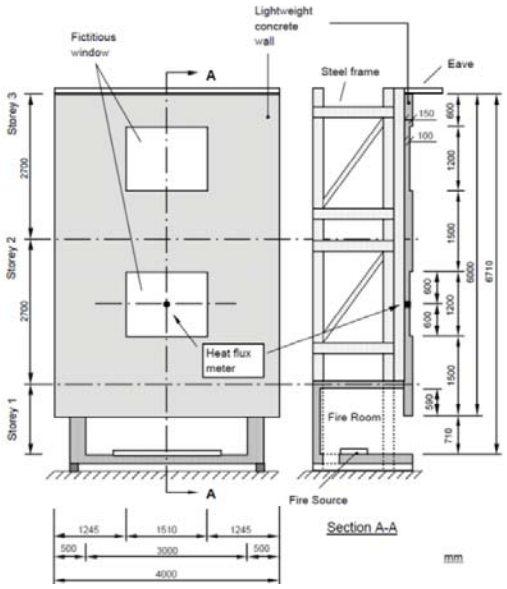

Fig. 3: SP Fire 105 test rig

Performance criteria are slightly different if the test is for combustible or non-combustible materials. If the test is for combustible materials, the burner would be turned off after 20 minutes, and for non-combustible materials, after 30 minutes. Then there will be some time allowed for observing the test specimen and assure that it will not keep burning or produce smoke for another 30 minutes.

The performance criteria are that there should not be burned damage on the test specimen 3,5m or more above the fire chamber; the temperature under or over the surface of the insulation should not be over 500°C 3,5m or more above the chamber; no continuous flaming for more than 30 seconds 3,5m above the fire chamber; no flaming allowed on the top of the specimen; falling debris and droplets must not keep on falling 90 seconds after the burners have been shut down [12].

This test is different from the French test as it doesn't include any openings other than for the crib or burner used. The French test also has a temperature criteria that is much lower than for the German test, which is also an interesting difference to mention. Which temperature should we measure, a lower or a higher temperature? The National Fire Protection Association (NFPA) states that the upper limit of human temperature tenability is 212°F [13], which is equivalent of 100°C, so it gives us an idea of how extremely warm 500°C is. We will now study the test used in Denmark to add another test to compare.

VI. Denmark

In Denmark, the SP Fire 105 method is used. It evaluates a large-scale façade fire where the test object is 4 x 6 m (width x height) and resembles the real façade system as much as possible (see figure 3) [14]. The fire exposure lasts around 15-20 minutes. The fire source is 60 liters of heptane burning in trays with attached flame suppressors. "The performance criteria of the façade system are maximum temperatures of the combustion gases at the eave and maximum heat flux to the specimen in the middle of the first fictitious window. No flame-spread above the second floor is allowed" [15].

This test is again different from the two others, though includes openings, the temperature criteria is not well defined. The differences between the three tests are so fundamental that it becomes impossible to make a relevant comparison. Because fire safety regulations are of national competences, there has been little work on harmonizing the test system and so it has been difficult to assure cooperation between the countries on this topic. However, after Grenfell, the EU has reached out to member states and a consortium has been working on a possible harmonized system, which work is currently ongoing.

One other important point from this section is that to get a robust test systems, countries must not only base their system on national disasters. Even though we hope to have learned a lot from the fire of the Grenfell Tower, we need to remember to have a holistic approach to fire resilience and consider all its dimensions. In the next section, we will demonstrate how fire resilience and technological resilience are linked.

VII. Technological Resilience

Fire safety regulation have an important role to play to secure better fire resilience. However, it is not the only important factor. As we mentioned earlier, technological resilience is a factor. We have used Holling's definition of technological resilience earlier in this paper, where we explained that the "concept of resilience focuses on system's behaviour near a stable equilibrium and the rate at which a system returns to steady state following a disturbance" [16].

Other definitions of the concept can be found, such as Pimm's where one "measures how fast a variable that has been displaced from equilibrium returns to it" [17]; or Haimes defining resilience as "the ability of the system to withstand a major disruption within acceptable degradation parameters and to recover within an acceptable time and composite cost and risks" [18].

So, if we take the example of a building, for it to be technologically resilient would mean that it would not be affected by an unexpected event or would be able to quickly recover. How can we secure this for a building? There are many solutions, if brought together, can make a difference on the level of resilience reached. For example, assure that there are sprinklers in the building so that small fires can be quickly extinguished, or have an alarm system that can alert first responders so they can rapidly respond. Another measure would be the use of non-combustible materials for high-rise and high-risk buildings. A combination of several of the mentioned solutions could increase buildings' fire resilience.

As mentioned earlier, solutions must contain elements from the different resilience dimensions to have an impact on the overall resilience of buildings and cities. We will now consider the role of the community in increasing resilience.

VIII. Community Resilience

Communities also have a role to play to strengthen fire resilience. Communities are composed of built, natural, social, and economic environments that influence one other in complex ways [19]. They absorb, adapt, or cope with unexpected events. Again, there are many definitions of community resilience; Magis defines community resilience as "the existence, development, and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise" [20]. Cutter et al. define community resilience as "the ability of social system to respond and recover from disasters and include those inherent conditions that allow the system to absorb impacts and cope with an event, as well as post-event, adaptive processes that facilitate the ability of the social system to re-organize, change and learn in response to threat" [21]. Aldrich and Meyer define community resilience as the "collective ability of neighbourhood or geographically defined area to deal with stressors and efficiently resume the rhythms of daily life through cooperation following shocks" [22].

How do we link these definitions of community resilience to fire resilience? It is about involving communities in anticipating the disaster. Therefore, in order to have a community contributing to fire resilience, we need to involved the community into emergency planning activities, such as evacuation training, identification of key persons in case of an emergency, guidelines for social media use, tools for response, etc. The National Institute of Standards and Technology (NIST) has developed a Community resilience planning guide, using six steps to support more resilient cities (see figure 4 below) [23]. The NIST example demonstrates well the need for a strong community resilience for any disaster, fire included.

Regulations, technological and community resilience are three dimensions that can play a significant role in strengthening fire resilience. In the next section, we will look more precisely into the link between fire resilience and resilient cities.

Fig. 4: NIST Community Resilience Planning Guide

IX. Fire Resilience and Resilient Cities

The short description of three fire regulations for façade testing was used to demonstrate how the systems can be different from a country to another. This is an important fact to understand as it demonstrates well that working towards more resilient cities is far from being a simple goal to achieve. Testing fire resilience on high-rise buildings is only one parameter part of a much bigger picture.

We then looked at technological and community resilience, which are also important dimension of resilience that are playing an active role in increasing fire resilience. But how do we define resilient cities and how does fire resilience play a role in this definition?

According to the organization "100 Resilient Cities", there

are seven qualities a city must have to be resilient: reflective, resourceful, inclusive, integrated, robust, redundant and flexible [24]. Not all the seven qualities are relevant for fire resilience, but we can look at the following: reflective, inclusive, robust and flexible.

A reflective city comprises individuals and institutions that are learning from the past and will modify regulations and behaviors accordingly. If we then take the example of fire, we would assume that we have learned from the past mistakes and adjusted so that we would reduce the impact of fires. Yet, when we look closer to residential fires, we can observe that they are still present, and that their impact is much more serious than in the past. That can be explained by the fact that our houses are now filled with all kinds of materials and notably plastic based items which are highly flammable and cause toxic smoke for inhabitants and the environment [25].

An inclusive city can be defined by the processes of good governance and leadership to assure that the changes needed are addressed for everyone. A good example for this is obviously the UK who is now going into the revision of its fire safety regulation under the Approved Document B, as well as the Hackitt review which should be completed in May 2018 and the Grenfell Tower inquiry which is ongoing. Such processes are lengthy and will not always make conclusion that will satisfy all parties, but the system is in place and give the opportunity for everyone to engage.

A robust city refers mainly to its infrastructures and assuring that they can withstand the effect of a disaster. Again, when we link robustness to fire, it is to say that the buildings are not collapsing rapidly because of a fire. It is not expected that a building suddenly catches fires and burns down within minutes. Several examples of this can be found just by doing a quick google search: Sao Paulo in May 2018, Dubai in August 2017 and of course Grenfell in June 2017. This is happening different places in the world, for different reasons, but often have the same element spreading the fire itself: the building structure and/or materials.

Finally, a flexible city, is a city that reflects the ability to adapt to changes and find alternatives solutions to the challenges brought by crises or new circumstances. To be flexible and fire resilient means that we need to keep doing research on materials to better understand their properties and use them in the best possible manner. For example, the use of non-combustible materials for facades of high-rise buildings is a good way to avoid unnecessary fire risks.

X. Findings

With this article, we have demonstrated the complexity of fire regulations and its effect on fire resilience. Changing fire safety regulations is difficult, as it is of national competences, but engaging the EU could provide solutions suitable for all member states. However, we need to be careful not to rest on existing systems, which have been mostly based on national disasters and experiences. We must develop a more scientific based approach, considering real scenario both representing the fire load and the building we are testing for. We have then studied technological resilience, for which we found that the choice of materials for buildings and the design of buildings itself can have a tremendous effect on their level of fire resilience. With community resilience, we have discussed the role of planning, preparation and training as important steps to increase community resilience and so fire resilience. Finally, we discussed the concept of resilience cities and how it can be linked to fire resilience through some of the resilient cities qualities that the "100 Resilient Cities" organization, pioneered by the Rockefeller Foundation, have cited. A city that is reflective, inclusive, robust and flexible is not only a resilient city but a fire resilient city.

XI. Conclusion

This article discussed the concept of fire resilience for which there is not much research to be found. Therefore, our suggestion would be to work further on the topic to understand better the effect of regulations, materials, design and communities in supporting fire resilience, as well as developing a common concept for fire resilience that can be used by all dimension of society.

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A Fuzzy AHP Approach for the Decision of Maintenance Priorities of Building Entities: A Case Study in a Facilities Management Company

Wai Ho Darrell, Kwok

***Abstract*—**Building entities are valuable assets of a society, however, all of them are suffered from the ravages of weather and time. Facilitating onerous maintenance activities is the only way to either maintain or enhance the value and contemporary standard of the premises. By the way, maintenance budget is always bounded by the corresponding threshold limit. In order to optimize the limited resources allocation in carrying out maintenance, there is a substantial need to prioritize maintenance work. This paper reveals the application of Fuzzy AHP in a Facilities Management Company determining the maintenance priorities on the basis of predetermined criteria, viz., Building Status (BS), Effects on Fabrics (EF), Effects on Sustainability (ES), Effects on Users (EU), Importance of Usage (IU) and Physical Condition (PC) in dealing with categorized 8 predominant building components maintenance aspects for building premises. From the case study, it is found that 'building exterior repainting or re-tiling', 'spalling concrete repair works among exterior area' and 'lobby renovation' are the top three maintenance priorities from facilities manager and maintenance expertise personnel. Through the application of the Fuzzy AHP for maintenance priorities decision algorithm, a more systemic and easier comparing scalar linearity factors being explored even in considering other multiple criteria decision scenarios of building maintenance issue.

***Keywords*—**Building Maintenance, Fuzzy AHP, Maintenance Priority

I. Introduction

All types of building are suffered from deterioration and need to the commencement of maintenance once they are completely erected on the lot lands. There is an increase from the building owners with the mindset that purely reactive maintenance manner is not the best way in dealing with maintenance issue of building entities by Arditi et al. [7]. Chew [5] claims that it is vital to facilitate proper maintenance so as to extend the life of a building. Besides, Hills and Worthing [8] share almost the same view as Chew believing that those building elements should extend the life through day-to-day maintenance work. By the way, decision should be made in dealing with maintenance works which implies cost, quality, duration time and resources allocation thereto [1].

Pitt [13] has an idea that it is not uncommon to face with insufficient resources in planning numerous maintenance activities. Building maintenance activities have pressure too no matter in reducing cost and staff level in order to optimize the available constraint resources for the premises. From Zavadekas et al. [21] point of view, disorganized maintenance resources associated with health and safety risk to both organization and occupants, however, top management still look for possibility in minimizing maintenance operation cost which also challenges maintenance is a kind of wastage in maintenance resources by Shen and Lo [17]. Shen et al. [14] states that even for professional property managers, determining maintenance priorities is really difficult to themselves. A lot of decisions in maintenance priority belongs to subjective evaluation which resulted in scarcity of resources and budget shortfall.

In this paper, a Fuzzy-AHP based model has been developed for the priority setting process to connect the factors identified with quantitative data from the corresponding maintenance decision prioritization survey. This Fuzzy AHP algorithm facilitate an approach for ranking maintenance and repair aspects on the basis of predetermined criteria and resulted in a more systemic and easier comparing scalar factors that has been explored in maintenance decision.

Five sections being included for this paper. Section 2 reviews the literature which comprise of building maintenance strategies & practices and the fuzzy analytic hierarchy process. In Section 3, the research methodology are described. As to Section 4, the Fuzzy AHP method is utilized to prioritize the maintenance work of a Facilities Management Company elaborated as a case study with detailed discussion. Finally, the conclusion is presented in Section 5 as well.

1.1 *Problem Statement*

The problem statement of this paper is whether it is feasible to apply Fuzzy Analytic Hierarchy Process (FAHP) approach for facilitating prioritization among numerous maintenance activities and exploring a more systemic scalar linearity weighted index for easy comparison via the objective mathematics even though subjective judgement and personal favoritism being encountered during decision making for determining maintenance priorities on the basis of predetermined criteria. They include:

- Building Status (BS)
- Effects on Fabrics (EF)
- Effects on Sustainability (ES)
- Effects on Users (EU)
- Importance of Usage (IU)
- Physical Condition (PC)

Facilities Management (FM) practitioners when incorporating FAHP approach in evaluating of priority for onerous building maintenance aspects need to consider:

- Whether the use of FAHP based model are effective or not in assigning scalar linearity weighted index to various

maintenance activities should ensure consistency for maintenance decisions elsewhere.

1.2 *Research Objectives*

This paper is to introduce a multi-criteria decision making tool Fuzzy AHP and illustrate how the integration of FAHP based model in addressing the maintenance priorities of a Facilities Management Company in dealing with different building components maintenance aspect for building premises.

II. Literature Review

2.1 *Building Maintenance Strategies and Practices*

Lee and Scott [10] have the same point that Maintenance Strategy is adopted for extending the building life cycle no matter in building structure & fabrics and its own fittings services as well. Three available basic maintenance strategies including preventive, corrective and condition-based maintenance. Further to these three basic maintenance strategies, the performance-based, time-based, breakdown-based, renovation-based and integration-based maintenance strategies having been explored afterwards by Chan [4]. As to the Planned Preventive Maintenance (PPM), it seems to be the most effective maintenance strategy in terms of breakdown frequency consideration [20]. As far as the Hong Kong maintenance practice is concerned, it mainly relies on time-based and failure-based strategies, however, there isn't any comprehensive maintenance approach being in line accordingly. There also exists a phenomenon that in case the Facilities Management Organization accompanied with sufficient maintenance resources have a higher maintenance standard and with also the initialization of a plenty of improvement works which resulted in even better than the original entity. Whereas, Facilities Management Organizations with limited or insufficient maintenance resources in the due course would facing with harsh difficulties to maintain the original standard or only have to fulfill the corresponding statutory requirements.

2.1.1 *Maintenance Prioritization Practice in Hong Kong*

The Hong Kong Housing Authority has rigorous and complicated named "CARE" which is constituted by condition, appraisal, repairs and examination conceptual framework. The contextual idea is to facilitate both the maintenance works and the improvement works of those public housing blocks one by one via a condition survey firstly and then overview the findings and carrying out such repair works with a 2-year intensive repairing period. Whereas, tenants would choose another option of a low 4-year low breakdown and "quiet" period with improved maintenance standard items thereto. Building data are collected for the next "CARE" cycle during such quiet period which also acts as an examination period as well [14].

According to "CARE" program, some guidelines for prioritizing the maintenance work from descending order as:

(i) Work for maintaining the safety of persons.

(ii)Work for keeping property habitable which including hygiene, security and building services consideration.

(iii)Work to ensure buildings under normal operation.

(iv)Work for maintaining the appearance of the entity and also up keeping the non-essential facilities and services in good condition.

2.1.2Multi-attribute Approach in Maintenance Prioritization

Spedding, Holmes and Shen [18] have proposed a multi-attribute approach in the manipulation of ranking priorities for planned maintenance activities. By the way, some criteria being adopted for ranking priorities which accompanied with a weighed factor for every criterion according to their comparatively importance to each other. Numerous specified criteria (see Figure 1) in facilitating maintenance priorities as stated below:

(i) Building Status (BS) – Comparing the relative importance of the building entity throughout the consideration of function and usage thereto.

(ii)Effects of Fabrics (EF) – The adverse effect or implication of defective components to the overall condition of the building entity.

(iii)Effects on Sustainability (ES) – The adverse effect and impact to our earth resources and global environment via sustainability chain consideration [7].

(iv)Effects on Users (EU) – The effect of failure or breakdown of the defective components to the users and occupants of the premises.

(v)Importance of Usage (IU) – Comparing the relative importance of the function for the said unit within the same building entity.

(vi)Physical Condition (PC) – The physical condition of existing building structures & fabrics. Higher priorities will be encountered in case the building elements as in extremely bad condition.

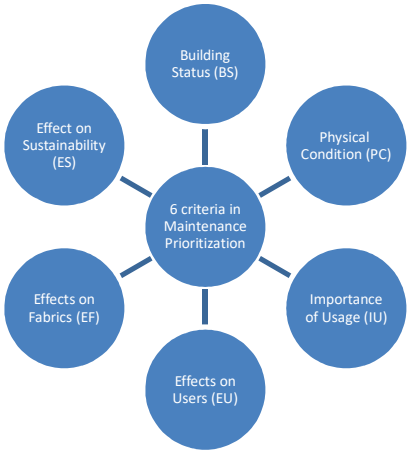

Fig. 1 Proposed Six Specified Criteria in Facilitating Maintenance Priorities

2.2 *Analytic Hierarchy Process (AHP)*

The AHP was developed by Saaty in 1980s. Ayhan [12] claims that it is a multi-criteria decision making methodology in dealing with complicated and unstructured problems which also being an approach by applying a simple hierarchical model with levels of goal, criteria, sub-criteria and possible alternatives together to splitting complicated problems from higher hierarchies to lower one (as shown in Figure 2). Besides, AHP could scale the weights of attributes at each level of the hierarchy with the use of a pairwise comparison matrix of attributes by Oguztimur [16].

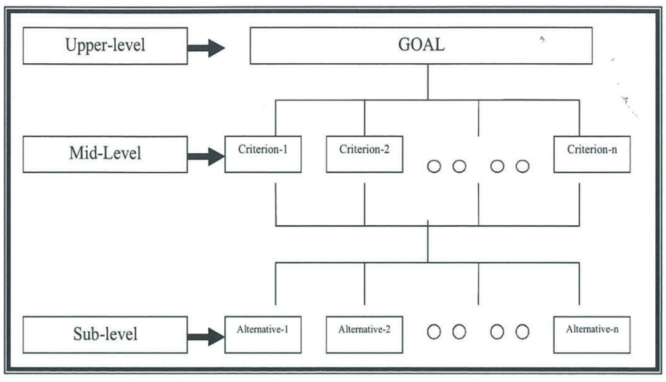

Fig. 2 Hierarchical Structure of AHP

Source: Adapted from Oguztimur [16]

The AHP application is usually to select the best alternatives among discrete alternatives. It is especially appropriate to cope with scenario in which feelings, ideas and emotions are quantified according to subjective judgement in facilitating a numeric scale for prioritizing decision among a lot of available alternatives. Briefly, the application of AHP constitutes of three main steps, viz., developing a hierarchy from the upper level (i.e., goal & objective) then via middle level (i.e., criteria or sub criteria) and to ending at lower level (I.e., alternatives), facilitating pairwise comparison among the criteria and finally identifying the relative weighting of each level, criterion, sub-criteria and alternatives for decision purpose by Saaty, [15].

Javanbarg et al. [11] has an idea that AHP is easy to adopt and can cope with no matter qualitative and quantitative data. Whereas, in some practical situation, human being might be found reluctant or unable to assign exact numerical values during the comparison judgements. By all means, the use of AHP corresponding discrete scale 1 – 9 to perform pairwise comparative analysis accompanied with advantage of simplicity, however, it is really difficult to determine the exact degree of performance and facilitate precise pairwise comparison judgement as well. As to this reason, such conventional AHP will have an extension and to integrate with fuzzy set theory in handling uncertainty and overcome the ineffective phenomenon in dealing ambiguous problems.

2.3 *Fuzzy Analytic Hierarchy Process (FAHP)*

Fuzzy Analytic Hierarchy Process (FAHP) embedding the fuzzy theory to conventional AHP which couldn't taking into account the vagueness for personal judgement and this problemed situation could be improved by applying fuzzy logic approach. According to Ayhan [12], pairwise comparison of FAHP of both the criteria and the alternatives are carried out through the linguistic variables which being represented by triangular number (see Figure 3). Laarhoven and Pedrycz [19] had initialized the triangular membership function for the pairwise comparison in application of fuzzy AHP. Again, the comparison ratio engagement of fuzzy priorities accompanied with triangular membership function having been determined by Buckley [3].

Saaty scale	Definition	Fuzzy Triangular Scale
1	Equally important (Eq. Imp.)	(1, 1, 1)
3	Weakly important (W. Imp.)	(2, 3, 4)
5	Fairly important (F. Imp.)	(4, 5, 6)
7	Strongly important (S. Imp.)	(6, 7, 8)
9	Absolutely important (A. Imp.)	(9, 9, 9)
2		(1, 2, 3)
4	The intermittent values between two adjacent scales	(3, 4, 5)
6		(5, 6, 7)
8		(7, 8, 9)

Fig. 3 Linguistic Variables and the Corresponding Triangular Fuzzy Numbers

Source: Adapted from Ayhan [12]

According to Zimmermann [22], a Triangular Fuzzy Number (TFN) was a format to represent the contextual of fuzzy relative importance. The TFN and the corresponding form of membership function are shown in Figure 4 and Figure 5 respectively.

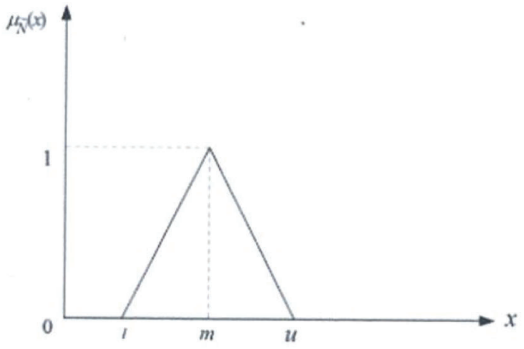

Fig. 4 Triangular Fuzzy Number

Source: Adapted from Javanbarg [11]

The TFN $\tilde{N}$ is normally expressed as a fuzzy set event with the form of (l, m, u) in which l, m and u are the parameters denote the least possible value, the most likely value and the highest possible value as well.

$$\mu_{\tilde{N}}(x) = \begin{cases} \frac{x-l}{m-l}, & l \leqslant x \leqslant m \\ \frac{u-x}{u-m}, & m \leqslant x \leqslant u \\ 0, & otherwise \end{cases}$$

Fig. 5 Mathematical Expression of Membership Function

Source: Adapted from Javanbarg [11]

Based on linguistic variables in the format of triangular fuzzy numbers, if in case the pairwise comparison of Criterion C1 is found "Fairly Important than" Criterion C2 then it uses (4, 5, 6) as the fuzzy triangular scale. However, if in case the pairwise contribution matrix of the criteria comparing C2 to C1 will uses (1/6, 1/5, 1/4) as the fuzzy triangular scale accordingly.

According to Figure 6, the pairwise contribution matrix is facilitated where $\widetilde{d_{ij}}$ represents the kth decision maker's preference of i[th] criterion over j[th] criterion in form of fuzzy triangular numbers and if there exists two or even more decision makers, the averaged preferences among decision makers are calculated as $\widetilde{d_{ij}}$ which also being applied in pairwise contribution matrix [12].

$$\widetilde{A}^k = \begin{bmatrix} \widetilde{d}_{11}^k & \widetilde{d}_{12}^k & \dots & \widetilde{d}_{1n}^k \\ \widetilde{d}_{21}^k & \dots & \dots & \widetilde{d}_{2n}^k \\ \dots & \dots & \dots & \dots \\ \widetilde{d}_{n1}^k & \widetilde{d}_{n2}^k & \dots & \widetilde{d}_{nn}^k \end{bmatrix}$$

$$\widetilde{d}_{ij} = \frac{\sum_{k=1}^{K} \widetilde{d}_{ij}^k}{K}$$

Fig. 6 Formation of Pairwise Comparison Matrix with kth decision maker's preference of i[th] criterion over j[th] criterion

Source: Adapted from Ayan [12]

Buckley [3] has an idea that the equation (1) is used for calculating each criterion's fuzzy comparison values in considering geometric mean. $\tilde{r}_i$ is the corresponding triangular values.

$$\tilde{r}_i = [\prod_{j=1}^{n} \widetilde{d_{ij}}\,]^{\frac{1}{n}} \quad , i = 1,2,..,n \quad \ldots . \textbf{Equation 1}$$

Then, the fuzzy weights of those criteria could be found by equation (2) with also the following steps. They are:

(i) Calculating the vector summation $\tilde{r_i}$ of all and find the -1 power of the said summation vector with ascending sequence to replace the fuzzy triangular number thereto.

(ii) Multiplying each $\tilde{r_i}$ with the mentioned reverse vector to calculate the corresponding fuzzy weight of criterion as equation (2) and follows by an de-fuzzification process with the adoption of Centre of Area method (see equation (3)) by Chou and Chang [6].

(iii) Normalizing M_i with $\sum M_i$ (i.e. i = 1 to n) to calculate the normalized weights of the criteria and the available alternatives. Afterwards, to multiple every alternative weighting factor with related criteria, those alternatives resulted score weighting could be calculated accordingly.

$$\mathbb{W}_i = ri \otimes (r_1 \oplus r_2 \oplus \ldots . \oplus r_n)^{-1}$$

$$= (lwi, mwi, uwi) \qquad \ldots\ldots\ldots \textbf{Equation 2}$$

$$Mi = \frac{lwi+mwi+uwi}{3} \qquad \ldots\ldots\ldots \textbf{Equation 3}$$

III. RESEARCH METHODOLOGY

This study is based on quantitative approach, however, it is supplemented by a semi-structured interview so as to collect whether there is any missing or special concern from the respondents in dealing with maintenance priorities decision of building entities. Data collection is resulted from questionnaire survey. The respondents in this study encompass Facilities Managers, Maintenance Managers, Building Surveyors and

Maintenance Engineers who are directly participated in prioritizing of maintenance aspects for building premises. 139 respondents from Company's list are received a set of questionnaires. And there are 41 completed questionnaires which act as the database for the quantitative analysis.

IV. DISCUSSION

4.1 *Case Study – Application in a Facilities Management Company*

In this case study, the fuzzy AHP methodology is applied in a Facilities Management Company which is currently managing more than 200 different portfolio properties including residential, commercial, industrial and public utilities premises in Hong Kong Island, Kowloon and New Territories of Hong Kong. Such Facilities Management Company is a service provider which facilitates a wide-span service job duties comprise of supporting administrative tasks, handling maintenance activities, supervising building repair works and controlling different kinds of expenses. Maintenance cost being a huge expenditure and accompanied with around 25% to 30% or even higher of overall operation cost of a building entity. In view of this, there is a substantial need to prioritize onerous maintenance work via Fuzzy AHP based maintenance decision algorithm [23]. There having been categorized 8 dominant building components maintenance aspects (see Figure 7) are taken into consideration of maintenance priorities thereto.

Fig. 7 Hierarchy Structure of FAHP of Evaluation of Maintenance Priorities

4.1.1 *Determination of Criteria in Facilitating Maintenance Priorities*

As to the preferences determination from the questionnaire survey among Facilities Managers, Maintenance Managers, Building Surveyors and Maintenance Engineers, pairwise comparison matrices for Facilities Maintenance priorities criteria should be formulated. Besides, the Facilities Maintenance Criteria with the categorized 8 dominant building components maintenance aspects have been evaluated during the decision making process. Table 2 illustrates the fuzzy comparison matrices with embedding of triangular fuzzy numbers.

TABLE 1
Fuzzy Comparison Matrices for Facilities Maintenance Criteria

Facilities Maintenance Criteria	BS	EF	ES	EU	IU	PC
Building Status (BS)	(1,1,1)	(1,1,1)	(6,7,8)	(0.25,0.33, 0.5)	(0.25,0.33, 0.5)	(0.17,0.2, 0.25)
Effects on Fabrics (EF)	(1,1,1)	(1,1,1)	(6,7,8)	(0.25,0.33, 0.5)	(0.25,0.33, 0.5)	(0.17,0.2, 0.25)
Effects of Sustainability (ES)	(0.13,0.14, 0.17)	(0.14,0.14, 0.17)	(1,1,1)	(4,5,6)	(4,5,6)	(0.13,0.14, 0.17)
Effects of Users (EU)	(2,3,4)	(2,3,4)	(0.17, 0.2, 0.25)	(1,1,1)	(0.25,0.33 0.5)	(0.25,0.33, 0.5)
Importance of Usage (IU)	(2,3,4)	(2,3,4)	(0.17, 0.2, 0.25)	(2,3,4)	(1,1,1)	(0.25,0.33, 0.5)
Physical Condition (PC)	(4,5,6)	(4,5,6)	(6,7,8)	(2,3,4)	(2,3,4)	(1,1,1)

The corresponding geometric means, relative fuzzy weight and normalized weights of each Facilities Maintenance Criteria are shown in Table 2.

TABLE 2
Geometric Means, Fuzzy & Normalized Weights of Facilities Maintenance Criteria

Facilities Maintenance Criteria	Geometric Means	Fuzzy Weights	Normalized Weights
Building Status (BS)	(1.43,1.46,1.50)	(0.15,0.16,0.17)	0.163
Effects on Fabrics (EF)	(1.43,1.46,1.47)	(0.15,0.16,0.16)	0.169
Effects of Sustainability (ES)	(1.45,1.50,1.54)	(0.16,0.17,0.18)	0.167
Effects of Users (EU)	(1.33,1.41,1.47)	(0.14,0.16,0.17)	0.156
Importance of Usage (IU)	(1.40.1.48,1.55)	(0.15,0.16,0.18)	0.164
Physical Condition (PC)	(1.63,1.70,1.75)	(0.18,0.19,0.20)	0.188

Upon completion of the normalized weight calculation for Facilities Maintenance Criteria, the same approach is adopted to calculate the weights of the building components maintenance aspects for each Facilities Maintenance Criterion (see Table 4) and the finalized aggregate results to each Facilities Maintenance Criterion are presented in Table 4.

TABLE 3
Normalized Non-fuzzy Relative Weights of Each Building Component Maintenance Aspect

Building Components Maintenance Aspects	Building Status (BS)	Effects of Fabrics (EF)	Effects of Sustainability (ES)	Effects of Users (EU)	Importance of Usage (IU)	Physical Condition (PC)
Building Exterior Repainting or Re-tiling (BER)	0.148	0.147	0.146	0.145	0.143	0.136
Building Exterior Repainting or Re-tiling (BIR)	0.109	0.108	0.114	0.122	0.122	0.122
Re-roofing (RER)	0.112	0.112	0.112	0.108	0.11	0.11
Lobby Renovation (LOR)	0.141	0.141	0.141	0.139	0.139	0.142
Spalling Concrete Repair Works (Exterior) (SCE)	0.144	0.144	0.144	0.141	0.14	0.145
Spalling Concrete Repair Works (Interior) (SCI)	0.115	0.115	0.115	0.113	0.115	0.114
Rehabilitation of Fire Rated Doors (FRD)	0.123	0.122	0.123	0.129	0.128	0.127
Windows Repairing or Replacement (WRR)	0.108	0.110	0.156	0.103	0.103	0.103

TABLE 4
Aggregated Results for Each Building Component Maintenance Aspect to Each Facilities Maintenance Criterion

		Scores with Respect to Related Facilities Maintenance Criteria							
Facilities Maintenance Criteria	Weights	BER	BIR	RER	LOR	SCE	SCI	FRD	WRR
BS	0.163	0.148	0.109	0.112	0.141	0.144	0.115	0.123	0.108
EF	0.169	0.147	0.108	0.112	0.141	0.144	0.115	0.122	0.110
ES	0.167	0.146	0.114	0.112	0.141	0.144	0.115	0.123	0.156
EU	0.156	0.145	0.122	0.108	0.139	0.141	0.113	0.129	0.103
IU	0.164	0.143	0.122	0.11	0.139	0.14	0.115	0.128	0.103
PC	0.188	0.136	0.122	0.11	0.142	0.145	0.114	0.127	0.103
Total		0.144	0.117	0.112	0.142	0.145	0.115	0.126	0.115

V. CONCLUSION

The study seeks to determine the maintenance priorities on the basis of predetermined criteria among categorized 8 predominant building components maintenance aspects for building entities. Physical Condition (PC) is the most vital criterion in ranking the decision of prioritizing maintenance for building premises which implies higher priority will be encountered in case poor condition is found for the existing building structures and fabrics.

After detailed calculation, it suggests that 'building exterior repainting or re-tiling', 'spalling concrete repair works among exterior areas' and 'lobby renovation' are the top three priorities of maintenance aspects. The three highest maintenance aspects items reveal that both safety to public or third parties and the aesthetic effects to having been concerned and emphasized since the deterioration of external wall surfaces will detrimentally affect the life of the building fabrics which also accompanied with un-expectable risk for jeopardizing the public in the vicinity accordingly. From the semi-structured interview, some of the interviewee express the decision for the maintenance priorities will also be influenced by the percentage of portion to the annual maintenance budget that imposed from the selected maintenance aspects. In view of this, the cost burden factor should be considered for a more comprehensive decision making of maintenance priorities thereto.

As a whole, owing to the fact that Facilities Management Companies need a systematic approach to prioritize the onerous maintenance works. However, such decision making process would rely on both tangible and intangible criteria, these kind of vague linguistic variables should be tackled by Analytic Hierarchy Process technique which empowered with fuzzy approach. Through the application of Fuzzy AHP approach, a more systemic and easier comparing linearity scores being

explored in facilitating multiple criteria decision of building maintenance priorities issue.

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Dynamic Design of Nano Laboratory

Mogens Saberi

Abstract

The present article describes the dynamic structural design of a building which is intended to be used as a nano laboratory. The laboratory is located in the middle of a large city whereas special dynamic attention is required due to several dynamic disturbance sources such as operating machinery, traffic and human induced vibration in the building. Different solutions principles are presented to suppress these dynamic disturbances and the performance of these solutions are evaluated. Besides theoretical analysis the design was also supported by on site measurements to determine the exact dynamic disturbances on the building.

Keywords—Finite Element Modelling, Dynamic Design, On-Site Measurements, Response Analysis.

I. Introduction

Nanotechnology research is the study and manipulation of matter at an atomic, molecular scale meaning that the research laboratory needs to be free of external vibrations since even small vibrations will make it impossible to work on this microscale level. The requirement to a vibration free environment is often in contradiction to have the laboratory located close to academic environment and placed in an area which is easy accessible by car or public transportation.

The present article is a case example of an upgrade project of an existing building which is to house a nanotechnology research center. The article presents the considerations, analysis and measurement campaigns conducted in connection with placing a nanotechnology laboratory in the middle of a large city in an existing building. In order to have an economical feasible upgrade project the aim was that only the foundation of the existing building was to be alter in order to accommodate the vibration requirements for a nano laboratory.

First the maximum allowed vibration levels are presented then the results of performed onsite measurements are presented together with response analysis of different solutions which can accommodate the required vibration levels.

II. VIBRATION LIMITS

The maximum allowed vibration limits for the nanotechnology center are defined according to the VC vibration limit scale which can be seen below. The vibration limits are as seen depended on the response frequency and is defined in terms of 1/3 octave band of a RMS(root mean square) signal. The VC curves are based on several years of best practice experience.

The VC requirements assumes that the structures is exposed to a more or less steady state loading and therefore there is no direct specification of what averaging time one should use when calculating an RMS value which shall be compared to the VC requirements in third octave band spectrum. If there are transient events cause by for example a passing buss or a door slamming one need in principal to reduce the averaging time or use a peak hold value in order to capture the transient event and compare this with the VC requirements.

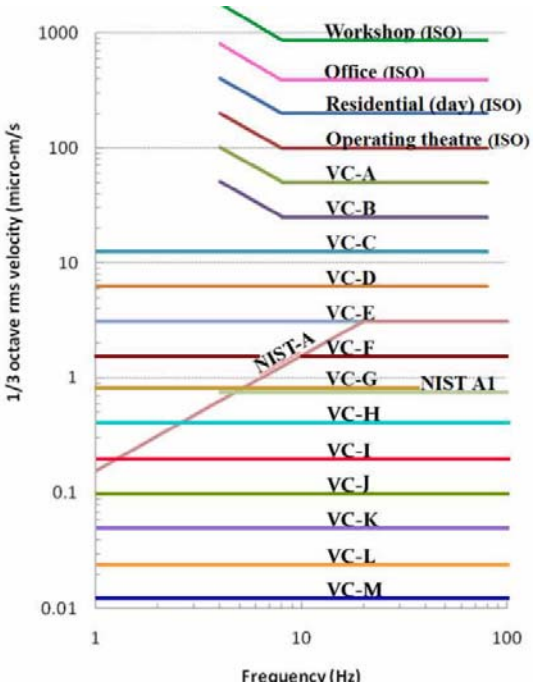

Fig. 1 VC vibration requirements.

In the current case project short time transient events is not essential critical for the nano equipment since different remedies can cope with these occasional transient disturbances. Based on this the transient events are smeared out by increasing the RMS averaging time. A RMS averaging time of 100s second has been used however results for and RMS averaging time of 20s and smaller are also simulated for comparison.

The VC-D requirements shall as a minimum be fulfilled but the design should aim at getting the VC-E requirement fulfilled if this is possible within an economical reasonable range.

III. On site measurements

Since the laboratory is to be placed in the middle of a large city multiple excitation sources will be presented. It was

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therefore concluded that performing numerical estimation of the external excitation sources would be difficult. It was decided to perform a measurement campaign. Continually measurements have been performed for one day at the different measurement points shown below.

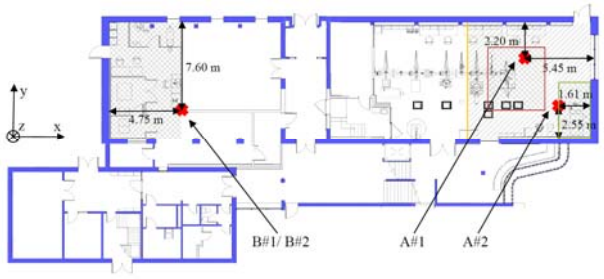


Fig. 2 Location of measurement points.

The measurements have been performed during weekdays and have been done during both morning and evening rush hours. In spite of this it could not be guaranteed that the measurements are fully statistical representative for the location due to the relatively short measurement period. No upscaling of the measurements has been done to take the statistical uncertainties into account. A typical measured signal is shown below.

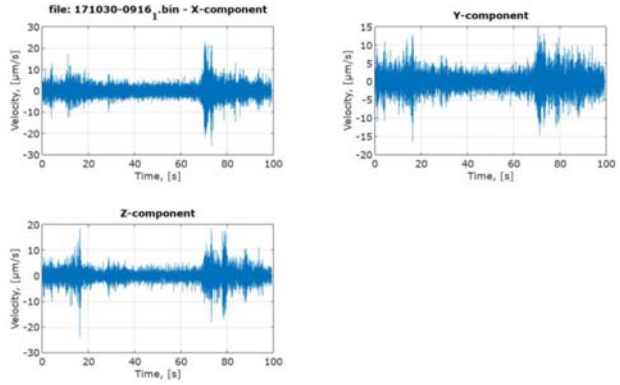


Fig. 3 Typical measured signal.

The measured signal has now determined the vibration level at the site. Furthermore the measured time signal can be used in numerical simulations of how the new foundation that shall support the nano equipment will perform.

IV. Soil Modeling

Since the current upgrade project only aims at improving the foundation to an extend where the vibration limits can be fulfilled the soil stiffness below the foundation needs to be evaluated. The soil at the site consist of different soil layers with different stiffness. The soil stiffness is evaluated on the basis of the soil profiles made at the time of the construction of the building. The measured soil strength is converted into soil stiffness's based on the two tables below.

TABLE I
Relation between soil strength and soil stiffness

Friktionsvinkel	Ballasttal (MPa/m)	Ref.: Terzaghi (MPa/m)
Medium fast lejret φ=30-35°	10-70	13
Fast lejret φ=35-40°	20-100	40
Meget fast lejret φ=>40°	40-110	157

Udrænet forskydningsstyrke	Ballasttal (Mpa/m)	Ref.: Terzaghi (MPa/m)
Fast ler c_u=50 – 100 kPa	25 - 80	24
Meget fast ler c_u=100-200 kPa	40 - 150	47
Hård ler c_u>200 kPa	>80	94

The top table is for sand like materials and the bottom table is for clay like materials. The above table is mainly used for converting measured strength into static stiffness. A well-recognized principle for converting into dynamic stiffness is currently not available and therefore special testing procedures must be performed on the soil in order to have a good estimate of the dynamic soil stiffness. In the current project this has not been done. Instead uncertainties, and the natural variation of the soil stiffness are taken into account by performing analysis with a ±50% variation of the best estimated soil stiffness.

From the soil profiles it was discovered that the top ~2-3m of soil is a peat like soil material which is very uncertain and is likely to variate quit a lot. Due to this the top peat layer was recommended to be replaced with a layer of gravel which is vibrated to achieve a well-defined stiffness. This shall be done in case of a direct foundation solution. Alternative mini piles can be installed and vibrated to the clay layers underneath.

In order to have an equivalent stiffness of the different soil layer these individual layers are implemented in a finite element model. A foundation is applied on top of the soil and it is given a constant pressure. The equivalent stiffness is then taken by dividing the applied force with the deflection underneath the foundation

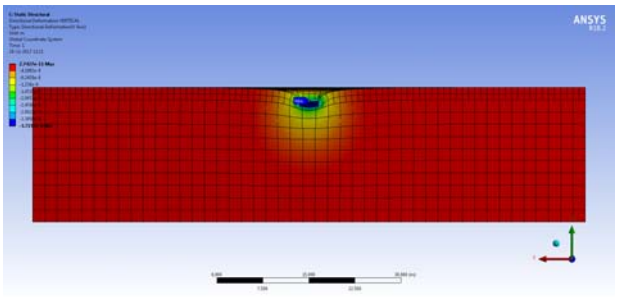


Fig. 4 Output from Ansys finite element model to determine equivalent soil stiffness..

V. Dynamic Foundation Design

Different approaches are available to design the building' foundation so it can fulfil the vibration requirements outlined above. The different possible approached will be presented in this chapter.

The different foundation designs are based on the on-site

measurement made in a limited periode. This means that the influence of new equipment which is to be installed in the building has not been accounted for in the design of the foundations. Therefore it was recommended that all new equipment which generates vibrations is to be placed on a seismic mass with a suitable weight and which furthermore is support by soft neopren bearings or spring elements.

IN SOIL BARRIERS

Instead of designing a foundation that can resist and damp the external vibrations one can choose an approach where the vibrations are kept out of the building. This can be done by having in-ground barriers as indicated on the figure below

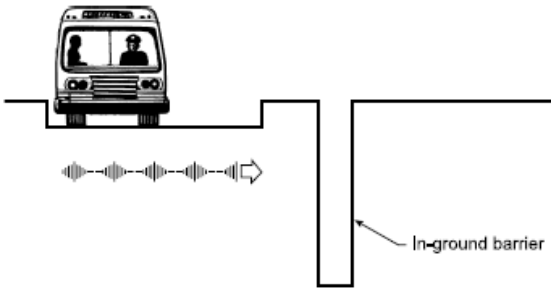


Fig. 5 Illustration of in ground barrier

Instead of having a trench a row of lime column or cement piles can be used adjacent to the vibration sources (road). The piles can be constructed in-situ by mechanical mixing of the soil with quick lime or cement. The depth of the piles or trench should be about 10-15 m since this is the depth of the Raleigh waves which dominates traffic born vibrations.

For the current site it would be a rather expensive solution method due to the dense arrangement of pavements, roads, buildings and especially buried cables and pipelines.

SLAB ON SOIL

A slab directly on the soil and which is isolated from the remaining part of the building foundation is a rather simple solution. This solution is analyzed below.

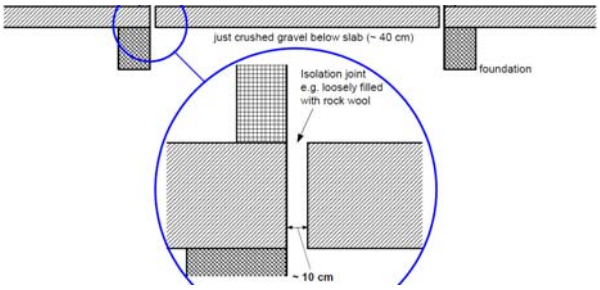
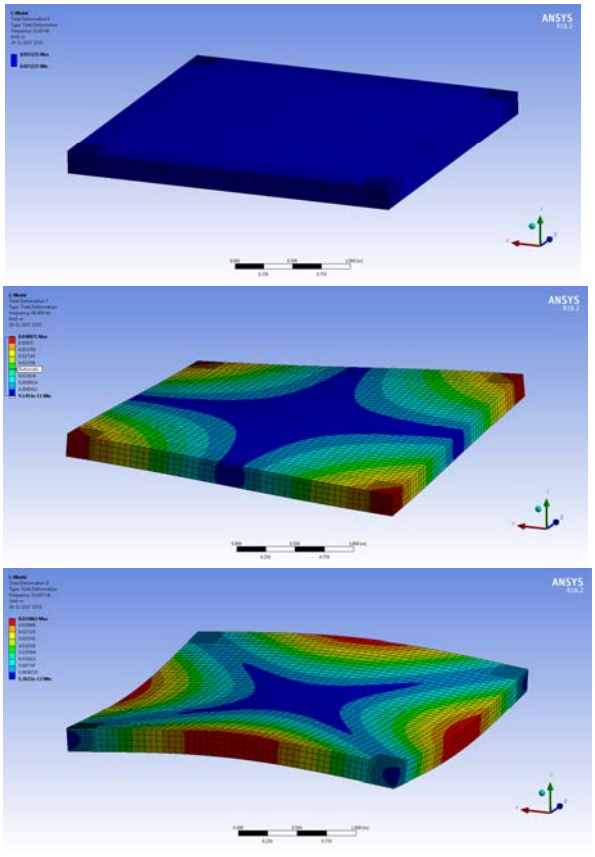


Fig. 6 Illustration of slab on soil

The performance of the slab will increase if the dimension of it is larger than the wave length of the vibrations. The vibration campaign was conducted on a reduced scale which means that there will be a relatively large uncertainty on the determined wave length. From the performed measurements the wave speed is determined to 250 m/s. Assuming a non-dissipative soil the wave length is estimated to ~17m in the area with the most input energy. This means that it is rather difficult to make a foundation that has a size which can smear out the vibrations with the current building layout. The measured wave speed is determined with a relatively large uncertainty since the distances between the measuring points are too small.

The measurement data shows generally the largest vibration amplitude in the vertical direction and it will also be in the vertical direction in which the foundation has the largest stiffness – this evaluation is based on analytical calculations.

A foundation slab of 3x3m is chosen for the analysis since it adapts well to the layout of the building. A thickness of 200mm is chosen since it will move the first eigen frequency away from the area with the most energy input. Having a thicker plate will only be beneficial if the loading is on the plate itself – this can be avoided by restricting walking in the area where the foundation is cut free from the main foundation in the building. With the chosen configuration the first 4 relevant vibration modes can be seen below.



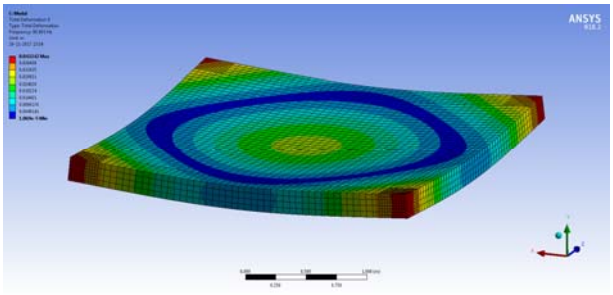
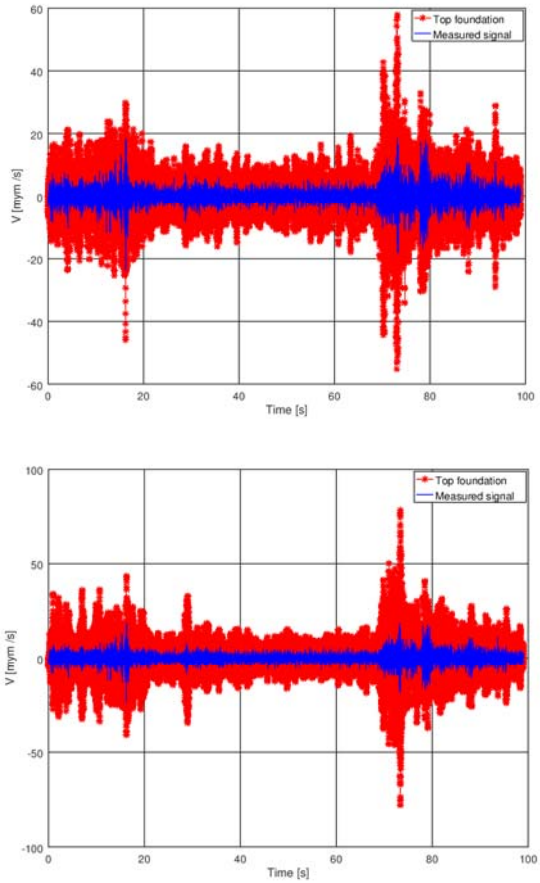


Fig. 7 Illustration of vertical vibration modes.

The above frequencies are calculated based on best estimates of the soil properties. Below the result of a response analysis is shown. The response analysis is performed for three soil stiffness' to cover uncertainties in the soil stiffness as mentioned above. The input for the response analysis is a vibration level which in the measurement report is categorized as normal vibration level. This means that the vibration levels can be higher or lower than the one illustrated below.

The dynamic analysis is performed with a soil damping equal to a logarithmic decrement of 20%.



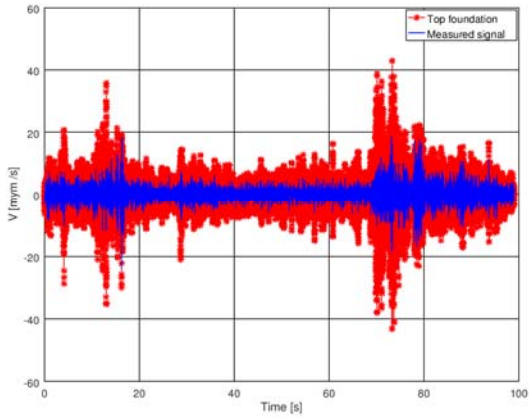


Fig. 8 Response analysis based on measurements (top: best estimate of soil stiffness middle: 50% low soil stiffness, bottom: 50% high soil stiffness)

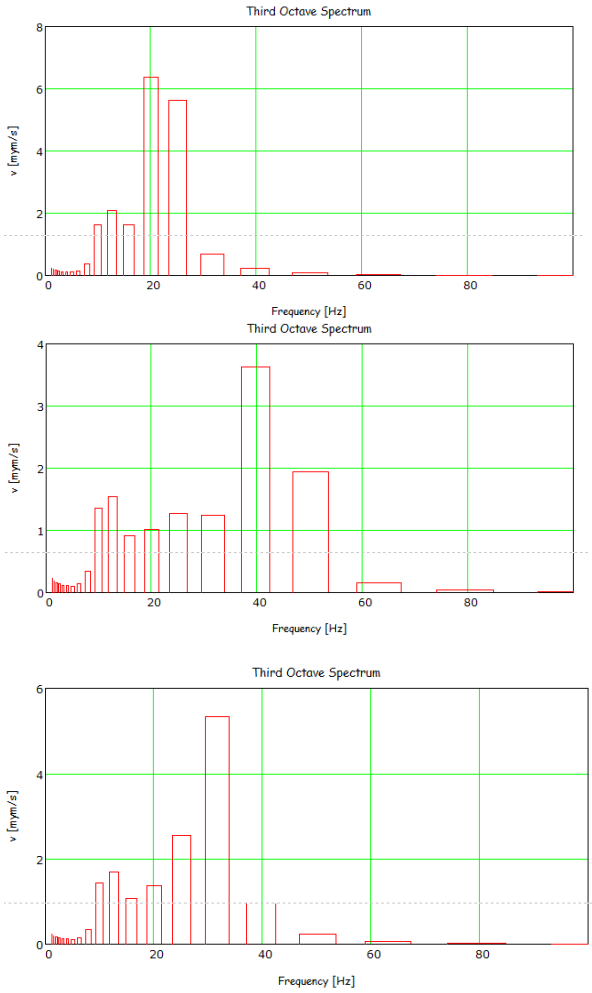


Fig. 9 Third octave band analysis with a RMS averaging of 100s based on response analysis of measurements (top: best estimate of soil stiffness middle: 50% low soil stiffness, bottom: 50% high soil stiffness).

With this foundation layout the VC-D vibration limit can apparently be fulfilled. However one must have in mind that

these limits will be exceed daily since the used input data is the normal vibration level. Furthermore the relatively long averaging time of 100 s has been used meaning that transient events will occur and result in an exceedance of the limits. Based on this it is not recommended to use this layout to achieve the VC-D curve.

A variation of the above principle can be done by letting the foundation plate rest on a set of piles. Assuming that the piles are stiff in the vertical direction a better performance of the foundation can be achieved in the vertical direction since the first natural frequency of the plate is increased, see below.

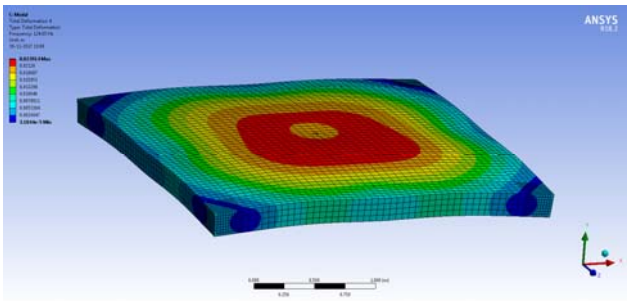


Fig. 10 Illustration of first vertical vibration modes when the foundation plate is supported by mini piles.

The performance in the horizontal directions will however not be improved noticeable whereas only a small overall improvement will be achieved.

VI. VIBRATION TABLE ON SANDWICH FOUNDATION

In this solution the equipment is placed on a vibration table – the vibration table is assumed to be a 100% passive system. The performance of a typical vibration table can be seen below. On the below figur an approximation to the performance curve is shown. The approximated curve is used in the dynamic response analysis below.

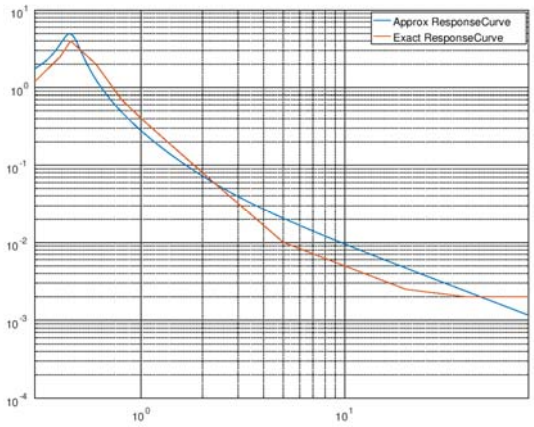


Fig. 11. Performance of vibration table.

In order to have a well-defined base for the table and at same time filter some energy input away from the table it is proposed to use a setup as illustrated below where two relatively thin concrete plates are connected by neoprene bearings. The bottom plate is supported by mini steel piles.

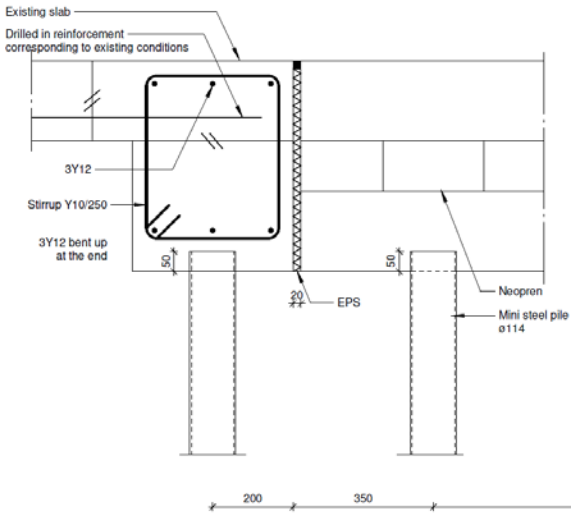


Fig. 12 Illustration of foundation for vibration table.

Below a dynamic response analysis is made with a loading corresponding to normal condition (file 171030_0916). This means that the vibration levels can be higher or lower than the one illustrated below.

The dynamic analysis is performed with a soil damping equal to a logarithmic decrement of 20%.

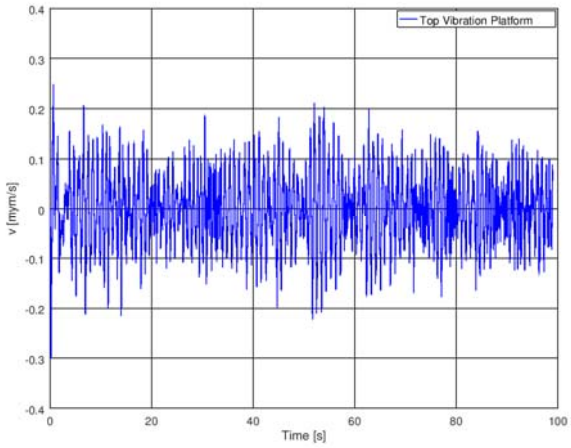


Fig. 13 Response analysis based on measurement 0916.

Below a third octave band analysis is performed with an RMS averaging period of 100s from where it can be seen that VC-K can be fulfilled.

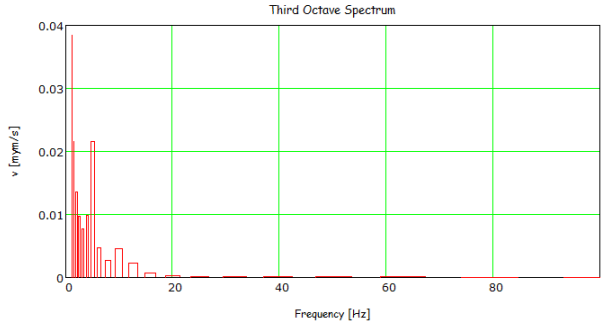
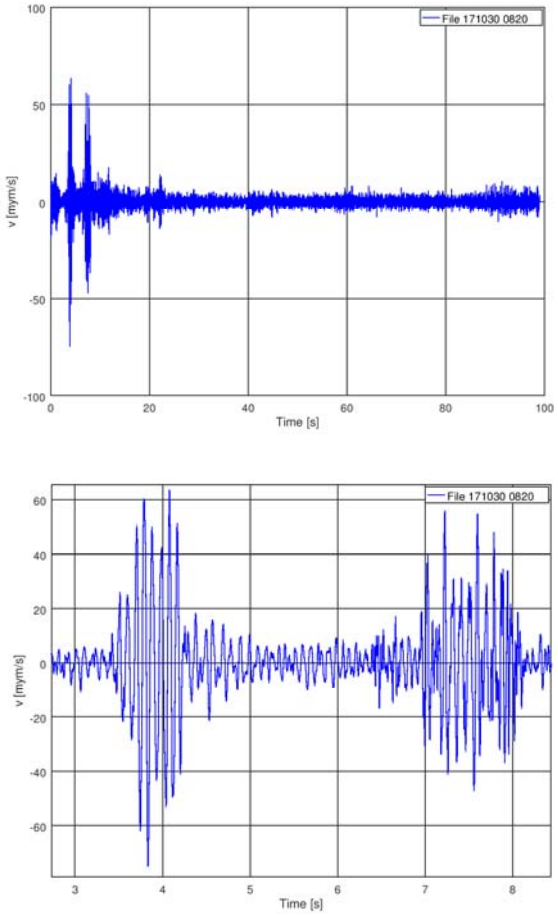


Fig. 14 Third octave band analysis with a RMS averaging of 100s based on response analysis of measurement 0916.

Due to the good performance of the system an analysis is also conducted using a measurement where strong transient event occurs. Below a third octave band analysis is performed with an RMS averaging in the period from 3-8s.



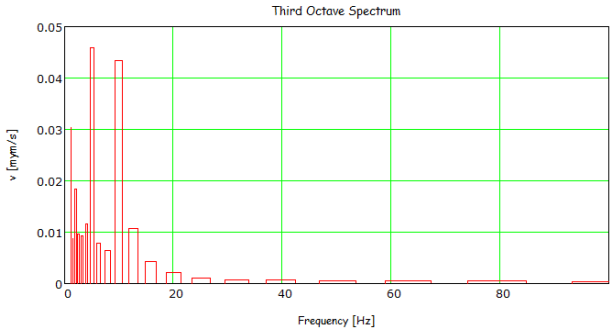


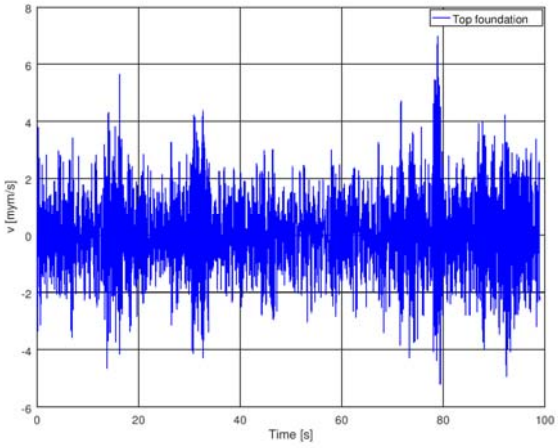
Fig. 15 Third octave band analysis with a RMS averaging in the period from 3 to 8s.

The analysis indicates that VC-K also almost can be reached. This is however likely not to be the case in reality since especially due to the performance of the vibration table. The performance of these tables is often not as good as informed at these low vibration levels and when they are exposed to non-steady state loading. The analysis however indicates a good and sound solution and reaching VC-E would probably be possible.

Only the vertical direction is analyzed since the performance of the bearings and the vibration level in general is more optimal in the horizontal directions. It is furthermore assumed that the vibration table perform equal well in the horizontal directions.

VII. Sandwich Foundation

This solution is equal to the one described above except that a vibration table is not used whereas the sensitive equipment is placed directly on the foundation.



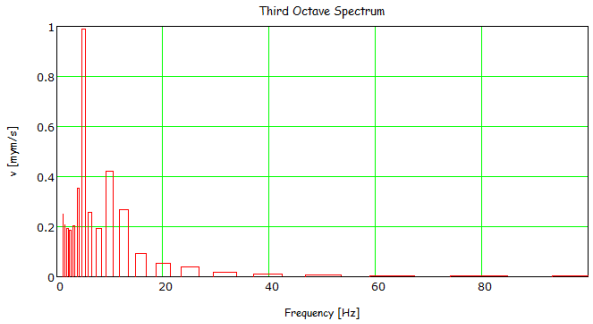


Fig. 16 Top: Output from response analysis with an excitation level corresponding to normal (File0916). Bottom: third octave band analysis with a RMS averaging of 100s.

This solution will theoretical result in achieving vibration level give VC-F when exposed to a vibration level corresponding to normal.

Below the response analysis is performed with an averaging period of 20s instead of 100s as used above.

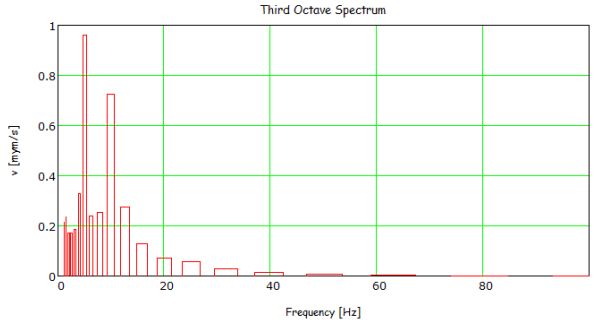


Fig. 17 Third octave band analysis with a RMS averaging of 20s in the period 65-85 s.

This solution will result in VC-F for an excitation corresponding to a normal external excitation level.

VIII. Conclusion

As seen from the above analysis two of three foundation principles can both accommodate the required vibration level VC-D. Using a vibration table will increase the performance of the sandwich foundation solution but since a vibration table can be post installed this solution can be postponed until a possible need for an even lower vibration level is required. The most optimal foundation layout is therefore the sandwich foundation layout.

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Quantitative Expansion Joint Spacing according to the Effect of the Rebar Ratio

So-Young Lee, Hong-Gun Park, Jung-Il Suh, Chang-Soo Kim, Won-Kyun Seok, Soon-Jeon Park

***Abstract*—**The structural frame is getting bigger, we need the application of expansion joint, but there are no standards about the location and spacing of expansion joint to our knowledge. To find the effect of the rebar ratio, structural tests were performed on specimens with adjustments of the rebar ratio. If the rebar ratio of the concrete slab increases, the average crack width of it decreases. It means that the number of crack increase but the concrete crack width decrease. Comparing results of experiment with those of analysis, it is important that the concrete tensile strength contains the contribution of the reinforcement ratio. And if we find the slab average strain by the structural analysis, we can predict the average crack width, which is based on the relationship between the average crack width and the slab average strain. It is possible to control the cracks under the allowable crack width.

***Keywords*—**Concrete slab, Cracking, Expansion joint, Rebar ratio, Temperature loading

I. Introduction

Recently, as the space of architectural structures are getting longer and larger, expansion joint is increasingly applied to large-scale structures such as shopping malls and logistics centers. Expansion joint is a functional joint that is designed to absorb the deformation of a structure caused by temperature change, drying shrinkage, settlement, vibration, and so on.

However, expansion joint complicates the process and delays the construction period. After the completion of construction, there is a problem of leakage of water and cracks of the structure due to expansion joint and it causes maintenance costs. So the use of expansion joint is minimized in the field. (Klein and Lindenberg [1], Iqbal [2], Saiyed et al. [3], Shirke [4])

Although the current design standards refer to the necessity for expansion joint, there are no clear limitations as to the location and spacing of expansion joint. It is being designed depending on the intuition and experience of the engineer. There are many differences, but it is known that 150 ~ 200 ft (46 ~ 61 m) is appropriate in past cases. If the spacing of expansion joint is 200 ~ 300 ft (61 ~ 91 m), the deformation is 1 in (25.4 mm) or less. (Fintel [5]) National Academy of Sciences (NAS) is based on research and analysis studies and the allowable building length is 400 ~ 600 ft(120 ~ 180 m). (NAS [6])

Structural tests are conducted on the set variables to examine the distribution of deformation, stress and cracks according to the temperature load effect. And the analytical modeling is verified through comparison with experimental results.

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II. Experimental Details

A. Variable Setting

The range is limited by the deformation of the structure due to the temperature change. Focusing on long-term temperature cracks, there is cracks caused by volume changes due to temperature changes and dry shrinkage, creep. Generally it occurs within a year after construction or in a direction perpendicular to the long axis.

If the stress in the member is greater than the tensile strength of the concrete, it will cause concrete cracking. Structural problems may occur if the crack width in the member is larger than the allowable crack width (0.3 mm). In this experiment, the deformation due to the temperature load is replaced with the change of the actual member length. The tensile force is directly applied to the slab.

$$\varepsilon_T = \alpha(\Delta T) = \Delta L/L \tag{1}$$

In $\varepsilon_T = \alpha(\Delta T)$ is the strain due to temperature load. $\Delta L/L$ is the strain due to the actual member length.

B. Main parameters

The effect of the rebar ratio among various parameters of the concrete slab members was examined. The size of specimens is 1000 mm × 3000 mm × 150 mm (the short length × long length × thickness), the concrete compressive strength f_c' = 24 MPa, the steel tensile strength f_y = 400 MPa, both of the end of specimens are reinforced.

The concrete compressive strength at 28 days is about 20MPa and the modulus of elasticity is about 14.3 ~ 16GPa. The concrete splitting tensile strength at 28 days is about 2 MPa, which is about 10% of the concrete compressive strength.

All specimens satisfied minimum rebar ratio or more. It considers internal restraint according to the rebar ratio, crack delay and dispersion effect. Rebar yield strength is 482 MPa for

SD400 D10, 507 MPa for SD400 D13 and the modulus of elasticity is 173 GPa, 185 GPa.

TABLE I
EXPERIMENTAL PARAMETERS

Specimen	Parameter	Detail
1	reference specimen	D10@200 mm (ρ = 0.594%)
2	downer rebar ratio	D10@450 mm (ρ = 0.357%)
3	upper rebar ratio	D13@200 mm (ρ = 1.056%)
4	mixed rebar ratio	D10@200 mm(ρ = 0.594% in left) D13@200 mm(ρ = 1.056% in right)

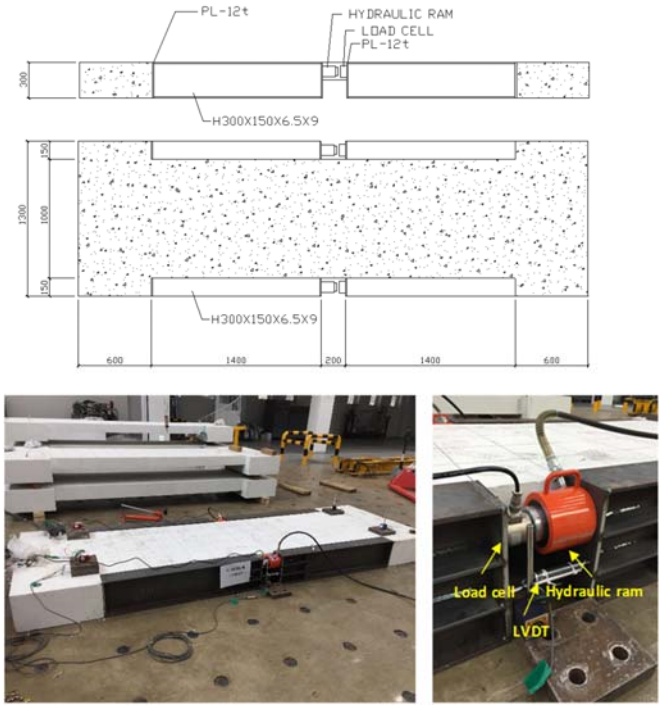


Fig. 1 Specimens details

III. EXPERIMENTAL RESULT

A. Specimen 1 (Reference Specimen)

Specimen 1 is rebar ratio (D10@200, ρ = 0.594%) which is the reference specimen. Slab deformation occurred at slab stress of 3 MPa, which is 1.5 times greater than concrete splitting tensile strength (about 2 MPa). Bars at the center, end, and corner part were not yielded because the strain was less than the rebar yield strain (ε_y=0.0028), but the stresses at the ends and corners were measured to be larger than those at the center.

As the slab average strain increases, the number of crack increases. The measured crack width was less than the allowable crack width (0.3 mm). Considering that the final stress (4.61 MPa) is equivalent to ΔT = -30 °C, it is suggested that the member itself is not structural problem even when the reference specimen is in an extremely low temperature environment.

Initial cracks occurred at the end of the concrete at a stress (1.89 MPa) similar to concrete splitting tensile strength. As the load increases at final load, cracks are dispersed at the same position as the transverse reinforcement.

B. Specimen 2

Specimen 2 is rebar ratio (D10@450, ρ = 0.357%) which is downer rebar ratio than the reference specimen. Slab deformation occurred at a slab stress of about 1.5 ~ 1.6 MPa, and the maximum tensile strain (ε_t'=0.0002) of the concrete reached the splitting tensile strength.

When the slab stress is more than 3.21 MPa (corresponding to ΔT = -20 °C), the measured crack width was larger than the allowable crack width and the crack width increased sharply to 1.6 mm. This is 4 times the allowable crack width, which can lead to structural defects of members if the temperature change is dramatically large.

Initial cracks occurred at the end of the concrete at a stress (1.97 MPa) similar to concrete splitting tensile strength. Cracks were not dispersed in the longitudinal direction but concentrated on the initial cracks, which led to an increase in the crack width.

C. Specimen 3

Specimen 3 is rebar ratio (D13@200, ρ = 1.056%) which is upper rebar ratio than the reference specimen. Slab deformation occurred at 4 MPa, which is twice the concrete splitting tensile strength.

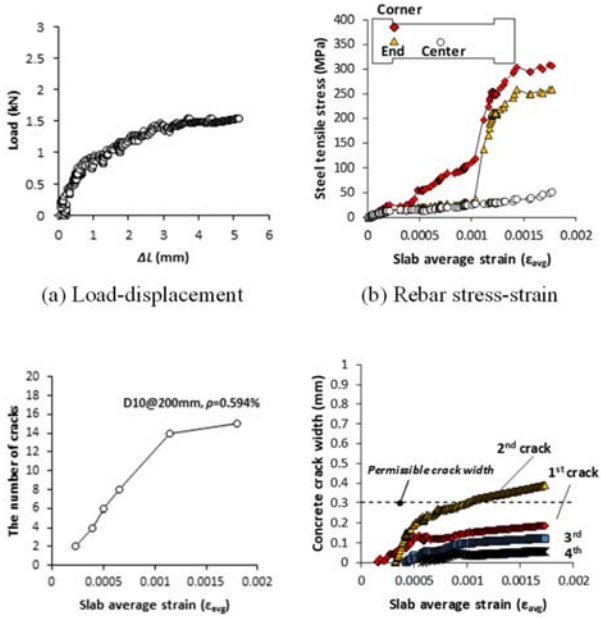
Considering that the final stress (6.84 MPa) is equivalent to ΔT = -43 ° C, the measured crack width was less than 0.2 mm and it was much less than the allowable crack width.

Initial cracks occurred at a stress more than twice as high as the splitting tensile strength of concrete, which is considered to be attributed to crack control. Cracks are distributed at the same position as the transverse reinforcement at final load.

D. Specimen 4

Specimen 3 is rebar ratio (D10@200, ρ = 0.594% in left and D13@200, ρ = 1.056% in right) which is mixed rebar ratio than the reference specimen. Cracks were concentrated on the left side of the slab with relatively small stiffness up to 4.03 MPa (ΔT= -25 °C).

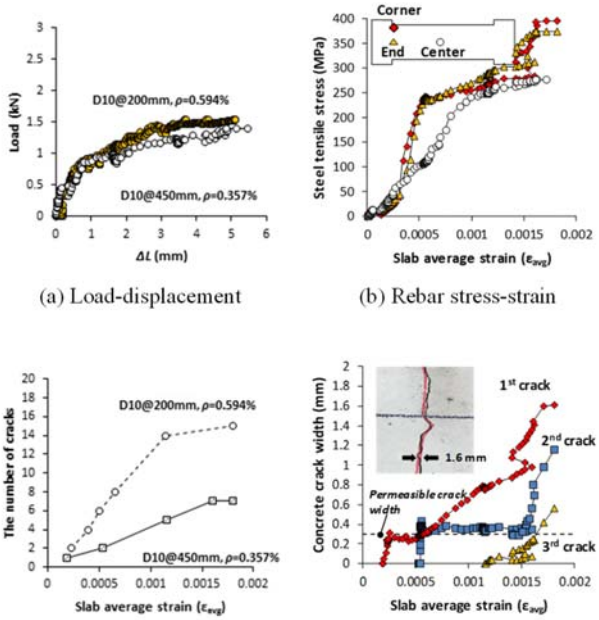
In case of the steel ratio of the slabs is overlapped, when the temperature is changed to the extreme low temperature environment or more, the cracks of the members having low stiffness exceed the allowable crack width and structural problems may occur.



(a) Load-displacement (b) Rebar stress-strain

(c) The number of crack-strain (d) Concrete crack width-strain

Fig. 2 The experiment result (specimen 1)



(a) Load-displacement (b) Rebar stress-strain

(c) The number of crack-strain (d) Concrete crack width-strain

Fig. 4 The experiment result (specimen 2)

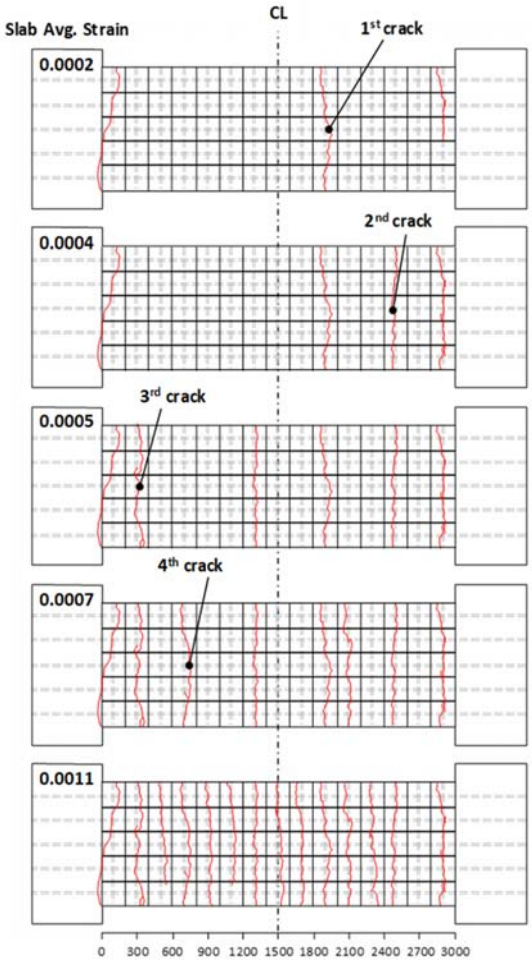


Fig. 3 The cracking pattern (specimen 1)

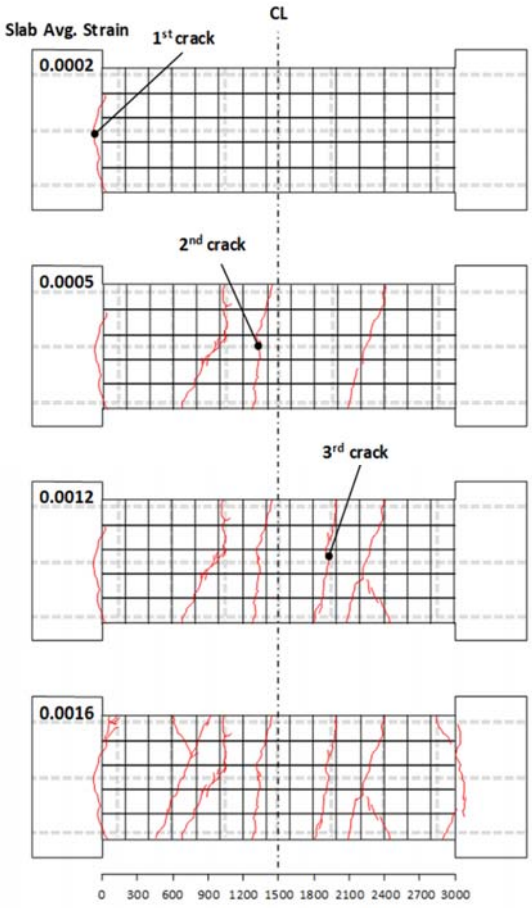
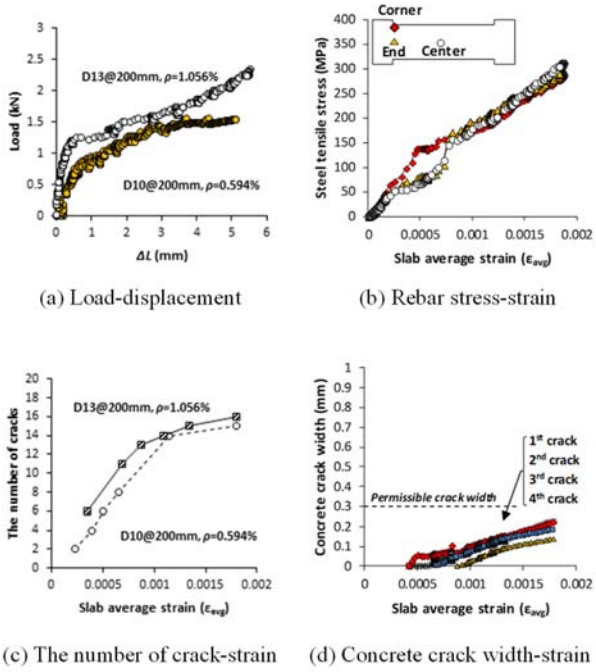


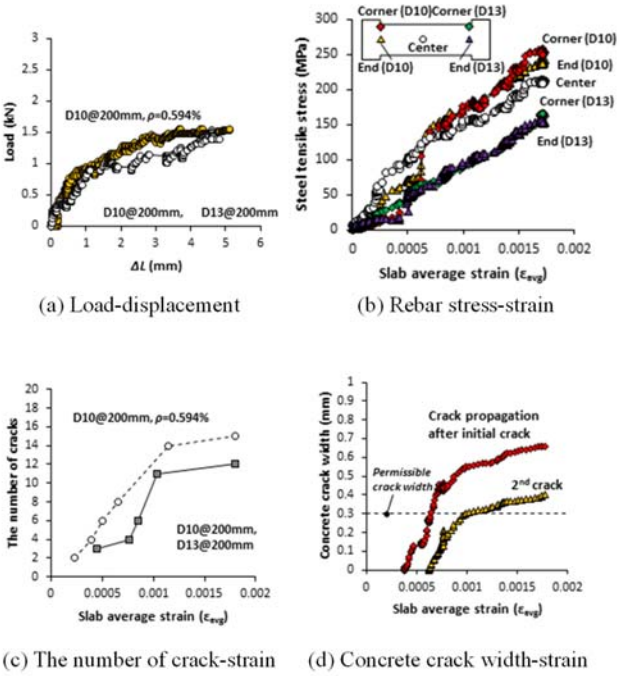
Fig. 5 The cracking pattern (specimen 2)



(a) Load-displacement (b) Rebar stress-strain

(c) The number of crack-strain (d) Concrete crack width-strain

Fig. 6 The experiment result (specimen 3)



(a) Load-displacement (b) Rebar stress-strain

(c) The number of crack-strain (d) Concrete crack width-strain

Fig. 8 The experiment result (specimen 4)

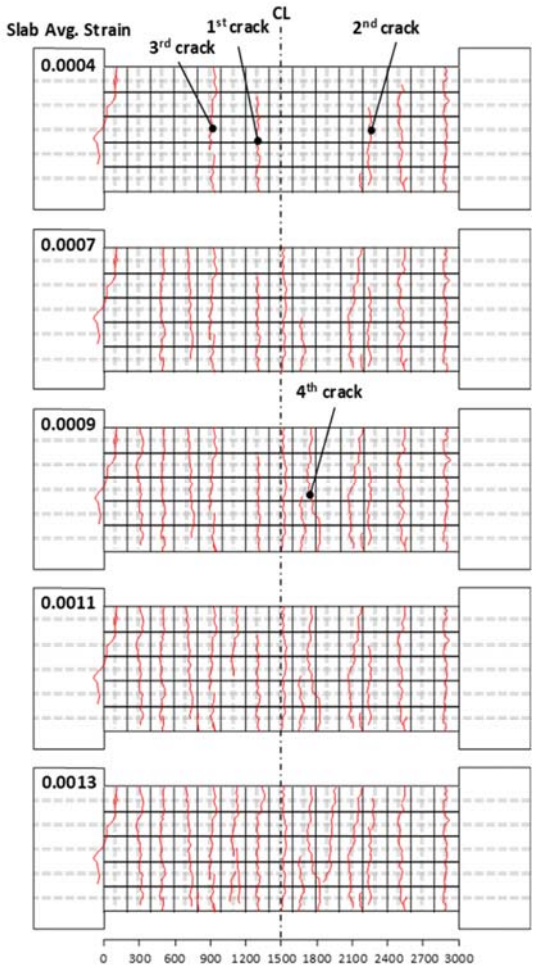


Fig. 7 The cracking pattern (specimen 3)

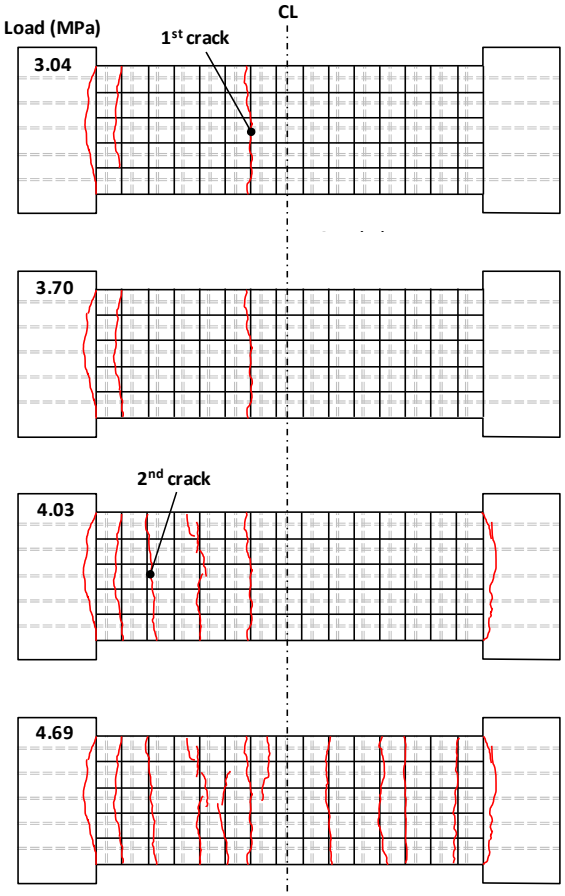


Fig. 9 The cracking pattern (specimen 4)

E. Result of Specimens

As the rebar ratio increased (ρ = 0.357% → ρ = 0.594% → ρ = 1.056%), the concrete slab stress increased until it reached the concrete maximum tensile strain. The rebar is contributes to the increase the tensile strength of the slabs, as well as the concrete.

In case specimen 2 (D10 @ 450) comparing with specimen 1 (D10 @ 200), the number of cracks decreased at the same stress in the slab. But, in case specimen 3 (D13 @ 200) comparing with specimen 1 (D10 @ 200), the number of cracks increased similarly to the number of transverse reinforcement in the slab. The average crack width is calculated as follows.

The average crack width = the slab average strain × the slab length / the number of crack

The allowable crack width is 0.3 mm under working load conditions in ACI 318. If the temperature load ($E\alpha\Delta T$) is replaced by the tensile force, the slab cracking behavior at the stress can be predicted. As the rebar ratio increases, the average crack width decreases. So it is very effective way to control the crack width. For the reference specimen, when the slab stress occur at least 4 MPa (ΔT = -25 °C), it may cause structural problems beyond the allowable crack width.

IV. Analysis Result

A. Specimen 1 (Reference Specimen)

At ΔT = -10 ~ -12 °C, the net principal tensile strain of the edge of the reference specimen increased sharply beyond the maximum tensile strain of concrete(ε_t'=0.0002), which is considered to be attributed to the tensile stress after the concrete cracking by the rebar. At ΔT = -13 °C, the concrete crack width at the corner exceeded the allowable crack width.

B. Specimen 2

At ΔT = -15 °C, the net principal tensile strain was higher than 3 times the corner of reference specimen and 1.8 times the end of it. ΔT = -11 ~ -12 °C, the concrete crack width at the corner and end exceeded the allowable crack width.

C. Specimen 3

At ΔT = -15 °C, the net principal tensile strain was less than 0.5 times the corner of reference specimen and 0.7 times the end of it. All sections of the slab did not exceed the allowable crack width until the temperature change (ΔT) reached –15 °C. It is very effective to increase the rebar ratio of the slab for the crack control according to the change to the extremely low temperature environment.

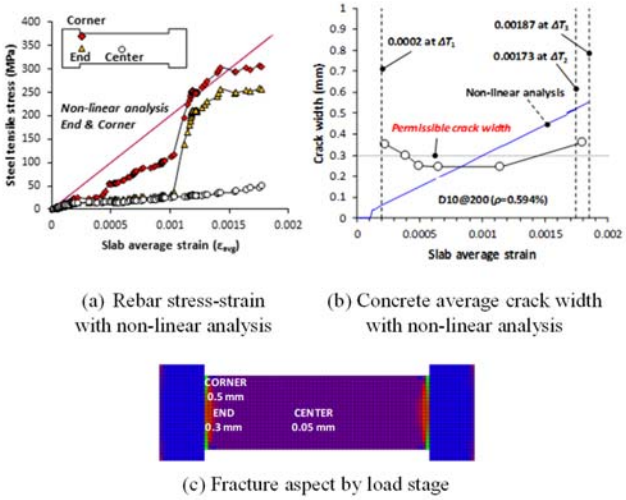
D. Specimen 4

When the temperature changes (ΔT=-15 °C), the net principal tensile strain is concentrated too much on the left side of the slab having low stiffness. The corner crack of the left side of the slab exceeds the allowable crack width, which occurred smaller than the temperature change comparing the reference specimen. Crack behavior may change due to stiffness differences of adjacent or connected members.

E. Result of Specimens

As a result of the analysis, the peak stress occurred the splitting tensile strength of concrete. Comparing with the analysis results, the maximum slab tensile stress in experimental results was 1.5 times that of the specimen 1 (reference specimen), 1 times that of the specimen 2 (the downer rebar ratio specimen), and 2 times that of the specimen 3 (the upper rebar ratio specimen). It is necessary to apply the concrete tensile strength, which reflects the contribution of the reinforcement ratio. The minimum rebar ratio has no contribution to the concrete tensile strength. If it is more than that, the safety factor can be applied by substituting the coefficient.

The fracture aspect of the analysis results was confirmed to be similar to the actual slab cracking pattern in experiments. Cracks appeared mainly at the end and corner. In the specimen 4 (the mixed rebar ratio specimen), cracks concentrated on the left side of the slab with relatively low stiffness and it is same results in the analysis and experiment.

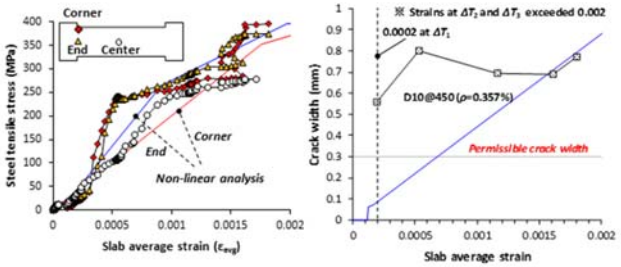


(a) Rebar stress-strain with non-linear analysis

(b) Concrete average crack width with non-linear analysis

(c) Fracture aspect by load stage

Fig. 10 The analysis result (specimen 1)

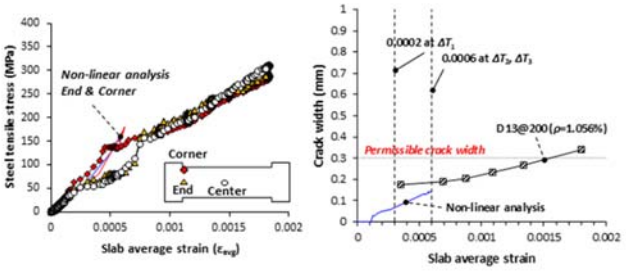


(a) Rebar stress-strain with non-linear analysis

(b) Concrete average crack width with non-linear analysis

(c) Fracture aspect by load stage

Fig. 11 The analysis result (specimen 2)

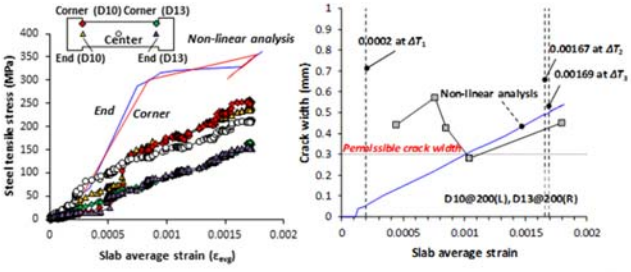


(a) Rebar stress-strain with non-linear analysis

(b) Concrete average crack width with non-linear analysis

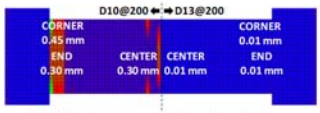
(c) Fracture aspect by load stage

Fig. 12 The analysis result (specimen 3)



(a) Rebar stress-strain with non-linear analysis

(b) Concrete average crack width with non-linear analysis



(c) Fracture aspect by load stage

Fig. 13 The analysis result (specimen 4)

V. Conclusion

The temperature analysis considering the use conditions is less conservative than the existing recommendation criteria, but the possibility of slab cracking is somewhat higher than the structure.

Although the temperature analysis showed more conservative results due to the use period of the structure, the thermal delay effect and the crack resistance depending on the details, it is more reasonable and practical than the unconditional expansion joint application according to the structure length from the design point of view.

Acknowledgment

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Empirical Modeling of Air Dried Rubberwood Drying System

S. Khamtree, T. Ratanawilai, C. Nuntadusit

Abstract**—** Southern Thailand is home to a large area of rubber tree which is a major source of timber. In drying technique, the knowledge and expertise in rubberwood drying is usually a result of years of experience of technician. In this study, the aim of the research is to develop empirical model for drying kinetics in rubber wood. During the experiment, the temperature of hot air and the average air flow velocity are kept at 80-100°C and 1.75 m/s. The moisture content in the samples were tested to achieve the drying basis of less than 12%. The drying kinetic is simulated using an empirical solver. The experimental results illustrated that the moisture content reduced as the drying temperature and time increased. The coefficient of moisture ratio (MR) between the empirical and experimental model was tested with three statistical parameters, R-square (R^2), Root Mean Square Error (*RMSE*) and Chi-square (χ^2) to predict the accuracy of the parameters. The experimental results on moisture ratio had a good fit with the empirical model. Additionally, the results indicated that the drying of rubberwood using Henderson and Pabis model revealed suitable level of agreement. The result presents good estimations (R^2=0.9963**)** for the moisture movement compared to other models. Therefore, the empirical results were valid and can be used in future experiments**.**

Keywords**—** Empirical models, rubberwood, moisture ratio, hot air drying.

I. INTRODUCTION

CURRENTLY, wood resources are rather scarce due to increasing demand while the supply remains constant or decreases. Industry sectors using wood seek to improve their manufacturing processes and look for alternative wood species, among by-products from agriculture sectors [1]. Rubberwood is a fast-growing specie that has attracted interest from investors; and the growing demand from industry requires alternative species to be planted because natural regeneration of rubberwood tree is not sufficient to meet the increasing demand. The tree is commonly harvested when it is between 20 to 30 years of age depending on the specie of the tree and when the diameter is less than 200 mm [2]. Rubber tree is naturally short in length and has to be glued during the crafting process in order to make useful wooden plank. One of the most important method of wood maintenance is drying which has to do with the complex combination of the application of heat treatment and the removal of moisture content (MC)[3]. In general, the conventional drying process of rubberwood in Thailand takes 5-8 days [4] due to the low thermal efficiency of the dryer and seasonal variation. The goal of drying is simply to elimination liquid from the dried sample without generating any destruction in the woods. Moisture can leave the surface at initial condition depending on many parameters. For the purpose of achieving good drying of lumber, it requires a method that eliminates the moisture from the inside of the dried wood to the outside surface at the same rate as the evaporation of surface moisture. Predicting MC distribution after lumber drying is useful in industry to determine the percentage of wet lumber. The model was validated with experimental data measured in a laboratory drying kiln. Many mathematical models have been used to describe drying process. All parameters used in simulation models are directly related to the drying conditions. The aim of this study is to determine kinetic drying of rubberwood drying by hot air dryer, an empirical modeling to describe the drying behavior of rubberwood.

Mathematical modelling

Moisture ratio (MR) is dimensionless moisture content and is defined as: [5]

$$MR = \frac{m - m_e}{m_0 - m_e} \quad (1)$$

where m, m_o, m_e are instantaneous, initial and equilibrium moisture contents respectively. In certain drying processes, materials are not continuously exposed to relatively uniform humidity and temperature conditions.

From Table I, it can be seen that all types of mathematical model have always been used together with the result from the drying process of the agricultural products [6-7].

TABLE I
EMPERICAL MODELS TO DESCRIBE DRYING KINETICS

Model name	Model equation
Page	$MR = [(M-M_{eq}) / (M_o- M_{eq})] = \exp(-k.t^n)$
Henderson and Pabis	$MR = [(M-M_{eq}) / (M_o- M_{eq})] = a \exp(-k.t)$
Logarithmic	$MR = [(M-M_{eq}) / (M_o- M_{eq})] = a \exp(-k.t) + c$
Two term exponential	$MR = [(M-M_{eq}) / (M_o- M_{eq})] = a \exp(-k.t) +(1-a) \exp(-k.a.t)$
Diffusion Approximation	$MR = [(M-M_{eq}) / (M_o- M_{eq})] = a \exp(-k.t) +(1-a) \exp(-k.b.t)$

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II. MATERIAL AND METHOD

In this work, drying of rubberwood was investigated experimentally and numerically. In the experiment, the rubberwood sample which has 7.6 mm in width, 25 mm in thickness and 1100 mm in length was dried in hot air dryer [8]. The hot air dryer unit with temperature controller consists of a blower, a 3-kW electric heater, and a valve. The blower with variable speed to control flow velocity is used to generated air flow for heat convection. The blower is connected with temperature control and electric heaters to the chamber including the uniform flow filter. airflow was measured with an anemometer (Model DIGICON DA-45S). The internal and external temperatures of rubberwood were detected by K-type thermocouples and a datalogger as seen in Fig.2. The weight loss of wood during drying was measured with a loadcell to determine MC (Fig.3). The temperature and velocity of hot air were 80, 90 and 100°C and 1.75 m/s[9]. The temperature profiles as well as the drying rates of three samples were observed. This was obtained by measuring the weight of the wood board after each period of drying.

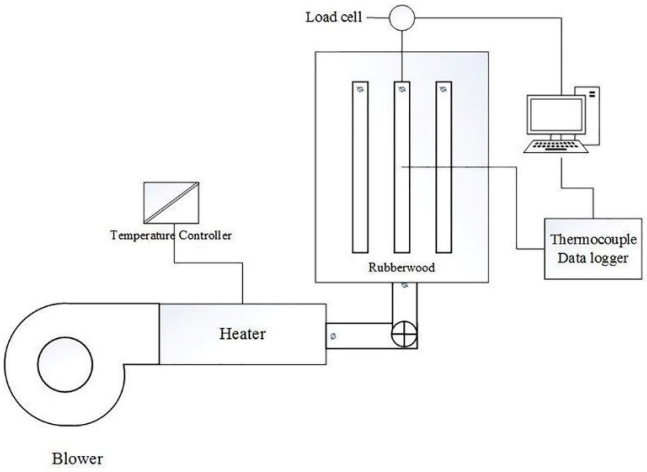

Fig.1 Schematic diagram of experimental setup and measurement.

Fig.2 Hot air dryer in lab-scale.

Fig.3 Wood samples and loadcell measurement weight loss.

A. Statistical analysis

The statistical parameters to assess this model were proved by the correlation parameter (R^2) for selection of the best model. In addition, the relationship between the computed and experimented *MR* was compared with three statistical parameters, R^2, Root Mean Square Error (*RMSE*) and Chi-square (χ^2) to show the prediction accuracy of the parameters and the model for the *MR* of rubberwood with three different temperature levels [10]. These parameters were calculated as:

$$R^2 = 1 - \frac{\sum_{n-1}^{N}(MR_{pre,n} - MR_{\exp,n})^2}{\sum_{n-1}^{N}(\overline{MR_{pre,n}} - MR_{\exp,n})^2} \quad (2)$$

$$RMSE = \left[\frac{1}{N}\sum_{n-1}^{N}(MR_{pre,n} - MR_{\exp,n})^2\right] \quad (3)$$

$$\chi^2 = \frac{\sum_{n-1}^{N}(MR_{pre,n} - MR_{\exp,n})^2}{N - z} \quad (4)$$

where $MR_{exp,n}$ is the experimental moisture ratio of n^{th} data, $MR_{pre,n,}$ is an estimated moisture ration of n^{th} data, $\overline{MR_{pre,n}}$ is the mean value of $MR_{pre,n,}$ N is the number of observations, and z is the number of constants in the drying model. High R^2 with low *RMSE* and χ^2 indicate better fit with the model.

III.RESULTS AND DISCUSSION

Drying curves of rubberwood drying under hot air at 80, 90 and 100°C were fitted with five models as shown in Table I. The effect of drying air temperature on the MR decreased gradually from the initial MC to reach an equilibrium moisture content (EMC) as seen in Figs. 4-6. The statistical results of five models, together with the drying model coefficients and the comparison criteria used to evaluate goodness of fit, including R^2 to explain representation of the model, χ^2 for fitting model and *RSME* to show accuracy of model prediction, are summarized in Table II. The models were evaluated based on R^2, χ^2 and *RMSE*. The model that best predict the drying process will have higher value of R^2 and lower values of χ^2 and *RMSE*.

The Henderson model (R^2=0.9963, χ^2=0.000399, *RMSE*=0.000155) was the best descriptive model for all treatments, Thus, it was accepted to represent the drying characteristics of rubberwood drying by hot air.

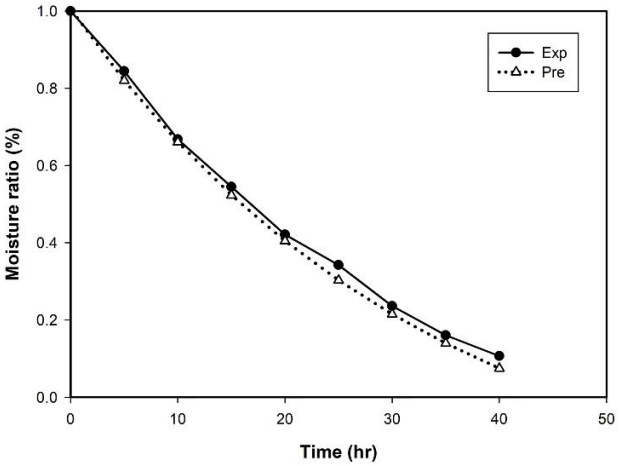

Fig. 4 Comparison of experimental moisture ratio and predicted moisture ratio from the Logarithmic model at 80 °C

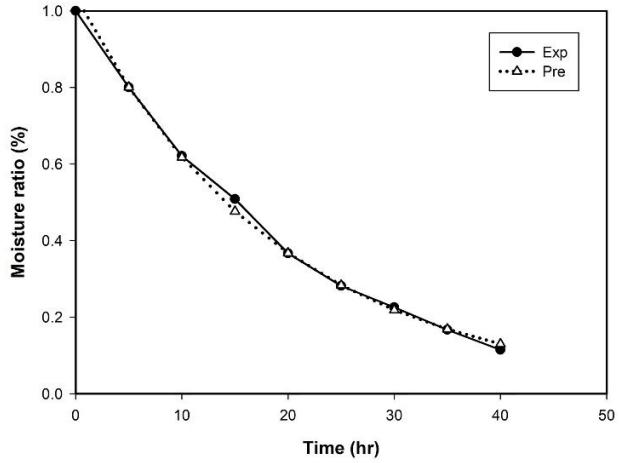

Fig. 5 Comparison of experimental moisture ratio and predicted moisture ratio from the Henderson model at 90 °C

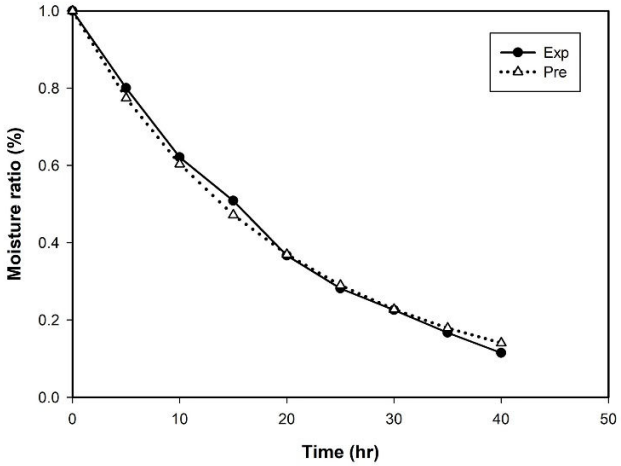

Fig. 6 Comparison of experimental moisture ratio and predicted moisture ratio from the Page model at 100 °C

TABLE II
MODELING OF MOISTURE RATIO ACCORDING TO DIFFERENT DRYING MODELS.

Model	Temp (°C)	Coefficience	R^2	χ^2	*RMSE*
Page	80	k=0.0007 n=0.9899	0.9800	0.0018	0.00069
Hender-son		k=0.0008 a= 1.038	0.9874	0.0013	0.00050
Logarit-hmic		k=0.0005 a=1.3331 c= -0.327	0.9939	0.00069	0.00027
Two term expo-nential		k=0.0007 a=0.9898	0.9805	0.00215	0.00083
Diffu-sion Approx imation		k=0.0007 a=0.9598 b=0.0573	0.9834	0.95989	0.05732
Page	90	k=0.0008 n=0.9851	0.9921	0.00075	0.00029
Hender-son		k=0.0008 a=1.038	**0.9963**	**0.00039**	**0.00015**
Logarit-hmic		k=0.0005 a=1.3159 c= -0.327	0.9932	0.00076	0.00029
Two term expo-nential		k=.00078 n=0.9898	0.9939	0.00054	0.00021
Diffu-sion Approx imation		k=0.0007 a=0.9598 b=0.2745	0.9837	0.00348	0.00135
Page	100	k=0.0009 n=0.9789	0.9952	0.00046	0.00018
Hender son and Pabis		k=0.0008 n=1.0381	0.9909	0.00094	0.00036
Logarit hmic		k=0.0005 a=1.3331 c= 0.327	0.9918	0.00094	0.00036
Two term expo-nential		k=0.0007 a=0.9898	0.9939	0.00054	0.00021
Diffu-sion Approx imation		k=0.00078 a=0.958 b=0.2745	0.9837	0.00348	0.00135

IV.CONCLUSION

This study presents empirical model in order to describe the moisture sorption curves as compared with an experimental investigation of the hot air drying of rubberwood under different conditions. The experimental results were further analyzed to find the best suitable drying kinetic model for rubberwood drying. Different mathematical models were also determined with the drying behavior of rubberwood. The Henderson and Pabis model were found to be the most suitable model for describing drying curve of the three conditions. Future research should study the physical properties of dried rubberwood.

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Verbal Expressions on Mosi and Relative Objects in Hansan District: Ethno-Scientific Descriptions

Ji-Eun Kim

Abstract**—**This paper concerns verbal expressions on Mosi(ramie) and relative objects in Hansan District. Hansan, a small village (Myoen) located in the southern part of Chungcheonnam-do has been traditionally famous for its Mosi, which led to the systematic development of relevant verbal expressions. Taking Hansan people making their living by Mosi as a speech community, this paper aims to describe the language of the community ethno-scientifically.

To collect the necessary data, field work was done in Hansan for 3 weeks with a dozen of informants. The informants were chosen by examining their specialities in either growing Mosi plants, weaving Mosi fabrics, or making Mosi clothes. The participation observation method was preferably used rather than simple interviews where questions are asked with designed answers in mind. Most of the prepared questions were asked very naturally while the researcher was helping out the informants with their Mosi work.

Finally, the collected data were later organized using the folk taxonomy and componential analysis in this paper.

Meanwhile, the results showed that the traditional expressions on Mosi were quickly being replaced by modern technical terminologies. This paper examined the reason for this phenomenon and the sociological factors. Designated as World Cultural Heritage by UNESCO in 2011, Hansan-Mosi has been revived as the core resource of the domestic economy in Hansan after undergoing long depression due to today's low demand for traditional fabrics. Revived thanks to modern institutes, Hansan-Mosi industry was studied and even 'refined' by modern research which resulted in the influx of modern concepts and terminologies.

Keywords**—**Social linguistics, ethno-scientific description, Moshi, folk taxonomy.

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Nuclear Issue of the Korean Peninsula and Prospective Scenarios for the Reunification

Yefrem Yefremov

Abstract**—**To date, the Asia-Pacific region is one of the fastest growing regions in the world. However, here, as in any other point of our planet, there are threats that can undermine its stable development. One of such threats is the Korean problem. We can single out two components of this issue: the problem of the unification of the North and the South, as well as the nuclear program of the DPRK.

Since the Korean War of 1950, America has followed a similar political line with regard to the Korean peninsula.

The first priority for the administration of the White House is the patronage, support and development of South Korea.

Sanctions, as a second priority, were for the most part the response to North Korean sabotage. Since the era of the Obama administration, Washington has significantly succeeded in sanctions.

The third priority is the cessation of the development of nuclear weapons by North Korea. The presence of Pyongyang's nuclear weapons, and even more international recognition of this, carries risks that threaten the vital interests of America.

Ultimately, the main issue for South Korean diplomacy is the ability (or inability) of the North Korean regime to reform.

Undoubtedly, under the current regime, the unification of the Korean peninsula is almost impossible, in such a situation, preparations for the collapse of the DPRK regime or the reunification of the DPRK and the Republic of Korea are more important than predicting the timing of unification of Korea.

However, unless reforms are carried out in the DPRK, the Republic of Korea will not be able to initiate any processes of unification or even integration. The process of unification can begin only after a reformist government appears in the DPRK, but today there are no prerequisites for the appearance of a political figure similar to MS. Gorbachev in the USSR.

A new reformist regime in the DPRK may possibly come to power gradually after several changes in the current ruling regime.

Even under rather optimistic conditions, the unification in Korea will cost several times more than in Germany.

Without a drastic change in the situation in North Korea's economic system, there is no reason to expect the emergence of conditions for large-scale and long-term trilateral cooperation with the participation of Russia, the DPRK and the Republic of Korea. The most optimal scenario is a change in the government of the DPRK, with further improvement of policy and modernization of the economy of the North with gradual integration into the economic and political system of the Republic of Korea.

Although the experience of the transitional transformation of the political and economic systems of Germany or the countries of the post-Soviet space can be instructive, the unification of Korea is a unique case, long history of the socialist regime and deep party propaganda can become a barrier to the transition to a market economy at the level of the population's consciousness.

Keywords**—**North Korea, denuclearization, sanctions, Korean Peninsula.

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Exploring the Capabilities of Sentinel-1A and Sentinel-2A Data for Landslide Mapping

Ismayanti Magfirah, Sartohadi Junun, Samodra Guruh

Abstract**—**Landslides are one of the most frequent and devastating natural disasters in Indonesia. Many studies have been conducted regarding these phenomenon. However, there is a lack of attention in the landslide inventory mapping. The natural condition (dense forest area) and the limited human and economic resources are some of the major problems in building landslide inventory in Indonesia. Considering the importance of landslide inventory data in susceptibility, hazard, and risk analysis, it is essential to generate landslide inventory based on available resources. In order to achieve this, the first thing we have to do is identify the landslides location. The presence of Sentinel-1A and Sentinel-2A data gives new insights in land monitoring investigation. The free access, high spatial resolution, and short revisit time, make the data become one of the most trending open sources data used in landslide mapping. Sentinel-1A and Sentinel-2A data have been used broadly for landslide detection and landuse/landcover mapping. This study aims to generate landslide map by integrating Sentinel-1A and Sentinel-2A data use change detection method. The result will be validated with field investigation to make preliminary landslide inventory in study area.

Keywords**—**Change detection method, landslide inventory mapping, Sentinel-1A, Sentinel-2A.

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3D GIS for Evacuation Modeling in Multi-Story Building

Azmiyatul Arifati, Junun Sartohadi, Taufik H. Purwanto

***Abstract*—**The occurrence of earthquakes has the potential to affect the buildings and humans. Therefore, a step of preparedness needs to be done to reduce the casualties in a building. One form of preparedness is evacuation planning. The evacuation process is a matter that requires being much studied in terms of earthquake response. As the development of earth science and computer technology, rehearsal or drill can be replaced using modeling. KLMB building (Clinic of Environment and Disaster Mitigation) at the Faculty of Geography, Universitas Gadjah Mada, became a case study in this research. Naturally, the building that serves as a disaster mitigation clinic can be equipped with an adequate disaster evacuation system. GIS in collaboration with an Agent-based model (ABM) is used to model the evacuation process after the earthquake. The study aims to (1) develop 3D models of multi-story building and (2) model the evacuation process in high rise building using a 3D model of the building by placing agents in it. Agent consisting of students, lecturer, staff, and guest are given the behavior such as walking speed and behavior responds to disasters. Agents should avoid obstacles like walls, cabinets, and tables according to the actual indoor building situation. The result is the total time of evacuation and the location of evacuation density.

***Keywords*—**Agent-based model, Evacuation modeling, GIS, Simulation.

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Investigation of Biocorrosion in Brass by *Arthrobacter sulfureus* in Neutral Medium

R. Manivannan, B. Sakthi Swaroop, S. Noyel Victoria

***Abstract*—**Microbial corrosion of brass gauze by the aerobic film forming bacteria *Arthrobacter sulfureus* in neutral media was investigated using gravimetric studies. Maximum weight loss of 166.98 mg was observed for a period of 28 days of exposure to the bacterial medium as against the weight loss of 13.69 mg for control. The optical density studies for the bacterial culture were found to show attainment of stationary phase in 48 h. Scanning electron microscopy analysis of the samples shows the presence of pitting corrosion. The energy dispersive X-ray analysis of the samples showed increased oxygen and phosphorus content in the sample due to bacterial activity.

Keywords*—Arthrobacter sulfureus*, biocorrosion, brass, neutral medium.

I. Introduction

MATERIAL loss due to the bacterial activity is commonly referred to as microbially induced corrosion (MIC) or biocorrosion [1], [2]. Biocorrosion accounts for 20% of the degradation costs and cannot be ignored [1]. There are various theories for the MIC separately explaining the corrosive action of aerobic and anaerobic bacterial strains. The accumulation of charges on the metal surface which has appreciable roughness facilitates the formation of biofilm which is a layer formed out of combination of bacterial cells and extracellular polymeric substances and dirt [3]. The metabolic product of the bacteria which includes various organic and inorganic acids results in corrosion of the material [4]. Brass and copper are commonly used material for transportation of water in industrial cooling systems [5]. When copper or its alloys such as brass are used for water transportation, blue green water problem or the formation of blue green deposits leading to material damage has been observed frequently [5]. *Arthrobacter sulfureus* is aerobic bacteria commonly found in soil which finds its way to the water carrying lines made of copper or its alloys. They have been mentioned to cause blue green water problem due to corrosion of the copper and its alloys. It has also been found that, due to their corrosive activity, sudden increase in the copper content has been observed [6]. The biocorrosion can be controlled by using biocides. Biocides are chemicals that can be added in small quantities to stop the growth of the microbes. The biocides are believed to work on two principles i) electrostatic interaction between negatively charged centers on the cell membrane and the positive groups on the biocide molecules ii) hydrophobic nature of the biocide molecules disrupts the cell membrane and causes physical damage to the bacterial cells [7]. The commercially used biocide chemicals are toxic and non-biodegradable [8], [9]. Hence, there is a search for environmental friendly corrosion inhibitors out of which plant extracts are important. The present work focuses on the corrosive effect of the *Arthrobacter sulfureus* on brass in a neutral medium using weight loss measurements conducted for a period of 28 days. The morphology of the samples after corrosion was studied using scanning electron microscopy. The changes in the elemental compositions of the coupons before and after corrosion were studied using energy dispersive X-ray analysis. The work also tests the ability of two plant extracts in controlling the bacterial activity namely ginger and neem extract.

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II. Experimental

A. Preparation of Sample Brass Coupons

Brass coupons with a dimension of 10 mm x 10 mm x 0.5 mm were used for the studies. Prior to each experiment, the coupons were polished with various grades of sand paper and washed with acetone and distilled water. Every coupon is punched with a hole, such that a nylon thread can be fastened into that.

B. Nutrient Preparation and Bacterial Culturing

Pure strains of *Arthrobacter sulfureus* were purchased from NCIM, Pune. The strains were subcultured on nutrient agar plates. Nutrient agar solution was prepared by adding 2.8 g of nutrient agar in distilled water and was allowed to boil till it dissolved completely. To it, 1.5 g/l of yeast extract, 15 g/l agar, 5 g/l peptic digest if animal tissue, 5 g/l of NaCl and 1.5 g/l of beef extract were added. The final pH was adjusted to 7.4±0.2. This solution was sterilized at 1.5 kg/cm^2 gauge pressure for 20 min. Finally, the nutrient medium was poured into sterile petri plates under aseptic conditions, and medium was allowed to solidify. Upon solidification, a loop full of microorganism from the stock was streaked on the solidified media under sterile conditions. The subcultured petri plates were then incubated at a temperature of 30±1 ^{o}C in the incubator.

C. Optical Density (O.D) Measurement

Prior to the corrosion studies, to know the growth characteristics of the *Arthrobacter sulfureus* species, nutrient medium was prepared using distilled water with 1.5 g/l of yeast extract, 5 g/l peptic digest of animal tissue, 5 g/l of NaCl and 1.5 g/l of beef extract. The final pH was adjusted to 7.4±0.2. This solution was sterilized at 1.5 kg/cm^2 gauge pressure for 20 min. To the medium taken in test tube, one loop full of culture was transferred and

incubated at 30±1 ^{o}C in the incubator. The optical density at 600 nm was measured at regular intervals.

D. Sample Preparation for Corrosion Studies

The corrosion studies were conducted by immersion of the metal coupons in media with and without bacterial culture. The nutrient medium was prepared in the similar manner reported in step *C*. The sterile nutrient medium was distributed evenly in multiple test tubes. Out of those tubes, 12 were termed as control, and bacterial culture was not added to them to check the corrosive nature of the nutrient medium. To the rest of the tubes, loop full of bacterial culture from agar plates was added under sterile conditions. To all the test tubes, sterile metal coupons were immersed and sealed using sterile cotton. All the test tubes were incubated at a temperature of 30±1 ^{o}C in the incubator. Three metal coupons were taken out at regular intervals, and their weight loss was measured. The average of the same has been reported here.

E. Inhibitor Preparation and Antimicrobial Activity

The ginger and neem leaves were dried individually and powdered. The obtained powder was individually soaked in ethanol for 24 h and filtered. The obtained filtrate of ginger and neem leaves was individually refluxed in reflux setup at 55 ^{o}C for 5 h. The obtained extract was then concentrated using rotary evaporator for concentration.

The concentrated extracts obtained from ginger and neem leaves were tested for antimicrobial activity. The nutrient broth containing one loop full of bacterial culture was taken in conical flasks. To the conical flasks the ginger and neem leaf extract were added individually. The volume % of the inhibitor extracts varied from 1 vol.% to 3 vol.%. After the addition of the inhibitor extract, the flasks were sealed and incubated. The optical density was measured for the samples periodically.

III. Results and Discussion

A. Growth of Bacteria

Table I shows the values of optical density measured at 600 nm for the nutrient medium with bacterial culture alone at different time durations. It is clearly observed that the OD values increases continuously till 16 h and was found to saturate at 2.63 at 20 h which is an indication of stationary phase attainment. This shows the attainment of stationary phase. It was ensured that the bacterial strains used for corrosion studies were in stationary phase at the time of adding the strains into the nutrient broth containing metal coupons.

B. Weight Loss Studies

Table II shows the weight loss of the brass coupons after immersion for various periods in control and bacterial cell containing neutral medium. It is clearly seen that the weight loss of the coupons significantly increases from 1.48 mg for 7-week immersion to 11. 7 mg for an immersion period of 14 days. With further increase in immersion period the weight loss increases; however, the magnitude of the weight loss observed is less than that observed after 2-week immersion. The corrosion rate, *CR*, can be calculated using (1) [5].

$$CR = \frac{87.6 \times w}{\rho \times a \times t} \quad (1)$$

where ρ is the density of brass in g/cm^3, A is the area of coupon in cm^2 and t is the immersion period in hours. It is seen from Table II that the corrosion rate is the maximum for two weeks and decreases slightly for third week and increases again for fourth week. *Arthrobacter sulfureus* is known to form biofilm. The biofilm thickness will be at smaller at initial immersion period. With progress of bacterial activity, the biofilm thickness increases which poses diffusion limitations for oxygen and nutrients [5], [6]. With increased thickness of the biofilm, its mechanical strength weakens causing detachment of the biofilm at some places which results in enhancing corrosion again like that observed for fourth week [5], [6].

TABLE I
Optical Density Measured at Regular Intervals of Time to Measure *Arthrobacter sulfureus* Growth

Duration (h)	Optical density
4	1.67
8	1.75
12	1.96
16	2.63
20	2.63
24	2.63
28	1.67

From Table II, it can also be seen that the sample immersed for 28 days in medium without bacterial cell (control) presented a weight loss of 13.69 mg after 28 days which indicates that the medium is mildly corrosive to the metal.

TABLE II
Results of Weight Loss Studies for Brass Coupons in Media with and without Bacteria

Immersion period h	Weight loss mg	Corrosion rate mm/y
Bacterial Medium		
7	1.78	0.11
14	11.7	0.35
21	14.4	0.29
28	22.4	0.33
Control		
28	13.69	0.2

C. Scanning Electron Microscopy (SEM)

Fig. 1 shows the scanning electron microscopy results of the brass coupons before immersion into the bacterial medium and the image of the brass coupon immersed in the bacterial medium for three weeks. It is clearly seen that the brass coupons after immersion for three weeks in bacterial medium has developed pits which is an indication of pitting corrosion. The biofilm is known to consist of 97% water into which the solutes such as extra cellular polymeric substances secreted by the bacteria, organic and inorganic acids due to the metabolic activity of the microbes are in dissolved condition [4]. The biofilm in the case of *Arthrobacter sulfureus* is reported to capture dissolved copper ions due to the opposite charge. Thus, the zones covered with biofilm are slightly more positive than the other areas resulting in localized cathodic and anodic

regions resulting in pitting corrosion [6].

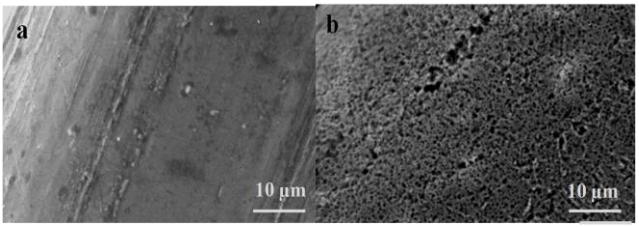

Fig. 1 Scanning electron microscopy images of brass coupon a) before immersion into the bacterial medium b) after immersion for three weeks in bacterial medium

Table III shows the elemental composition of the coupons before and after immersion (for three weeks) into the bacterial medium. It is clearly seen that for the sample before immersion into the bacterial medium, the copper content was about 39.52% which has significantly dropped to 25.64% after immersion into the bacterial medium for three weeks. Similarly, there is an increase in oxygen content from 4.87 % to 23.92% after immersion into the bacterial medium. This could be due to the formation of copper oxides due to the bacterial activity. Similarly, phosphorus which is absent in sample before immersion shows its presence to significant extent which could be due to the extracellular polymeric substances consisting the biofilm [5].

TABLE III
ELEMENTAL ANALYSIS OF THE BRASS SAMPLES BEFORE AND AFTER CORROSION IN THE PRESENCE OF BACTERIA FOR AN IMMERSION PERIOD OF 3 WEEKS

Element	Before corrosion wt.%	After 3 weeks, corrosion Wt.%
Copper	38.52	35.79
Zinc	37.42	32.73
Carbon	19.19	13.31
Oxygen	4.87	14.00
Phosphorus	-	1.85
Magnesium	-	0.72
Silicon	-	1.26
Calcium	-	0.33

D.Antimicrobial Activity of the Inhibitors

Table IV shows the optical density values taken after 28 h of incubation with ginger extract and neem leaf extract. It is clearly seen that the 3 vol.% ginger extract is able to decrease the bacterial population only slightly. The neem leaf extract decreases the growth of the bacteria when the concentration is 1 vol.% and 2 vol.% but stops the growth when its concentration was increased to 3 vol.% which is reflected by the very low optical density value. The optical density value of 0.04 may be due to the initial culture that has been added to the system.

TABLE IV
OPTICAL DENSITY MEASUREMENTS AT 600 NM FOR THE MEDIUM CONTAINING ONLY *ARTHROBACTER SULFUREUS* STRAINS AFTER 28 HOURS OF INCUBATION IN THE PRESENCE OF INHIBITOR EXTRACT

Extract concentration vol%	Optical density
Ginger	
1	2.2
2	2.2
3	1.9
Neem	
1	2
2	1.2
3	0.04

E. Mechanism

Studies on bacterial corrosion have shown two types of mechanisms occurring individually or together resulting in microbial corrosion [8], i) metal oxidation coupled with intracellular reduction called as type I MIC ii) material degradation due to corrosive products formed from bacterial activity [5], [10]. Three possible mechanisms have been proposed for copper reactions in microbial system [11] which is anodic half reactions resulting in Cu^{+} and Cu^{2+}. The first is simultaneous mechanism shown by reactions 2 and 3.

$$2Cu + H_2O \rightarrow Cu_2O + 2e^- + 2H^+ \quad (2)$$

$$Cu \rightarrow Cu^{2+} + 2e^- \quad (3)$$

The second mechanism proposed is sequential mechanism given by (4) and (5) [11]

$$2Cu + H_2O \rightarrow Cu_2O + 2e^- + 2H^+ \quad (4)$$

$$Cu_2O + 2H_2O \rightarrow Cu^{2+} + H_2 + 2e^- + 2OH^- \quad (5)$$

The third mechanism is redeposition mechanism shown by (6) and (7).

$$Cu \rightarrow Cu^{2+} + 2e^- \quad (6)$$

$$Cu + Cu^{2+} + H_2O \rightarrow 2Cu_2O + 2H^+ \quad (7)$$

Arthrobacter sulfureus are electrogenic bacteria capable of electron transfer [5]. Thus, type I MIC occurs in the present situation. Moreover, the biofilm formed has greater affinity for copper ions. The copper ions that diffuse out to the bulk liquid from the biofilm readily react with dissolved oxygen to form cuprite, Cu_2O. It was observed that the solution upon immersion of the brass coupons turned to bluish green. Blue green deposits that occur during copper and its alloys corrosion could be due to the formation of malachite or some sulfur compounds. Since the energy dispersive X-ray analysis results did not show the presence of any sulfur, the blue green color could be due to malachite [12]. Earlier studies on the analysis of copper and brass samples used for water distribution by X-ray absorption spectroscopy also indicate the formation of malachite on the surface [11]. Thus, based on the earlier theories and the

obtained results, it can be said that the *Arthrobacter sulfureus* acts as electrogenic species and thus type I MIC occurs in the system. The biofilm formed varies in its thickness and causes mass transfer limitation which is verified from the weight loss studies. The formation of blue green deposits on the brass coupons and the energy dispersive X-ray analysis results suggest the formation of Malachite which is due to the reaction of Cu_2O with the ions available in the solution. The formation of corrosion products along with biofilm also suggests the presence of type II MIC caused by corrosive products formed by bacterial metabolism.

IV. Conclusion

An attempt to study the microbial corrosion of brass using aerobic bacteria *Arthrobacter sulfureus* was made. The gravimetric studies have shown that the bacterial population is active enough to cause corrosion for a period of 28 days. The scanning electron microscopy results suggest pitting corrosion which is supported by the theories which state the formation of concentration cells due to biofilm formation. Further analysis using electrochemical techniques such as potentiodynamic polarization and electrochemical impedance spectroscopy will be helpful in understanding the behavior clearly. Extensive studies using 3 vol.% neem inhibitor have to be carried out.

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Synthesis of Brominated Pyrazoline Derived from Chalcone and Its Antimicrobial Activity

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Abstract**—**Despite the availability of antimicrobial agents in the market, the urge to study and find other chemical compounds with better potential to replacing them still tempting the scientists. This experiment is in the aim to explore a novel brominated pyrazoline ring which was made from intermediate chalcone as a candidate to answer the challenge. Using green chemistry approach by microwave irradiation from domestic oven, both known chalcone and 5-(2-bromophenyl)-3-(naphthalen-1-yl)-4,5-dihydro-1H-pyrazole were successfully synthezized. Pyrazoline's structure was confirmad based on UV, IR, ^{1}H-NMR, ^{13}C-NMR and MS and together with its intermediate were examined against some microorganisms (*Bacillus subtilis*, *Eschericia coli* and *Candida albicans)* under agar diffusion method. The results collected during experiment revealed that both tested compounds showed weak activity on *B.subtilis* which was proven by zone of inhibitions, while there were no zone of inhibitions observed in *E. coli* and *C. Albicans*. This is suggested because of the bulky structure around pyrazoline could not provide the main ring to interact with microbial's cell wall. The study shows that the proposed compound had low capability as promising antimicrobial agent, yet it still enrich the information about pyrazoline ring.

Keywords**—**Antimicrobial, chalcone, microwave irradiation pyrazoline.

I. Introduction

AMONG nitrogen containing five membered heterocycles, pyrazoline demonstrates various types of biological activities. Pyrazoline has known effectively utilized as antibacterial [1], antidepressant [2], anti-cancer [3], anti-inflammatory [4], antimalarial, antitrypanosomal, antileishmanial [5] and antitumor [6] activities. The synthesis of pyrazoline by reaction of chalcone derivatives and various hydrazine were also reported in many literatures [7], [8], [9], [10]. Pyrazoline derivatives of methoxy substituted naphthyl chalcone 1-acetyl-5-(2-naphthyl)-3-(3,4,5-trimethoxyphenyl)-4,5-dihydro-1H-pyrazole [9] and 5-(4-fluorophenyl)-1-methoxy-3-(naphthalene-2-yl)-4,5-dihydro-1H-pyrazole [10] were synthesized using 2-acetylnaphthalene.

This paper reported the synthesis of a novel brominated 1-naphtyl pyrazoline derived from a chalcone under microwave irradiation. This method was considered to have variety of advantages, including shorter reaction time, better yield [11] and environmentally friendly effects [12], [13]. Therefore, it has been widely used in organic synthesis area. Compound will be tested as antimicrobial for its first simply screening.

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II. Methodology

A. Materials

The materials were analytical grade including 1-acetylnaphthalene, 2-bromobenzaldehyde, hydrazine hydrate, NaOH, HCl, CH_3COOH glacial, universal indicator and some organic solvents, such as ethanol, n-hexane and ethyl acetate. Melting point was determined in Fisher John (SMP 11-Stuart®) and uncorrected. The IR spectra were recorded on Shimadzu FTIR (IR Prestige-21) using KBr powder. JEOL JNM ECA-500 MHz was used to record ^{1}H NMR and ^{13}C-NMR spectra of the synthesized compound. Mass spectral data for pyrazoline was recorded using HRMS (Mariner Biospectrometry) instrument. The reaction was monitored by thin-layer chromatography (TLC) using silica gel GF_{254} (Merck) and UV lamp (Camag® 254 and 366 nm) for visualization the spots. For determined result, compounds purity was tested again using HPLC (Shimadzu LC solution) after checked its wavelenght using UV-Visible spectrophotometer (GENESYS 10S UV-VIS v4.002 2L9N175013).

Antimicrobial activity test used *Bacillus subtilis* (Gram-positive), *Eschericia coli* (Gram-negative) and *Candida albicans* (fungi) through agar diffusion. Other materials were Nutrient Broth (Difco), Nutrient Agar (Merck), Water Peptone (WP), Potato Dextrose Agar (PDA), paper disc and alcohol 70%. Amoxsan® and Ketoconazole® were used as positive control. Since chalcone is known as intermediate for many organic reactions, it also set in bioactivity test so there will be a comparison between pyrazoline and its chalcone. The synthesis follows as the figure below.

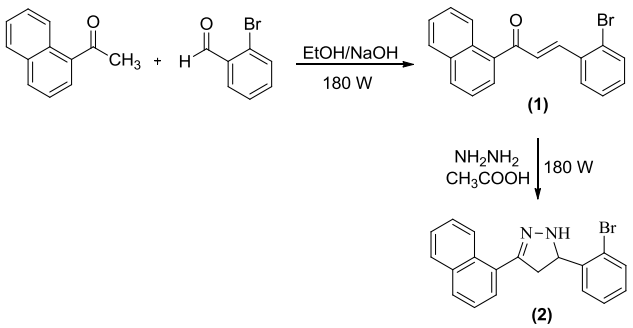

Fig. 1 Scheme of synthesis of 5-(2-bromophenyl)-3-(naphthalen-1-yl)-4,5-dihydro-1H-pyrazole

B. Preparation of Chalcone (1)

The starting chalcone was made from a mixture of 1-acetylnaphthalene (0.85 g, 5 mmol), 2-bromobenzaldehyde (0.92 g, 5 mmol) and 5 mL of NaOH (1 N) in 7.5 mL ethanol which was irradiated using microwave (180 W) for 1-3 minutes. The solid was added into 15 mL of cold destilled water and neutralized with HCl 1N. The crude solid product was filtered, washed with cold n-hexane and

recrystallized from ethyl acetate to afford compound **(1)** amount 62 % as yellow crystals.

C. Preparation of Pyrazoline (2)

1 mmol chalcone (diluted in 10 mL EtOH), 11 mmol hydrazine hydrate (diluted in 5 mL EtOH) were mixed. Acetic acid glacial was added drop wise. The mixture was irradiated for 1-2 minutes in 180 W. The resultant solution was cooled until formed precipitation as crystal. The crystal was filtered, washed with cold n-hexane and dried. The product afforded as 72% in white crystal appearance was the pure one. All the starting materials were generally used as received (Merck) without any purification. Compounds structure was determined by UV-Vis, IR, HPLC, ^{1}H NMR, ^{13}C NMR and HRMS.

D. Antimicroabial Test

Antimicrobial activity test was performed by agar diffusion method. 1 mL of NB solution containing bacterial culture (OD_{600nm} ~ 0.1) was added into petri dish that has been sterilized, then 50 mL of Nutrient Agar (NA) was poured and rocked the bacteria uniformly. NA was allowed to solidify first before 6 paper discs were put (6 mm diameter). The discs have been dissolved in sample solution under various concentrations as 10, 30 and 50 µg/disc. Amoxsan® was used as positive control (3 mg/disc) and ethyl acetate as negative control because it is used as solvent. Petri dish was incubated at 37 ^{0}C. Diameter of clear zone around the paper disc was measured as zone of inhibition after it was incubated for 24 hours. Same method was used for fungi, with Ketoconazole as positive control and incubated for 48 hours. All the test above were done in three replications.

III. RESULTS AND DISCUSSION

A. Synthesized Compounds

The pyrazoline structure has been characterized by UV-Vis, FTIR, HRMS, ^{1}H NMR, and ^{13}C NMR. The progress of all reactions were monitored by TLC using n-hexane:ethyl acetate (9:1). The HRMS mass spectrum showed its molecular mass to be $[M-H]^{+}$ *m/z* 349,2994.

In the ^{1}H NMR spectra, the ABX pattern was observable as *doublet of doublets* for H_A (δ 3.11 ppm) and H_B (δ 3.83 ppm). Meanwhile H_X showed as *triplet* at δ 5.33 ppm with J_{AB} = 16 Hz, J_{AX} = 9 Hz and J_{BX} = 10 Hz. The protons of aromatic ring were observed at δ 7.33-9.19 ppm.

The specific ^{13}C NMR spectrum occurred at δ 151.9 ppm (C=N), δ 42.8 (CH, H-4 pyrazoline), δ 62.7 ppm (CH, H-5 pyrazoline) and δ 123.1 ppm (C-Br). The electronic spectra for aryl substituted bromo and naphtyl ring (studied in UV-Vis region) showed two absorption bands at λmax 225 and 317 nm. The melting point of this compound calculated at 102-104^{0}C.

IR spectral details: 3328 (N-H); 3053 (C-H aromatics); 2861 (C-H aliphatic); 1592 (C=N); 1465 (C=C aromatics); 1319 (C-N) and 565 (C-Br).

^{1}H-NMR (500 MHz, $CDCl_3$) δ (ppm): 9,19 (d, 1H); 7,86 (d, 1H); 7,82 (d, 1H); 7,69 (dd, 1H); 7,58 (t, 2H); 7,51 (t, 2H); 7,43 (t, 1H); 7,33 (t, 1H); 7,15 (td, 1H); 5,33 (t, $1H_X$, J_{XB} = 10 Hz and J_{XA} = 9,5 Hz); 3,83 (dd, $1H_B$, J_{BX} = 10 Hz and J_{BA} = 16 Hz); 3,11 (dd, $1H_A$, J_{AX} = 9 Hz and J_{AB} = 16 Hz).

^{13}C-NMR (500 MHz, $CDCl_3$) δ (ppm): 42,8; 62,7; 123,1; 124,9; 126,1; 127,0; 127,1; 127,4; 128,0; 128,5; 129,1; 129,7; 130,9; 133,0; 134,1; 141,5 and 151,9.

B. Antimicrobial Activity

Antimicrobial activity of synthesized compounds was studied against certain pathogenic organisms. *Bacillus subtilis* (Gram-positive), *Eschericia coli* (Gram-negative) and *Candida albicans* (fungi) were selected as representative organisms. From the result which is given in Table I, pyrazoline indicated to act more valuable as antibacterial more than its intermediate chalcone.

TABLE I
ANTIMICROBIAL ACTIVITY DETAILS OF SYNTHESIZED COMPOUNDS

Compound	Concentration (µg/disk)	Zone of inhibition (mm)		
		B. Subtilis	*E. Coli*	*C. albicans*
Chalcone	10	8,38	-	-
	30	8,77	-	-
	50	9,60	-	-
Pyrazoline	10	8,50	-	-
	30	10,23	-	-
	50	10,53	-	-
Amoxsan®	3	26,20	30,0	-
Ketoconazole®	3	-	-	31,20
Ethyl acetate	-	-	-	-

There are some factors considered caused this antimicrobial activity, which one of them is the diffusion's speed of tested compounds in agar medium. The two tested compounds are semi-polar shown by the TLC test which make diffusion ability of them to agar medium containing water is descending.

The structure of cell wall from each bacteria also play role in the results of the test. Gram negative bacterial's cell wall consist of outer layer (lipopolysaccharide and protein) and inner layer (peptidoglycan). It will make it more difficult to be penetrated in comparison to Gram-positive's cell wall which is made by one peptidoglycan layer.

Another considered reason is the bulky structure around pyrazoline ring. According to previous experiment, a quinoline based pyrazoline with same subtutited aryl group in C-5 of pyrazoline ring increased antimicrobial activity against same tested microorganisms. This is because the halogen group which subtitued in *para* position of aryl do not give any tensions from benzene ring to pyrazoline ring [14]. Meanwhile, this experiment use *ortho* position of Bromo atom in benzene ring and estimated give tension to pyrazoline in the center. Thus, it affect its ability to encounter with chemical compounds from cell wall of each microorganism.

IV. CONCLUSION

In conclusion, brominated pyrazoline derived from chalcone has successfully synthesized using domestic

microwave oven from the reaction of 1-naphtyl chalcone and hydrazine hydrate. The reaction occurred in a short time and resulted 72% yield of pure compound. All the spectroscopic data agreed with the structure of product. From the study, it can be concluded that pyrzoline in this experiment demonstrated weak antimicrobial activity only at Gram positive bacteria. Although the first screening of compound did not bring a promising view to act as antibiotic in the future, the result still enriched information about pyrazoline derivatives.

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Selling Electric Vehicles: Experiences from Car Salesmen in Sweden

Jens Hagman, Jenny Janhager Stier, Ellen Olausson, Anne Y. Faxer, Ana Magazinius

Abstract—Sweden has the second highest electric vehicle (plug-in hybrid and battery electric vehicle) sales per capita in Europe but in relation to sales of internal combustion engine electric vehicles sales are still minuscular (< 4%). Much research effort has been placed on various technical and user focused barriers and enablers for adoption of electric vehicles. Less effort has been placed on investigating the retail (dealership-customer) sales process of vehicles in general and electric vehicles in particular. Arguably, no one ought to be better informed about needs and desires of potential electric vehicle buyers than car salesmen, originating from their daily encounters with customers at the dealership. The aim of this paper is to explore the conditions of selling electric vehicle from a car salesmen's perspective. This includes identifying barriers and enablers for electric vehicle sales originating from internal (dealership and brand) and external (customer, government) sources. In this interview study five car brands (manufacturers) that sell both electric and internal combustion engine vehicles have been investigated. A total of 15 semi-structured interviews have been conducted (three per brand, in rural and urban settings and at different dealerships). Initial analysis reveals several barriers and enablers, experienced by car salesmen, which influence electric vehicle sales. Examples of as reported by car salesmen identified barriers are: -Electric vehicles earn car salesmen less commission on average compared to internal combustion engine vehicles. -It takes more time to sell and deliver an electric vehicle than an internal combustion engine vehicle. -Current leasing contracts entails relatively low second-hand value estimations for electric vehicles and thus a high leasing fee, which negatively affects the attractiveness of electric vehicles for private consumers in particular. -High purchasing price discourages many consumers from considering electric vehicles. -The education and knowledge level of electric vehicles differs between car salesmen, which could affect their self-confidence in meeting well prepared and question prone electric vehicle buyers. Examples of identified enablers are: -Company car tax regulation promotes sales of electric vehicles; in particular, plug-in hybrid electric vehicles are sold extensively to companies (up to 95 % of sales). -Low operating cost of electric vehicles such as fuel and service is an advantage when understood by consumers. -The drive performance of electric vehicles (quick, silent and fun to drive) is attractive to consumers. -Environmental aspects are considered important for certain consumer groups. -Fast technological improvements, such as increased range are opening up a wider market for electric vehicles. -For one of the brands; attractive private lease campaigns have proved effective to promote sales. This paper gives insights of an important but often overlooked aspect for the diffusion of electric vehicles (and durable products in general); the interaction between car salesmen and customers at the critical acquiring moment. Extracted through interviews with multiple car salesmen. The results illuminate untapped potential for sellers (salesmen, dealerships and brands) to mitigating sales barriers and strengthening sales enablers and thus becoming a more important actor in the electric vehicle diffusion process.

Keywords—customer barriers, electric vehicle promotion, sales of electric vehicles, interviews with car salesmen

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Engineering Entrepreneurship

K. H. Lee

***Abstract*—**Engineers invent new products, determine new methodologies and create new solutions. Some engineers analyze while others solve daily problems using systematic or innovative approach. Engineers usually discuss their ideas, with classmates, friends and family and many believe that it is just only a short step to take the inventions or methodologies to market as an entrepreneur, but, there are only several successful engineering entrepreneurs.

In this paper, the author, which is an engineer, will share his experiences on how he transited from being an engineer to becoming an entrepreneur. He will also discuss the contradicting attributes and his route to becoming sustain his existence. Finally, the author will summarize with who an engineering entrepreneur is and how will one measure successes in entrepreneurship

***Keywords*—**Engineer, Engineering, Entrepreneur, Start-up.

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Training the Hospitality Entrepreneurship on the Account of Constructing Nascent Entrepreneurial Competence

Ching-Hsu Huang, Yao-Ling Liu

Abstract—Over the past several decades there has been considerable research on the topics of entrepreneurship education and nascent entrepreneurial competence. The purpose of this study is to explore the nascent entrepreneurial competence within entrepreneurship education via the use of three studies. It will be a three-phrases longitudinal study and the effective plan will combine the qualitative and quantitative mixed research methodology in order to understand the issues of nascent entrepreneurship and entrepreneurial competence in hospitality industry in Taiwan. In study one, the systematic literature reviews and twelve nascent entrepreneurs who graduated from hospitality management department will be conducted simultaneously to construct the nascent entrepreneurial competence indicators. Nine subjects who are from industry, government, and academia will be the decision makers in terms of forming the systematic nascent entrepreneurial competence indicators. The relative importance of indicators to each decision maker will be synthesized and compared using the Analytic Hierarchy Process method. According to the results of study one, this study will develop the teaching module of nascent hospitality entrepreneurship. It will include the objectives, context, content, audiences, assessment, pedagogy and outcomes. Based on the results of the second study, the quasi-experiment will be conducted in third study to explore the influence of nascent hospitality entrepreneurship teaching module on learners' learning effectiveness. The nascent hospitality entrepreneurship education program and entrepreneurial competence will be promoted all around the hospitality industry and vocational universities. At the end, the implication for designing the nascent hospitality entrepreneurship teaching module and training programs will be suggested for the nascent entrepreneurship education. All of the proposed hypotheses will be examined and major finding, implication, discussion, and recommendations will be provided for the government and education administration in hospitality field.

Keywords—entrepreneurial competence, hospitality entrepreneurship, nascent entrepreneurial, training in hospitality entrepreneurship

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A Series of Teaching Modules to Prepare International Students for Real-World China

Jui-Chien Wang

Abstract—Because of China's continued economic growth and dominance, increasingly many students of Chinese from western countries are interested in pursuing careers related to China. Unless we do more to teach them about contemporary Chinese society and Chinese cultural codes, however, few will be able to do so successfully. Most traditional language textbooks treat these topics only cursorily, and, because of the rapid pace of China's social and economic development, what they do cover is frequently outdated and insufficient. However, understanding contemporary Chinese society and Chinese cultural codes is essential to successfully negotiating real-world China. The current paper details one of the main ways in which the presenter has dealt with this educational lacuna: the development and implementation of a series of teaching modules for advanced Chinese language classes. Each module explores a particular area, provides resources, and raises questions to engage students in strengthening their language and cultural competencies. The teaching modules address four main areas: (1) Chinese behavioral culture; (2) critical issues in contemporary China; (3) current events in China; and (4) great social transformations in contemporary China. The presenter will also discuss lessons learned and insights gained during the development and implementation process as well as the benefits of using these modules. In addition, the presenter will offer suggestions for the application of these modules, so that other language teachers will be able to make better use of them in their own classrooms.

Keywords—behavioral culture, contemporary Chinese society, cultural code, teaching module

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Analyzing the Risk Pricing in the Highly Liberalized Emerging Market

Yin Yin Koay, Chee Wooi Hooy

Abstract**—**In the context of asset pricing, the integrated market is desired. A fully integrated market has zero pricing of local market risk and only world market risk pricing does matter; a mildly segmented market has both pricing of world and local market risk. We revisit the definition of the "integrated market" and have address the inconsistency in the previous literature. Previous literature generally treated developed market as the integrated market and all the emerging market as the mildly segmented market. However, we had identified a Highly Liberalized Emerging Market (HLEM) that matches the definition of the "integrated market" in the existing empirical studies. We examine the time-varying risk pricing using Partially International Asset Pricing Model to the HLEM and other Asia Emerging Markets. The sample period is from January 2009 to September 2016. The results from our study showed that both world and local market risk are still priced in HLEM and other Asia Emerging Markets, which draw to the conclusions that neither of them are fully integrated into the world market. While this result is not surprising for the other Asia Emerging Markets, it is more remarkable for HLEM, given that the market is highly liberalized within the sample period. We found that HLEM still do not fully integrated into the world market even though the explicit barriers are generally absent in this type of emerging market. Therefore, this study provides further evidence on the existence of implicit barriers as the hindrance to the globalization process.

Keywords**—**Asset pricing, integration, local market risk, risk pricing, world market risk.

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A New Integral Equation Formulation for American Put Options

Song-Ping Zhu, Xin-Jiang He, Xiaoping Lu

***Abstract*—**A completely new integral equation for the price of an American put option as well as its optimal exercise price is successfully derived. The original problem for option prices is casted into a new free boundary problem for the option Theta (the first-order derivative with respect to the time to maturity as one of the important Greeks in option pricing). Taking the advantage of the free boundary being a monotonic decreasing function of the time to expiry, a novel approach is adopted, in which the optimal exercise price itself is taken as an independent variable first, replacing an original independent variable, the time to expiry. Fourier transform is then applied to obtain a simple and elegant integral equation.

Compared to existing integral equations for pricing American options, the new integral formulation has two distinguishable advantages; i) it is in a form of one-dimensional integral, and ii) it is in a form that is free from any discontinuity and singularities associated with the optimal exercise boundary at the expiry time. These rather unique features have led to a significant enhancement of the computational accuracy and efficiency as shown in the examples.

***Keywords*—**American put options, Computational accuracy and efficiency, Fourier transform, Integral equation.

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Strategic Thinking to Enhance Critical Transport Infrastructure and Build Resilience

Jayantha Withanaarachchi, Sujeeva Setunge, Sara Moridpour

Abstract—Gaps in strategic thinking and planning leads to critical transport infrastructure resilience. These gaps in strategic transport and land use development planning have an impact on communities and cities. Natural and man-induced disasters can be catastrophic to communities.

After a disaster, many types of critical infrastructure, including transport infrastructure gets un-usable or gets damage. This paper examines strategic thinking behind the resilience and protection of Critical Transport Infrastructure (CI) within transport networks by investigating the impact of disasters such as bushfires, hurricanes and earthquakes.

A detailed analysis of three case studies have been conducted to identify the gaps in strategic transport planning and strategic decision making processes required to mitigate the impacts of disasters. Case studies will be analysed to identify existing gaps in road design, transport planning and decision making.

This paper examines the effect of road designing, transport corridors and decision making during transport planning stages and how it impacts transport infrastructure as well as community resilience. A set of recommendations to overcome the shortcomings of existing strategic planning and designing process are presented.

This research paper reviews transport infrastructure planning issues and presents the common approach suitable for future strategic thinking and planning which could be adopted in practices.

Keywords—Community Resilience, Strategic Transport Planning, Transport Infrastructure, Decision Making and Infrastructure Resilience.

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Return of Equity and Labor Productivity Comparison on Some Sino-Foreign Commercial Banks

Xiaojun Wang

***Abstract*—**In a lucky emerging market, most Sino commercial banks has developed rapidly and achieved dazzling performance in recent years. As a large sound commercial bank with long history, Wells Fargo Company(WFC) is taken as a mirror in this paper in order to roughly find out the relevance on life circle of the Sino banks in comparison with WFC. Two financial measures return on equity(ROE) and overall labor productivity(OLP), three commercial banks the Hong Kong and Shanghai Banking Corporation Limited(HSBC), the Bank of Communication(BCM) and China Minsheng Bank(CMSB) are selected. The comparison data coming from historical annual reports of each company vary from 13 years to 51 years. Several conclusions from the results indicate that most Sino commercial banks would be continually developing with lower financial measures performance for later several decades.

***Keywords*—**Commercial Bank, Features Comparison, Labor Productivity, Return on Equity.

I. Introduction

IN 2006, Charlie Munger said, why Warren Buffett insisted on holding Wells Fargo Company's shares for twenty years? His answer was that the action was for evaluation on other investee's value. Since founded in 1852, Wells Fargo Company(WFC) has been more than 160 years. In theory, it should have typical life cycle including growth, mature and recession such three stages. Although in 2016 it had illegal sales scandal, the financial market still regarded Wells Fargo as lying during the mature stage of its life cycle by means of maintaining roughly smooth stocks prices from 2016 to 2017. Nowadays, Most Sino commercial banks have been developing rapidly. Exploring the relevance of life circle between Sino banks and typical international commercial banks is necessary and valuable for analyzing Sino commercial banks and the stocks market situation in Chinese mainland on the whole.

This paper consists of 4 parts. In section 2, two measures are introduced for comparison and the Euclidean distance of these measures between several Sino commercial banks and WFC is presented. The comparison results on each measure between three Sino commercial banks and WFC are analyzed in section 3. In section 4, several conclusions are put forward for further discussion.

II. Concepts and Criterion

As for a company, life circle is a subjective measure. Here two primary objective criteria are selected to describe the life circle. One is Return on Equity (ROE) measuring how well a company uses investments to generate earnings growth, which is equal to a fiscal year net income divided by total equity. The other is Overall Labor Productivity (OLP), which measures the amount of goods or services produced by one year of total labor in a company. The higher OLP indicates the more economic efficiency.

In order to compare life circle of different corporations with ROE and OLP, Euclidean distance is adopted as the criterion. Let a vector $X = x_1, x_2, \dots x_N$, and $Y = y_1, y_2, \dots y_N$, $N \in \mathrm{Z}$, indicating ROE or OLP of different corporation. Define the Euclidean Distance between X and Y as[1]

$$\mathrm{D}(X,Y) = \sqrt{\sum_{i=1}^{N}(x_i - y_i)^2} \tag{1}$$

If given ROEs and OLPs of company A in three life circle stages, searching the minimum Euclidean distance between two features of company B and company A, then the life circle stage of company B could be revealed roughly.

In this paper four commercial banks are selected for comparison. One is Wells Fargo Company(WFC), the other is the Hong Kong and Shanghai Banking Corporation Limited(HSBC). The other two banks are Sino commercial banks, one is the Bank of Communication(BCM), the other is China Minsheng Bank(CMSB).

III. Results and Analysis

From the literature[2]-[5], four group of ROE values of WFC, HSBC, BCM and CMSB companies are obtained within time periods from 1966 to 2016, from 1987 to 2016, from 2004 to 2016 and from 2003 to 2016, respectively. These data of ROE value are adopted by Eqn.(1) to calculate the Euclidean distance.

A. Return on Equity

The graphs of ROEs among WFC, HSBC, BCM and CMSB are shown as Fig.1.

From 1966 to 2016, the average return of equity of WFC is 12%. From 1987 to 2016, the average ROE of HSBC is 12.3. From 2004 to 2016 and from 2003 to 2016, the average ROEs of BCM and CMSB are 14.4 and 18.1, respectively. Both WFC and HSBC, within their 50 and 30 years history, for a certain time period they had ever reached the high ROE value like BCM or CMSB in their recent years.

From 1966 to 2016, the average return of equity of WFC is 12%. From 1987 to 2016, the average ROE of HSBC is 12.3. From 2004 to 2016 and from 2003 to 2016, the average ROEs of BCM and CMSB are 14.4 and 18.1, respectively. Both WFC and HSBC, within their 50 and 30 years history, for a certain time period they had ever reached the high ROE value like BCM or CMSB in their recent years.

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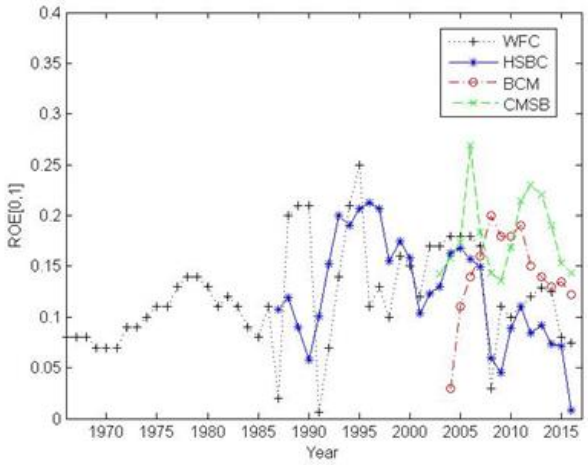

Fig. 1 ROEs of WFC, HSBC, BCM and CMSB

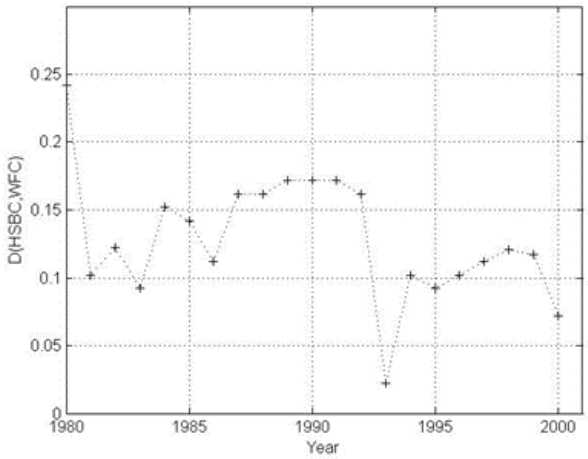

Fig. 2 Distance of ROE between HSBC and WFC

As for HSBC and WFC, the similarity on ROE curves in Fig.1 is shown as Fig.2. From Eqn.(1), it can be found that in 1993 the Euclidean distance from HSBC and WFC is the minimum. That is to say, taken 1993 as the central year the curve of WFC ROEs from 1979 to 2008 is the most similar to that of HSBC ROEs from 1987 to 2016.

The graphs of Euclidean distance between BCM and WFC is shown as Fig.3, and that between CMSB and WFC is shown as Fig.4. In Fig.3, there are four minimum Euclidean distance values occurring in 1976, 1995, 2006 and 2008, respectively. These four central years indicate four time periods such as from 1970 to 1982, 1989 to 2001, 2000 to 2012, 2002 to 2014. The average ROE values of WFC within these four time periods are 13.3, 14.4, 13.8 and 13.7, respectively. The result from Fig.3 shows that the ROE curve of BCM company within 2004 and 2016 is in concord with that of WFC from 1989 to 2001.

From Fig.4, in 1986 and 1993 the Euclidean distance of ROEs between CMSB and WFC is the minimum, which indicates from 1980 to 1993 and from 1987 to 2000 two time periods the ROE values of WFC coincide with ROEs of CMSB from 2003 to 2016.

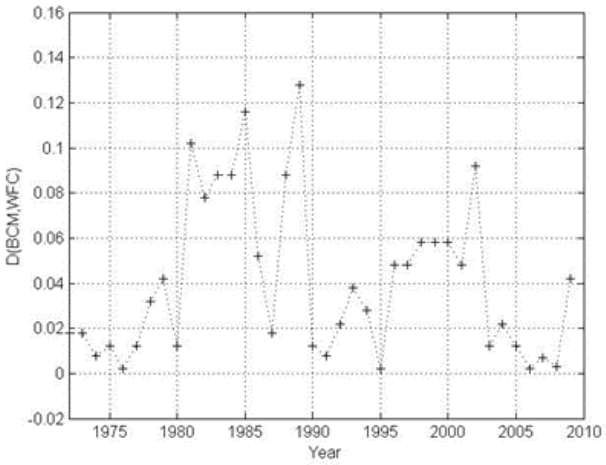

Fig. 3 Distance of ROE between BCM and WFC

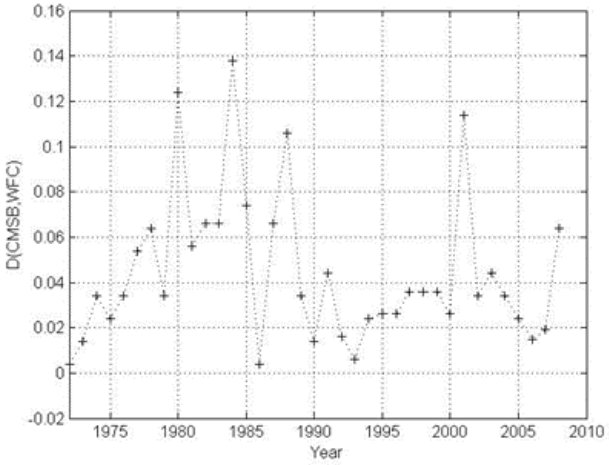

Fig.4 Distance of ROE between CMSB and WFC

B. Overall Labor Productivity

From the literature[2-5], four groups of OLP values of WFC, HSBC, BCM and CMSB companies are obtained within time periods from 1966, 1992, 2004, 2005 to 2016, respectively. The graphs of OLPs among WFC, HSBC, BCM and CMSB are shown as Fig.5. In which, the unit of OLP of BCM and CMSB is converted into U.S. dollars/person based on the exchange rate of RMB against the U.S. dollar[6].

From Fig.5, it can be found that the average value of WFC OLPs from 1966 to 2016 is 16.3 tens of thousand dollars/person. If we calculate the mean value from 1980 to 2016, the result would be 20.2 tens of thousand dollars/person. As for HSBC, the average value of OLPs from 1992 to 2016 is 16.8 tens of thousand dollars/person. From 2004 to 2016 and from 2005 to 2016, the average OLPs of BCM and CMSB are 19.3 and 30.8 tens of thousand dollars/person, respectively.

By Eqn.(1) the calculation results for Euclidean distance of OLPs among WFC, HSBC, BCM and CMSB are shown from Fig.6 to Fig.8. In Fig.6, it is in 1979 that the Euclidean distance of OLPs between HSBC and WFC has the minimum value, which indicates that the curve of OLPs of WFC from 1967 to 1991 is the most similar to that of HSBC from 1992 to 2016. Moreover, from Fig.5 the average value of OLPs of WFC from 1967 to 1991 is 12.5 tens of thousand dollars/person.

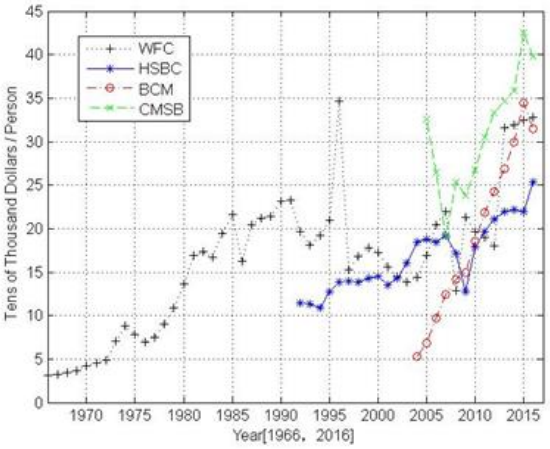

Fig.5 OLPs of WFC, HSBC, BSM and CMSB

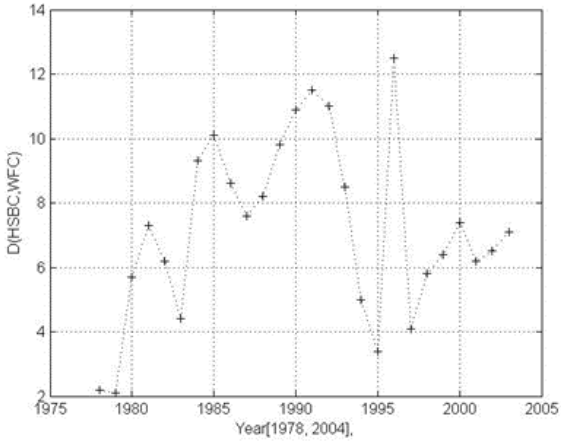

Fig.6 Distance of OLP between HSBC and WFC

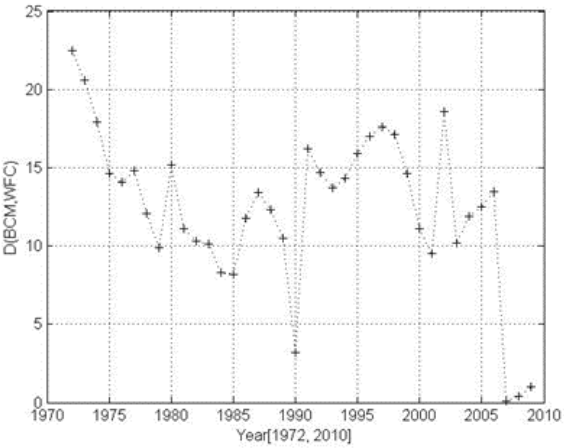

Fig.7 Distance of OLP between BCM and WFC

From Fig.7, it can be found that in 2007, 2008 and 2009 the Euclidean distance of each year is much smaller than those of other years, in which in 2007 the Euclidean distance is near to zero, indicating within time period from 2001 to 2013 the OLPs of WFC are close to the OLPs of BCM between 2004 and 2016. From Fig.5, the average value of WFC OLPs from 2001 to 2013 is 18.5 tens of thousand dollars/person, closing to 19.3 tens of thousand dollars/person of CMSB OLP mean value from 2005 to 2016. In Fig.8, the Euclidean distance of OLPs between CMSB and WFC has the minimum value in 1991, which shows that the OLPs of WFC from 1986 to 1997 are in concord with the OLPs of CMSB from 2005 to 2016. And from Fig. 5, the mean value of WFC OLPs from 1986 to 1997 is 21.2 tens of thousand dollars/person.

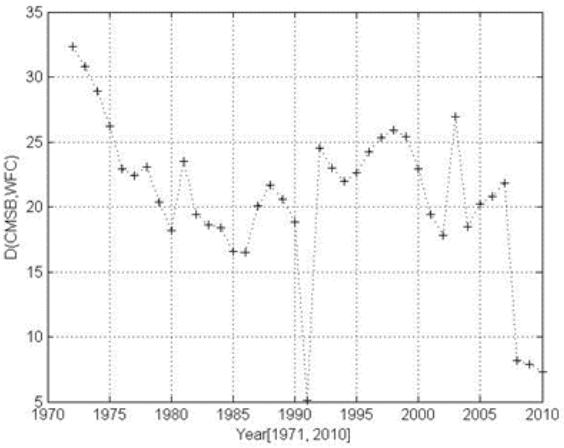

Fig.8 Distance of OLP between CMSB and WFC

IV. SUMMATION

From ROE and OLP points of view, two conclusions would be drawn. First, the operating performance of HSBC, BCM and CMSB are largely in concord with that of WFC from 1980 to 2010 period. In detail, the life circle of HSBC nowadays matches that of WFC from 1979 to 2008, BCM and CMSB largely match WFC within time period from 1986 to 1997. Secondly, the measures of HSBC were slightly poorer than those of WFC, while BCM and CMSB were better than WFC in the time period above. These points maybe verified by comparison for other financial characteristics such as saving ratio(SR), non-performing loan ratio(NPLR) and capital adequacy ratio(CAR), et al, which shows the revision path of this paper.

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An Assessment of Digital Platforms, Student Online Learning, Teaching Pedagogies, Research and Training at Kenya College of Accounting University (KCA)

Jasmine Renner, Alice Njuguna

Abstract**—**The booming technological revolution is driving a change in the mode of delivery systemss especailly for elearning and distance learning in higher education. The report and findings of the Study; *An Assessment of Digital Platforms, Student Online learning, Teaching Pedagogies, Research* and Training at Kenya College of Accounting University (hereinafter "KCA") was undertaken as a joint collaboration project between the Carnegie African Diaspora Fellowship and input from the staff, students and faculty at KCA university. The participants in this assessment/research met for selected days during a six-week period during which one-one consultations, surveys, questionnaires, foci groups, training, and seminars were conducted to ascertain "Online Learning and Teaching, Curriculum Development, Research and Training at KCA."

The project was organized into an eight-week project work flow with each week culminating in project activities designed to assess digital online teaching and learning at KCA. The project also included the training of distance learning instructors at KCA and the evaluation of KCA's distance platforms and programs. Additionally, through a curriculum audit and redesign, the project sought to enhance the curriculum development activities related to of distance learning at KCA. The findings of this assessment/research represents the systematic deliberate process of gathering, analyzing and using data collected from DL students, DL staff and lecturers and a librarian personnel in charge of online learning resources and access at KCA. We engaged in one-on-one interviews and discussions with staff, students and faculty and collated the findings to inform practices that are effective in the ongoing design and development of eLearning earning at KCA University.

Overall findings of the project led to the following recommendations. First, there is a need to address infrastructural challenges that led to poor internet connectivity for online learning, training needs and content development for faculty and staff. Second, there is a need to manage cultural impediments within KCA; for example fears of vital change from one platform to another for effectiveness and *Institutional goodwil*l as a vital promise of effective online learning. Third, at a practical and short-term level, the following recommendations based on systematic findings of the research conducted were as follows: There is a need for the following to be adopted at KCA University to promote the effective adoption of online learning: a) an eLearning compatible faculty lab, b) revision of policy to include an *eLearn strategy* or strategic management, c) faculty and staff recognitions engaged in the process of training for the adoption and implementation of eLearning and d) adequate website resources on eLearning.

The report and findings represent a comprehensive approach to a systematic assessment of Online Learning and Teaching, Research and Training at KCA.

Keywords**—**eLearning, Digital Platforms, Student online learning, Online Teaching Pedagogies.

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Nuclear Terrorism and Proliferation: A Conceptual Clarification

Uche A. Nnawulezi

Abstract—This paper analyzes the advancing nature of nuclear terrorism and proliferation in the global environment and its attendant impacts. It analyzes discourse and practice with respect to the general prohibition on the utilization of fissionable radioactive materials. Thus, there has been a few ideological, reasonable and academic recommendations of policies aimed at eliminating nuclear weapons which its ultimate nightmare has remained an assault including nuclear explosion in densely populated urban areas. Likewise, this paper concentrates on safety measures aimed at preventing nuclear assaults which should not just concentrate on endeavors to prevent terrorists from exploding nuclear gadgets but should be more concerned on endeavors aimed at preventing the acquisition of nuclear weapons in the first place. The author of this paper has pointed out that the non-proliferation treaty should be vigorously supported as well as the Comprehensive Test Ban Treaty brought into force. This paper depended unequivocally on secondary sources, for example, textbooks, journals, articles, and periodicals. It concludes that the fundamental proposals made in this paper if completely used shall remain a cornerstone of efforts made in preventing the spread of nuclear weapons. At last, the only way is to eliminate stockpiles of nuclear weapons in the world or else the likelihood of nuclear terrorism remains a nightmare.

Keywords—nuclear, terrorism, proliferation, global environment

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Pathogenic Effects of IgG and IgM Apoptotic Cell-Reactive Monoclonal Auto-Antibodies on Innate and Adaptive Immunity in Lupus

Monika Malik, Pooja Arora, Ruchi Sachdeva, Vishnampettai G. Ramachandran, Rahul Pal

***Abstract*—**Apoptotic debris is believed to be the antigenic trigger in lupus. Whether such debris, and autoantibodies induced in lupus-prone mice which specifically recognize its constituents, can mediate differential effects on innate and humoral responses in such mice was assessed. The influence of apoptotic blebs and apoptotic cell-reactive monoclonal antibodies on phenotypic markers expressed on bone marrow-derived dendritic cells (BMDCs) and secreted cytokines was evaluated. Sera from lupus-prone and healthy mice immunized with the antibodies were analyzed for anti-self reactivity.

Apoptotic blebs, as well as somatically-mutated IgG and non-mutated IgM apoptotic-cell reactive monoclonal antibodies, induced the preferential maturation of BMDCs derived from lupus-prone mice relative to BMDCs derived from healthy mice; antibody specificity and cell genotype both influenced the secretion of inflammatory cytokines. Immunization of lupus-prone mice with IgM and IgG antibodies led to hypergammaglobulinemia; elicited antibodies were self-reactive, and exhibited enhanced recognition of lupus-associated autoantigens (dsDNA, Ro60, RNP68 and Sm) in comparison with adjuvant-induced sera. While "natural" IgM antibodies are believed to contribute to immune homeostasis, this study reveals that apoptotic cell-reactive IgM antibodies can promote inflammation and drive anti-self responses in lupus. Only in lupus-prone mice did immunization of IgG auto-antibodies enhance the kinetics of humoral anti-self responses, resulting in advanced-onset glomerulosclerosis. This study reveals that preferential innate and humoral recognition of the products of cell death in an autoimmune milieu influences the indices associated with lupus pathology.

***Keywords*—**Antigen spreading, Apoptotic cell-reactive pathogenic IgG and IgM autoantibodies, Glomerulosclerosis, Lupus.

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Identifying Reforms Required in Construction Contracts from Resolved Disputed Cases

K. C. Iyer, Yogita Manan Bindal, Sumit Kumar Bakshi

***Abstract*—**Construction industry is plagued with disputes and litigation in India with many stalled projects seeking dispute resolution. This has an adverse effect on the performance and overall project delivery and impacts future investments within the industry. While construction industry is the major driver of growth, there has not been major reforms in the government construction contracts. The study is aimed at identifying the proactive means of dispute avoidance, focusing on reforms required within the construction contracts, by studying 49 arbitration awards of construction disputes. The claims presented in the awards are aggregated to study the causes linked to the contract document and are referred against the prospective recommendation and practices as surveyed from literature review of research papers. Within contract administration, record keeping has been a major concern as they are required by the parties to substantiate the claims or the counterclaims and therefore are essential in any dispute redressal process. The study also observes that the right judgment is inhibited when the record keeping is improper and due to lack of coherence between documents, the dispute resolution period is also prolonged. The finding of the research will be relevant to industry practitioners in contract drafting with a view to avoid disputes.

***Keywords*—**Construction contract, Contract administration, Contract management, Dispute avoidance.

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Urban Design as a Tool in Disaster Resilience and Urban Hazard Mitigation: Case of Cochin, Kerala, India

Vinu Elias Jacob, Manoj Kumar Kini

***Abstract*—**Disasters of all types are occurring more frequently, and are becoming more costly than ever due to various manmade factors including climate change. A better utilisation of the concept of governance and management within disaster risk reduction is inevitable and of utmost importance.

There is a need to explore the role of pre and post-disaster public policies. The role of urban planning/design in shaping the opportunities of households, individuals and collectively the settlements for achieving recovery has to be explored. Governance strategies that can better support the integration of disaster risk reduction and management has to be examined. The main aim is to thereby build the resilience of individuals and communities and thus the states too.

Resilience is a term that is usually linked to the fields of disaster management and mitigation, but today has become an integral part of planning and design of cities. Disaster resilience broadly describes the ability of an individual or community to "bounce back" from disaster impacts, through improved mitigation, preparedness, response, and recovery.

The growing population of the world has resulted in the inflow and use of resources, creating a pressure on the various natural systems and inequity in the distribution of resources. This makes cities vulnerable to multiple attacks by both natural and man-made disasters.

Each urban area need elaborate studies and study based strategies to proceed in the discussed direction. Cochin in Kerala is the fastest and largest growing city with a population of more than 26 lakhs. The main concern that has been looked into in this paper is making cities resilient by designing a framework of strategies based on urban design principles for an immediate response system especially focussing on the city of Cochin, Kerala, India.

The paper discusses, understanding the spatial transformations due to disasters and the role of spatial planning in the context of significant disasters. The paper also aim in developing a model taking into consideration of various factors such as land use, open spaces, transportation networks, physical and social infrastructure, building design and density and ecology that can be implemented in any city of any context.

Guidelines are made for the smooth evacuation of people through hassle free transport networks, protecting vulnerable areas in the city, providing adequate open spaces for shelters and gatherings, making available basic amenities to affected population within reachable distance, etc. by using the tool of urban design. Strategies at the city level and neighbourhood level have been developed with inferences from vulnerability analysis and case studies.

***Keywords*—**Disaster management, resilience, spatial planning, spatial transformations.

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Neuroprotective Effect of Chrysin on Thioacetamide-Induced Hepatic Encephalopathy in Rats: Role of Oxidative Stress and TLR-4/NF-κB Pathway

S. A. El-Marasy, S. A. El Awdan, R. M. Abd-Elsalam

Abstract**—**This study aimed to investigate the possible neuroprotective effect of chrysin on thioacetamide (TAA)-induced hepatic encephalopathy in rats. Also the effect of chrysin on motor impairment, cognitive deficits, oxidative stress, neuroinflammation, apoptosis and histopathological damage was assessed. Male Wistar rats were randomly allocated into five groups. The first group received the vehicle (distilled water) for 21 days and is considered as normal group. While, the second one received intraperitoneal dose of TAA (200 mg/kg) at three alternative days during the third week of the experiment to induce HE and is considered as control group. The other three groups were orally administered chrysin for 21 days (25, 50, 100 mg/kg) and starting from day 17, rats received intraperitoneal dose of TAA (200 mg/kg) at three alternative days. Then behavioral, biochemical, histopathological and immunohistochemical analyses were assessed. Then behavioral, biochemical, histopathological and immunohistochemical analyses were assessed. Chrysin reversed TAA-induced motor coordination in rotarod test, cognitive deficits in object recognition test (ORT) and attenuated serum ammonia, hepatic liver enzymes, reduced malondialdehyde (MDA), elevated reduced glutathione (GSH), reduced nuclear factor kappa B (NF-κB), tumor necrosis factor-alpha (TNF-α) and Interleukin-6 (IL-6) brain contents. Chrysin administration also reduced Toll-4 receptor (TLR-4) gene expression, caspase-3 protein expression, hepatic necrosis and astrocyte swelling. This study depicts that chrysin exerted neuroprotective effect in TAA-induced HE rats, evidenced by improvement of cognitive deficits, motor incoordination and histopathological changes such as astrocyte swelling and vacuolization; hallmarks in HE, via reducing hyperammonia, ameliorating hepatic function, in addition to its anti-oxidant, inactivation of TLR-4/NF-κB inflammatory pathway, and anti-apoptotic effects.

Keywords**—**Chrysin, hepatic encephalopathy, oxidative stress, rats, thioacetamide, TLR4/NF-κB pathway.

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Risk Analysis of Flood Physical Vulnerability in Residential Areas of Mathare Nairobi, Kenya

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Abstract—Vulnerability assessment and analysis is essential to solving the degree of damage and loss as a result of natural disasters. Urban flooding causes a major economic loss and casualties, at Mathare residential area in Nairobi, Kenya. High population caused by rural-urban migration, Unemployment, and unplanned urban development are among factors that increase flood vulnerability in Mathare area. This study aims to analyse flood risk physical vulnerabilities in Mathare based on scientific data, research data that includes the Rainfall data, River Mathare discharge rate data, Water runoff data, field survey data and questionnaire survey through sampling of the study area have been used to develop the risk curves. Three structural types of building were identified in the study area, vulnerability and risk curves were made for these three structural types by plotting the relationship between flood depth and damage for each structural type. The results indicate that the structural type with mud wall and mud floor is the most vulnerable building to flooding while the structural type with stone walls and concrete floor is least vulnerable. The vulnerability of building contents is mainly determined by the number of floors, where households with two floors are least vulnerable, and households with a one floor are most vulnerable. Therefore more than 80% of the residential buildings including the property in the building are highly vulnerable to floods consequently exposed to high risk. When estimating the potential casualties/injuries we discovered that the structural types of houses were major determinants where the mud/adobe structural type had casualties of 83.7% while the Masonry structural type had casualties of 10.71% of the people living in these houses. This research concludes that flood awareness, warnings and observing the building codes will enable reduce damage to the structural types of building, deaths and reduce damage to the building contents.

Keywords—flood loss, Mathare Nairobi, risk curve analysis, vulnerability

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Development of Highly Sensitive Molecular Imprinted Sensor for Selective Detection of Chloramphenicol in Honey Samples

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***Abstract*—**Chloramphenicol (CAP) is a phenicol antibiotic, used to treat bacterial infections including meningitis, plague, cholera and typhoid fever in food animals. However, nowadays its use becomes prohibited in numerous countries. Despite ban, it still given surreptitiously as veterinary treatment, for it low cost and high efficiency when safer antibiotics cannot be used. This misuse leads to hazardous effects, which can seriously affect human health. Therefore, its spread in the food products has to be restricted. Herein, we aimed to develop a sensitive and very selective molecularly imprinted polymer (MIP) for CAP detection in honey samples. The synthesis of this sensor was carried out firstly by coating the gold working area of screen-printed electrode (Au-SPE) with a layer of carboxylate polyvinyl chloride (PVC-COOH) enable the covalent binding of analyte under mild conditions. Secondly, CAP as template molecule was bounded to the activated carboxylic groups and the MIP was performed by a biocompatible polyacrylamide matrix. CAP was detected by measurements of differential pulse voltammetry (DPV). The developed sensor displayed a high sensitivity when compared with the non-imprinted polymer (NIP), and a linear behavior between the regenerated current and the logarithmic concentrations from 0.1 $pg.mL^{-1}$ to 1000 $pg.mL^{-1}$. This technique was successfully applied to determine CAP residues in honey samples with a limit of detection (LOD) of 0.4 $pg.mL^{-1}$ and an excellent selectivity when compared to the results of interfering compound namely florphenicol (FAP). The proposed method is cheap, sensitive, selective and simple. It is applied successfully to detect CAP in honey with a recovery of 100.5 % and 99.8 % obtained with a relative standard deviation (RSD) less than 13 %. Considering these advantages, this system provides a new horizon for bio-sensing applications in industrial food control.

***Keywords*—**Chloramphenicol, Food control, Honey, MIP Sensors.

I. Introduction

Chloramphenicol (CAP) is an antibiotic characterized by inhibiting bacterial protein synthesis with a broad-spectrum bacteriostatic effect. Nevertheless, it has confirmed to have dangerous side effects on human health as aplastic anemia or grey-syndrome [1]. According to these health concerns, its use to treat food-producing animals has been banned within the European Union (EU 2010) and in many other countries, including the Australia, Canada, China, Japan and the United States [2]. Although, despite ban, its use still attractive in some countries, due to its low cost and high efficiency when safer antibiotics cannot be used. In the case of beekeeping, CAP still given to treat the most replied diseases for honeybees such as American foulbrood [3]. For this reason, the EU has defined a minimum required performance limit (MRPL) for CAP in products of animal origins at a level of 0.3 μg/kg [4].

A series of analytical methods have been used for CAP determination by high performance liquid chromatography [5], liquid chromatography tandem mass spectroscopy [6], Raman spectroscopy [7], DNA [8], photonic [9] and electrochemical [10] sensors. However, most of these methods are time consuming, solvent-usage intensive and expensive, which limit its use in quality control laboratories as pharmaceutical dosage forms. Recently, some studies involving immunochemical determination of CAP have also been reported [11], [12]. The principal advantage of this type of sensors is manifested in the high selectivity of the antibodies, but they remain very expensive product and non-reusable after their first contact with the target antigen. Hence, a new cheap materials able to mimic the role of antibodies, was been created.

These mimic's methods by means of molecular imprinting polymers (MIP), offer a clear advantages for sensor technology when compared with antibodies: due to their simple achievement, stability, reusability, low-cost, and simple selective binding sites in polymeric matrices [13], which provide a emergent promise for bio-sensing development in food analysis [14]. Until today, various MIPs for CAP detection was reported [15]–[17].

In this study, we describe the synthesis of a sensitive and very selective sensor based MIP for CAP detection in honey samples. Furthermore, this approach based on MIPs as electrochemical sensor has shown a great enhancement in the detection limit of CAP in real matrices such as honey.

II. Material and Method

Materials

Chloramphenicol (CAP), florphenicol (FAP), 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide (EDC), N-hydroxysuccinimide (NHS), poly(vinyl chloride) carboxylate (PVC-COOH), methanol, ethanol, 1,4 dioxane, phosphate buffered saline (PBS) , potassium hexacyanoferrate (II) $K_4[Fe(CN)_6]$, and (III) $K_3[Fe(CN)_6]$

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were all purchased from Sigma-Aldrich (France). Acrylamide (AAM), N,N-methylene-bisacrylamide (NNMBA), tetra-methyl-ethylene-diamine (TEMED) were provided from Fluka (Germany), ammonium persulphate (APS) from Scharlauchemie (Spain), acetic acid from Riedel-dehäen (Germany). Two commercial honey samples assured CAP-free were used for recovery study. Screen-printed gold electrodes (Au-SPE) were provided by Dropsens, Spain under the reference DRP-8X220AT.

Preparation of CAP imprinted polymer

Firstly, the Au-SPE was washed three times with ethanol, and then rinsed with ultra-pure water. Then, a film of PVC-COOH was achieved by deposing 4 µL of completely dissolved PVC-COOH (8.4 mg.mL^{-1}) in dioxane, the incubation of this film was let drying for 2 h at room temperature. The carboxylic groups were incubated for 2 h in an aqueous solution of EDC (50 mM) and NHS (25 mM). Afterword, a solution of 1 mg.mL^{-1} of CAP was casting on the activated carboxylic groups for 3 h at 4 °C. Next, the electrode was rinsed with PBS buffer (pH 7.4) to remove any unbound CAP. Polymerization step was carried out by casting on the surface of Au-SPE a mixture of AAM (1 M), NNMBA (0.07 M) as crosslinking agent and APS (0.06 M) as precursor, all prepared in PBS (pH 7.4), in the presence of TEMED (5 %). The polymerization reaction was performed overnight in room temperature. After washing with deionized water, the CAP template was extracted from the polymer by a mixture of methanol and acetic acid (7:3 (v/v)) for 10 min. The developed sensor based MIP was ultimately ready to use for CAP recognition after washing with ultra-pure water.

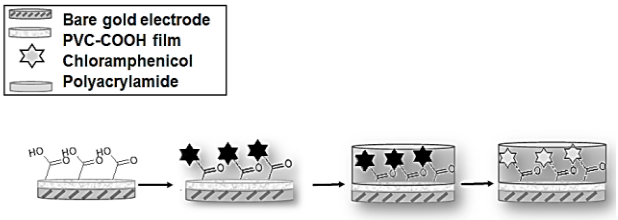

Fig. 1 Synthesis steps of CAP imprinted polymer

Electrochemical measurements

The electrochemical measurements were performed by cyclic voltammetry (CV) scanned between −0.4 V and +0.6 V at a scan rate of 30 mV.s^{-1} and by differential pulse voltammetry (DPV) in the potential range from −0.1 V to +0.2 V with a scan rate of 10 mV.s^{-1} in a solution of 5.0 mM $[Fe(CN)_6]^{3-/4-}$ prepared in PBS buffer (pH 7.4).

III. RESULT AND DISCUSSION

Electrochemical characterization of the developed MIP sensor

Cyclic voltammetry assay was used in order to confirm the surface modification of electrodes. As can be identified in Fig. 2, there is a relationship between peak current and all steps of Au-SPE surface modification. In the inset of Fig. 2, we can observe that the application of PVC-COOH film on bare gold electrode surface produce a decrease in the electron transfer process noticed by the high peak-to peak potential over the Au-SPE. After CAP binding on the Au-SPE/PVC-COOH surface, an increase of peak current was also observed. Afterword, the polymerization of AAM toward poly AAM on the modified electrode surface, shows a small increase of current, which reveal the conducting behavior of the forming CAP-PolyAAM matrix.

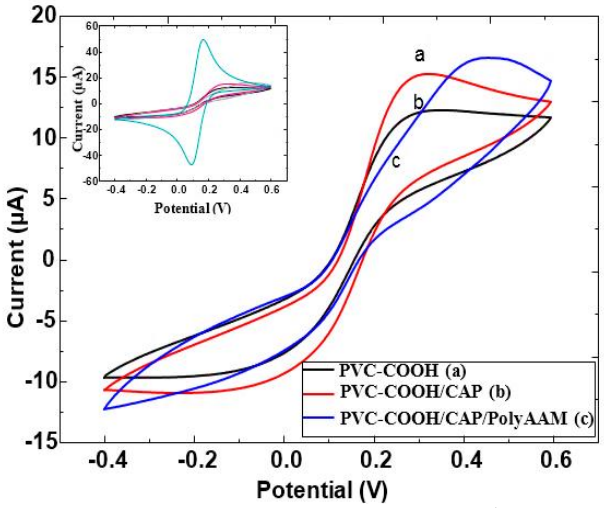

Fig. 2 Cyclic voltammograms of 5 mM $[Fe(CN)_6]^{3-/4-}$ at Au-SPE electrode after: (a) PVC-COOH deposition, (b) CAP- binding (c), AAM polymerization. Scan rate, 50 mV/s. Inset: Cyclic voltammograms taking into account that of the bare Au-SPE

Detection of CAP by MIP sensor

The detection of CAP on the prepared MIP sensor was performed with different concentrations solutions from 0.1 pg.mL^{-1} to 1000 pg.mL^{-1}. The obtained differential pulse voltammograms were presented in Fig. 3 (a). We can observe that the increase of CAP concentrations leads to a decrease of peak current associated to the oxidation potential of $[Fe(CN)_6]^{3-/4-}$, which illustrate the cavity filling by the specific template. A non-imprinted polymer (NIP) was also performed without use of template molecule, in order to investigate the sensor sensitivity. Fig. 3 (b) represent the differential pulse voltammograms of the oxidation peaks, revealing the non-sensitivity of NIP material, which explain the non-formation of specific sites capable to recognize CAP. Fig. 3 (c) shows the calibration curves represented by a linear correlation between the variation of peak currents and its related logarithmic concentration for MIP and NIP sensors. The linearity of both plots was explained by the coefficient of determination (R^2) of 0.999 and 0.996 for MIP and NIP respectively. Furthermore, the high sensitivity of MIP was expressed by its high slope compared to the NIP one, explaining that the electrochemical behavior of MIP sensor is not depending to the non-specific reaction between polyacrylamide and CAP. The limit of detection (LOD) for this system was expected to be 0.4 pg.mL^{-1}. It is interesting to highlight that this LOD is 750 times lower than the MRPL of CAP fixed by the EU.

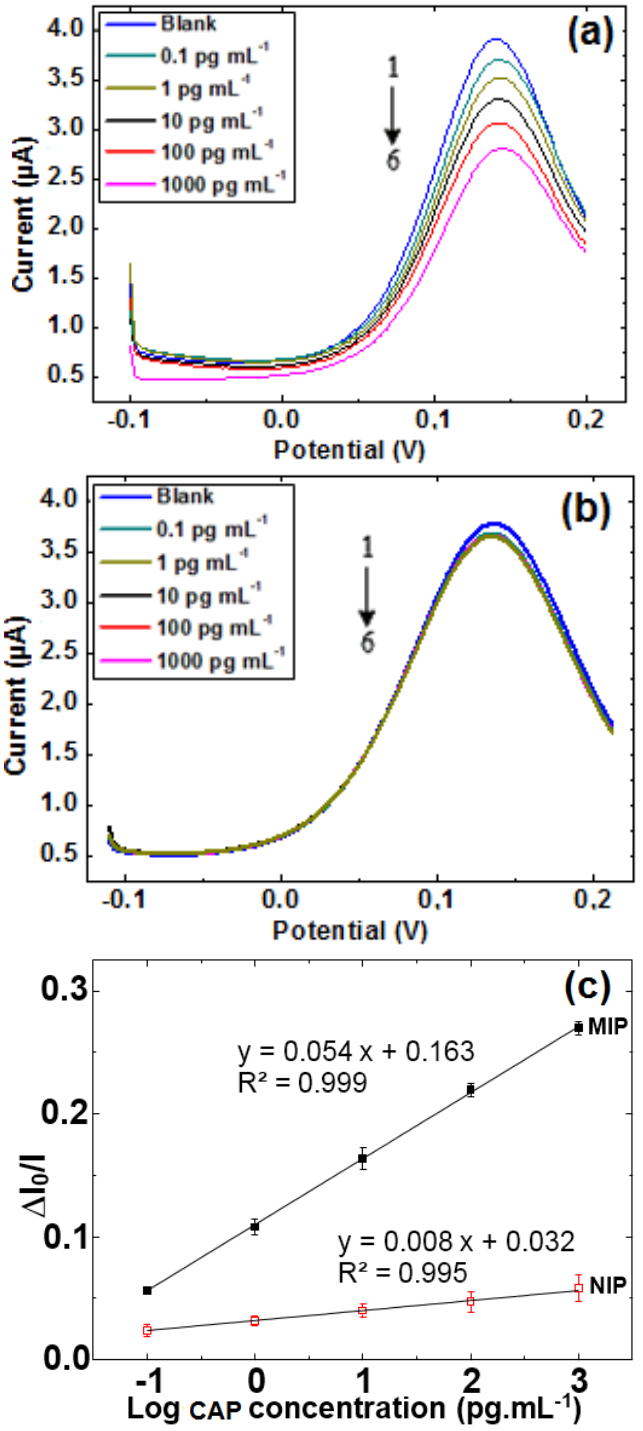

Fig. 3 Differential pulse voltammograms for CAP detection at the five concentrations on (a): MIP and (b): NIP sensors and (c) the related calibration curves obtained

Selectivity study

The selectivity of this study was performed by incubating the fabricated CAP sensor with different concentrations of florphenicol (FAP) as interfering specie with a chemical formula close of that of CAP (Fig. 4).

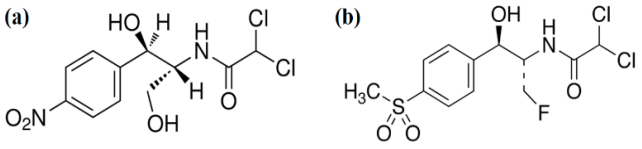

Fig. 4 Chemical structure of (a) Chloramphenicol, and (b) Florphenicol

As can be seen in Fig. 5, the generated current from this compound was negligible, which explain the ability of this system to reveal the slight variation in the chemical structure of the interfering compounds. This indicates that the synthetized sensor based MIP represent an excellent selectivity for CAP detection and can offer credible signal in the presence of interfering specie.

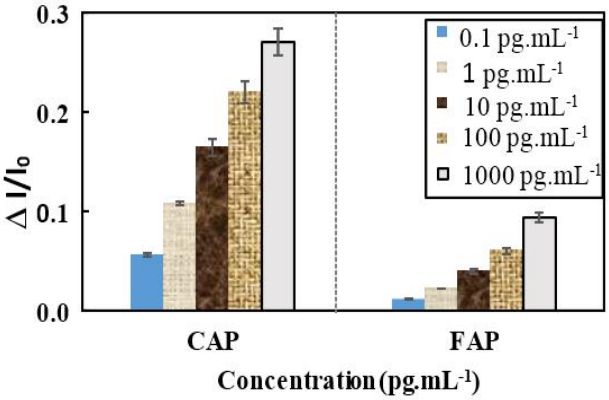

Fig. 5 Selectivity diagram for MIP system in the presence of CAP and its interferent FAP using DPV measurements

Recovery study

The applicability of the developed sensor based MIP for honey quality control, was performed by a spiking method realized as follow: 1 g of honey was dissolved in 1 mL of PBS buffer (pH = 7.4) under magnetic stirring. Then diluted to a ratio of 1:10 (v/v) and filtered through a 0.8 µm cellulose acetate filter. Next, the sample was spiked with known amounts of CAP standard solutions at: 10 pg.mL^{-1} and 100 pg.mL^{-1} and measurements were performed by DPV as described before. Table 1 recapitulate the MIP sensor results of CAP detection in spiked honey sample. Recoveries of 100.5 % and 99.8 % were obtained, with a relative standard deviation coefficient (RSD) of 12.2 % and 11.1 %. It was demonstrated that the method was adequate for the total content determination of CAP in real matrix such as honey samples.

TABLE I
DETERMINATION OF CAP IN SPIKED HONEY SAMPLES

Added (pg.mL^{-1})	Found (pg.mL^{-1})	Recovery (%)	RSD (%)
10.0	10.1	100.5	12.2
100.0	98.8	99.8	11.1

IV. CONCLUSION

A molecular imprinted polymer based on Au-SPE was synthetized and used to detect CAP residues in honey samples. This MIP based sensor presented a high detection ability to CAP when compared to the non-imprinted material with a remarkable selectivity for CAP than other analogous molecules. The detection limit of the developed technique was found to be 0.4 pg.mL^{-1} with recoveries of 99.8 % and 100.5 %. Therefore, the present sensor have a good sensitivity, selectivity, and accuracy, which allow it to be used in honey quality control.

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Social Mobility and Urbanization: Case Study of Well-Educated Urban Migrant's Life Experience in the Era of China's New Urbanization Project

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Abstract—Since the financial crisis of 2008 and the resulting Great Recession, the number of China's unemployed college graduate reached over 500 thousand in 2011. Following the severe situation of college graduate employment, there has been growing public concern about college graduates, especially those with the less-privileged background, and their working and living condition in metropolises. Previous studies indicate that well-educated urban migrants with less-privileged background tend to obtain temporary occupation with less financial income and lower social status. Those vulnerable young migrants are described as 'Ant Tribe' by some scholars. However, since the implementation of a new urbanization project, together with the relaxed Hukou system and the acceleration of socio-economic development in middle/small cities, some researchers described well-educated urban migrant's situation and the prospect of upward social mobility in urban areas in an overly optimistic light. In order to shed more lights on the underlying tensions encountered by China's well-educated urban migrants in their upward social mobility pursuit, this research mainly focuses on 10 well-educated urban migrants' life trajectories between their university-to-work transition and their current situation. All selected well-educated urban migrants are young adults with rural background who have already received higher education qualification from first-tier universities of Wuhan City (capital of Hubei Province). Drawing on the in-depth interviews with 10 participants and Inspired by Lahire's Theory of Plural Actor, this study yields the following preliminary findings; 1) For those migrants who move to super-mega cities (i.e., Beijing, Shenzhen, Guangzhou) or stay in Wuhan after college graduation, their inadequacies of economic and social capital are the structural factors which negatively influence their living condition and further shape their plan for career development. The incompatibility between the sub-fields of urban life and the disposition, which generated from their early socialization, is the main cause for marginalized position in the metropolises. 2) For those migrants who move back to middle/small cities located in their hometown regions, the inconsistency between the disposition, which generated from college life, and the organizational habitus of the workplace is the main cause for their sense of 'fish out of water', even though they have obtained the stable occupation of local government or state-owned enterprise. On the whole, this research illuminates how the underlying the structural forces shape well-educated urban migrants' life trajectories and hinder their upward social mobility under the context of new urbanization project.

Keywords—life trajectory, social mobility, urbanization, well-educated urban migrant

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Characterization of Waste Thermocol Modified Bitumen (WTMB) by Spectroscopy, Microscopic Technique, and Dynamic Shear Rheometer

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***Abstract*—**The global production of thermocol increasing day by day, due to vast applications of use of thermocole in many sectors. Thermocol being non-biodegradable and more toxic than plastic leads towards number of problems like its management into value added products, environmental damage and landfill problems due to weight to volume ratio. Utilization of waste thermocol for modification of bitumen binders resulted in waste thermocol modified bitumen (WTMB) used in road construction and maintenance technology. Modification of bituminous mixes through incorporating thermocol into bituminous mixes through dry process is a one of the new option besides recycling process which consumes lots of waste thermocol. This process leads towards waste management and remedies against thermocol waste disposal.

The present challenge is to dispose the thermocol waste under different forms in road infrastructure, either through dry process or wet process to be developed in future. This paper focuses on the use of thermocol wastes which is mixed with VG 10 bitumen in proportions of 0.5%, 1%, 1.5% and 2% by weight of bitumen. The physical properties of neat bitumen are evaluated and compared with modified VG 10 bitumen having thermocol. Empirical characterization like penetration, softening and Viscosity of bitumen has been carried out. Thermocol and waste thermocol modified bitumen (WTMB) were further analyzed by Fourier Transform Infrared Spectroscopy (FT-IR), Field emission scanning electron microscopy (FESEM) and Dynamic Shear Rheometer (DSR).

***Keywords*—**Thermocol wastes, FT-IR, FESEM, DSR.

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Cycleloop Personal Rapid Transit: An Exploratory Study for Last Mile Connectivity in Urban Transport

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Abstract—In this paper, author explores for most sustainable last mile transport mode addressing present problems of traffic congestion, jams, pollution and travel stress. Development of energy-efficient sustainable integrated transport system(s) is/are must to make our cities more livable. Emphasis on autonomous, connected, electric, sharing system for effective utilization of systems (vehicles and public infrastructure) is on the rise. Many surface mobility innovations like PBS, Ride hailing, ride sharing, etc. are, although workable but if we analyze holistically, add to the already congested roads, difficult to ride in hostile weather, causes pollution and poses commuter stress. Sustainability of transportation is evaluated with respect to public adoption, average speed, energy consumption, and pollution. Why public prefer certain mode over others? How commute time plays a role in mode selection or shift? What are the factors play-ing role in energy consumption and pollution? Based on the study, it is clear that public prefer a transport mode which is exhaustive (i.e., less need for interchange – network is widespread) and intensive (i.e., less waiting time - vehicles are available at frequent intervals) and convenient with latest technologies. Average speed is dependent on stops, number of intersections, signals, clear route availability, etc. It is clear from Physics that higher the kerb weight of a vehicle; higher is the operational energy consumption. Higher kerb weight also demands heavier infrastructure. Pollution is dependent on source of energy, efficiency of vehicle, average speed. Mode can be made exhaustive when the unit infrastructure cost is less and can be offered intensively when the vehicle cost is less. Reliable and seamless integrated mobility till last ¼ mile (Five Minute Walk-FMW) is a must to encourage sustainable public transportation. Study shows that average speed and reliability of dedicated modes (like Metro, PRT, BRT, etc.) is high compared to road vehicles. Electric vehicles and more so battery-less or 3rd rail vehicles reduce pollution. One potential mode can be Cycleloop PRT, where commuter rides e-cycle in a dedicated path – elevated, at grade or underground. e-Bike with kerb weight per rider at 15 kg being 1/50th of car or 1/10th of other PRT systems makes it sustainable mode. Cycleloop tube will be light, sleek and scalable and can be modular erected, either on modified street lamp-posts or can be hanged/suspended between the two stations. Embarking and dis-embarking points or offline stations can be at an interval which suits FMW to mass public transit. In terms of convenience, guided e-Bike can be made self-balancing thus encouraging driverless on-demand vehicles. e-Bike equipped with smart electronics and drive controls can intelligently respond to field sensors and autonomously move reacting to Central Controller. Smart switching allows travel from origin to destination without interchange of cycles. DC Powered Batteryless e-cycle with voluntary manual pedaling makes it sustainable and provides health benefits. Tandem e-bike, smart switching and Platoon operations algorithm options provide superior through-put of the Cycleloop. Thus Cycleloop PRT will be exhaustive, intensive, convenient, reliable, speedy, sustainable, safe, pollution-free and healthy alternative mode for last mile connectivity in cities.

Keywords—cycleloop PRT, five-minute walk, lean modular infrastructure, self-balanced intelligent e-cycle

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Building Resilience: A Critical Framework for Greater Bay Area Sustainable Development

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***Abstract*—**Resilience as a goal of climate responsive design presents new challenges to architects. Their responsibilities for the increasingly risk-prone Greater Bay Area (GBA) are critical. The concept of adaptive resilience is coined in post-hazard protocols evaluating the ability and capacity of systems to persist. However, debate arises between engineering resilience and ecological resilience. According to Gunderson (2000), this engineering perspective is inadequate for design because of the assumption on a system at equilibrium. Nonetheless, ecosystems in natural settings do not have single equilibria with functions monitored at proximity. Holling (1973) argued from an ecological perspective that resilience as the "ability of a system to return to equilibrium after a temporary disturbance." Resilience is not bound to the ability to 'spring back', but to absorb shock, and change through renewal, reorganization, and adaptation. Urban researchers Laboy & Fannon (2016) similarly applied this theory to the built environment. They agreed that "architecture are neither stable nor resilient, washed by tides of ecological deterioration, cultural devaluation, and disinvestment." Hence, the integration of knowledge with public engagement and adaptive designs is vital to achieve resilience in GBA. An integrative framework is determinate to address urban vulnerability. Flynn (2016) characterizes urban vulnerability as islands of resilience awash in a sea of fragility. He recognized that architecture is not mere physical building, but as a network of systems. Cultural values and design theories distinguish architecture from buildings. Hence, Robustness, Redundancy, and Resourcefulness in the engineering perspective are basic, yet limited. Additional of Risk Avoidance, Rapidity, and Recovery prior and after the event, thus, are keys for systems of different scales in transfer the state of equilibria in creating opportunities and advancing preparation.

Understanding adaptive resilience as a network of systems, the objective is to bridge the gap at the interface of building and neighborhood scale. This paper would analytically compare and contrast the best practices in GBA on ecological resilience at the building, neighborhood, and regional scale. Firstly, in the context of mega cities like GBA, risky locations such as seacoast and floodplains confer important benefits. The buildable land, well-appointed sites for collection, and transshipment of goods set GBA apart from land-locked regions. Initial development took advantage of available safe site, but subsequent growth spills over to high-risk areas. Secondly, new development implies paving over water-sheds reduces infiltration, speeds runoff, and increases flood volumes. The impact of creating condition for disaster is highly visible, but it is also an opportunity for implementing risk avoidance strategies, like blue-green infrastructure, to enhance resilience. Lastly, mega-cities escalate the disaster potential by concentrating people and investments. The disproportionate amount of material wealth is bound up in the built environment. Historic typhoons inflicted billions of properties damage in GBA which took weeks to resume. Harnessing inter-city resources, by investing rapidity, can better prepare back-up and enhance restoration. In conclusion, this paper would propose a potential road map of how resilience as dynamic design strategy can tackle the climatic and geographical characteristics of GBA socially, environmentally, and economically for a sustainable future.

***Keywords*—**Communities, Ecological Resilience, Governance and Leadership Integrative Design Framework, Mega-cities, Resilience Cities, Sustainable Urban Development.

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Towards the Need of Resilient Design and Its Assessment in South China

Alan Lai, Wilson Yik

Abstract—With rapid urbanization, there has been a dramatic increase in global urban population in Asia and over half of population in Asia will live in urban regions in the near future. Facing with increasing exposure to climate-related stresses and shocks, most of the Asian cities will very likely to experience more frequent heat waves and flooding with rising sea levels, particularly the coastal cities will grapple for intense typhoons and storm surges. These climate changes have severe impacts in urban areas at the costs of infrastructure and population, for example, human health, wellbeing and high risks of dengue fever, malaria and diarrheal disease. With the increasing prominence of adaptation to climate changes, there have been changes in corresponding policies. Smaller cities have greater potentials for integrating the concept of resilience into their infrastructure as well as keeping pace with their rapid growths in population. It is therefore important to explore the potentials of Asian cities adapting to climate change and the opportunities of building climate resilience in urban planning and building design. Furthermore, previous studies have mainly attempted at exploiting the potential of resilience on a macro-level within urban planning rather than that on micro-level within the context of individual building. The resilience of individual building as a research field has not yet been much explored. Nonetheless, recent studies define that the resilience of an individual building is the one which is able to respond to physical damage and recover from such damage in a quickly and cost-effectively manner, while maintain its primary functions. There is also a need to develop an assessment tool to evaluate the resilience on building scale which is still largely uninvestigated as it should be regarded as a basic function of a building. Due to the lack of literature reporting metric for assessing building resilience with sustainability, the research will be designed as a case study to provide insight into the issue. The aim of this research project is to encourage and assist in developing neighborhood climate resilience design strategies for Hong Kong so as to bridge the gap between difference scales and that between theory and practice.

Keywords—resilience cities, building resilience, resilient buildings and infrastructure, climate resilience, hot and humid southeast area, high-density cities

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Feasibility Study and Experiment of On-Site Nuclear Material Identification in Fukushima Daiichi Fuel Debris by Compact Neutron Source

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***Abstract*—**After the Fukushima Daiichi nuclear power reactor incident, there are a lot of unaccountable nuclear fuel debris in the reactor core area, which are subject of safeguard and criticality safety. Before the actual precise analysis is performed, preliminary on-site screening and mapping of nuclear debris activity needs to be performed to provide a reliable data in the nuclear debris mass-extraction planning. Through a collaboration project with Japan Atomic Energy Agency, an on-site nuclear debris screening system by using dual energy X-Ray inspection and neutron energy resonance analysis has been established. By using the compact and mobile pulsed neutron source constructed from 3.95 MeV X-Band electron linac, coupled with Tungsten as electron-to-photon converter and Beryllium as photon-to-neutron converter, short-distance neutron Time of Flight measurement can be performed. Experiment result show this system can measure neutron energy spectrum up to 100 eV range with only 2.5 meters Time of Flight path in regards to the X-Band accelerator's short pulse. With this, on-site neutron Time of Flight measurement can be used to identify the nuclear debris isotope contents through Neutron Resonance Transmission Analysis (NRTA). Some preliminary NRTA experiments has been done with Tungsten sample as dummy nuclear debris material, which isotope Tungten-186 has close energy absorption value with Uranium-238 (15 eV). The results obtained shows that this system can detect energy absorption in the resonance neutron area within 1-100 eV. It can also detect multiple elements in a material at once with the experiment using a combined sample of Indium, Tantalum, and silver, makes it feasible to identify debris containing mixed material. This compact neutron Time of Flight measurement system is a great complementary for dual energy X-Ray CT method that can identify atomic number quantitatively but with 1-mm spatial resolution and high error bar. Combination between these two measurement methods will able to perform on-site nuclear debris screening at Fukushima Daiichi reactor core area, providing the data for nuclear debris activity mapping.

***Keywords*—**Neutron source, neutron resonance, nuclear debris, time of flight.

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Participation in IAEA Proficiency Test to Analyse Cobalt, Strontium and Caesium in Seawater Using Direct Counting and Radiochemical Techniques

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***Abstract*—**Radiation monitoring in the environment and foodstuffs is one of the main responsibilities of Office of Atoms for Peace (OAP) as the nuclear regulatory body of Thailand. The main goal of the OAP is to assure the safety of the Thai people and environment from any radiological incidents. Various radioanalytical methods have been developed to monitor radiation and radionuclides in the environmental and foodstuff samples. To validate our analytical performance, several proficiency test exercises from the International Atomic Energy Agency (IAEA) have been performed. Here, the results of a proficiency test exercise referred to as the Proficiency Test for Tritium, Cobalt, Strontium and Caesium Isotopes in Seawater 2017 (IAEA-RML-2017-01) are presented. All radionuclides excepting ^{3}H were analysed using various radioanalytical methods, i.e. direct gamma-ray counting for determining ^{60}Co, ^{134}Cs and ^{137}Cs and developed radiochemical techniques for analysing ^{134}Cs, ^{137}Cs using AMP pre-concentration technique and ^{90}Sr using di-(2-ethylhexyl) phosphoric acid (HDEHP) liquid extraction technique. The analysis results were submitted to IAEA. All results passed IAEA criteria, i.e. accuracy, precision and trueness and obtained 'Accepted' statuses. These confirm the data quality from the OAP environmental radiation laboratory to monitor radiation in the environment.

***Keywords*—**International atomic energy agency, proficiency test, radiation monitoring, seawater.

I. Introduction

RADIATION monitoring with reliable data and good data quality is critical to determine radiation and radionuclides in the environment for the assessment of the radiological impact and the risk to the public and environment. Especially, during a nuclear emergency situation, it is important to accurately determine radiation contamination data for a proper determination of the risk assessment on the public and environment to protect the Thai population. The need for this was highlighted following the nuclear power plant accident which happened in Japan, Fukushima on March 2011, where radionuclides were released into the environment, i.e. the atmosphere, seawater, river and land [1]. The data and ability of OAP to accurately determine radioactive concentrations in environmental samples are not only important for the Thai people but also contribute towards international efforts to monitor the environment. The International Atomic Energy Agency (IAEA) is an inter phase organisation who is greatly concerned about radioactive data quality. It has therefore regularly conducted interlaboratory comparisons and proficiency tests on radionuclides in various samples. Since the Fukushima accident, it organised a new proficiency test (PT) in the frame of the IAEA Technical Cooperation project RAS/7/021 "Marine benchmark study on the possible impact of the Fukushima radioactive releases in the Asia-Pacific Region for Caesium Determination in Sea Water". Since then, the PT has been conducted annually.

The Office of Atoms for Peace (OAP) has a radiation monitoring laboratory to carry out a radiation surveillance program in Thailand. All data would be used to establishment a radiation baseline information and assessment of the radiological impact on the environment in the case of any incidents. These tests allow the OAP to validate the data quality of our procedures and to ensure an accurate estimation for any nuclear and radiation circumstances. We have participated in a number of PT exercises organized by the IAEA. Lastly, the OAP was one of 74 laboratories from countries from the Asia-Pacific Region who participated in the new exercise which was referred to as the Proficiency Test for Tritium, Cobalt, Strontium and Caesium Isotopes in Seawater 2017 (IAEA-RML-2017-01). The results presented here were for the OAP developed methodologies applied for the radionuclide analysis of ^{60}Co, ^{134}Cs, ^{137}Cs and ^{90}Sr. All participant results were published in the IAEA proficiency test report [2].

II. Experimental

A. PT Sample Description

The proficiency test sample was 5-L of seawater containing ^{3}H, ^{60}Co, ^{134}Cs, ^{137}Cs, and ^{90}Sr which was received from the IAEA. The sample was of unknown activity and was used as test case for the determination of its ^{60}Co, ^{134}Cs, ^{137}Cs and ^{90}Sr activities. The analysis results were submitted to the IAEA to evaluate accuracy and quality control. The PT sample is shown in Fig. 1.

Fig. 1 5-L proficiency test samples contained in plastic bottle

B. ^{60}Co Determination Method

Co-60 was determined by direct gamma-ray counting without further chemical treatment.

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1. Calibration Source

With mix radionuclide standard in 1-L cylinder shape bottle, Eckert and Ziegler Isotope Product No.1954-6-2, contained multinuclides covering energy range from 59.5409 keV to 1836.0520 keV were used for efficiency calibration for direct gamma-ray counting techniques.

2. Sample Preparation and Analysis

1-L aliquots were transferred to a 1-L bottle as the same geometry type as the calibration source.

3. Counting Equipment and Measurement Method

The gamma-ray spectrometry system, HPGe (Li) detector (CANBERRA) with MAESTRO software was used. The calibration source was used to calibrate counting efficiency. The sample in the calibrated container was measured with the same gamma-ray spectrometry system for 80000 s.

C. ^{134}Cs and ^{137}Cs Determination Methods

Cs-143 and ^{137}Cs were determined by two methods, i.e. direct gamma-ray counting technique without further chemical treatment and AMP pre-concentration technique.

1. Chemicals and Calibration Sources

Ammonium phosphomolybdate (AMP), CsCl, HNO_3 and NaOH used were analytical grade. Mix radionuclides obtained from the National Physical Laboratory (NPL), NPL no. X09083 in 2 mm thick coin shape compressed filter paper, was used as calibration source for prepared samples from AMP pre-concentration technique. The mix radionuclide standard in 1-L bottle, Eckert and Ziegler Isotope Product No.1954-6-2, was used for efficiency calibration for the sample from direct gamma-ray counting technique.

2. Sample Preparation and Analysis

For the direct counting technique, the same sample as those of ^{60}Co determination was used to measure ^{134}Cs and ^{137}Cs.

In terms of the AMP pre-concentration technique, the method for radiochemical analysis of caesium in seawater was developed from Hirose's technique [3], [4]. A 500-gram aliquot was transferred into a beaker. The sample was acidified with 14 M HNO_3 to pH 1.6. Then 0.26 g of CsCl (caesium carrier) and 4 g of AMP were added to the sample. The mixture was stirred for one hour and left overnight to allow the precipitate to settle. The precipitate sample was filtered using 5B filter paper. The precipitate sample was dried under IR lamp. The pictures of caesium determination method with AMP pre-concentration technique are shown in Fig. 2.

3. Counting Equipment and Measurement Method

The gamma-ray spectrometry system, HPGe (Li) detector (CANBERRA) with MAESTRO software, was used.

For direct counting technique, the same measurement method as those of ^{60}Co determination was applied.

In terms of AMP pre-concentration technique, The NPL no. X09083 calibration source was used for calibrating counting efficiency. The sample source was measured with the same gamma-ray spectrometry system for 80000 s.

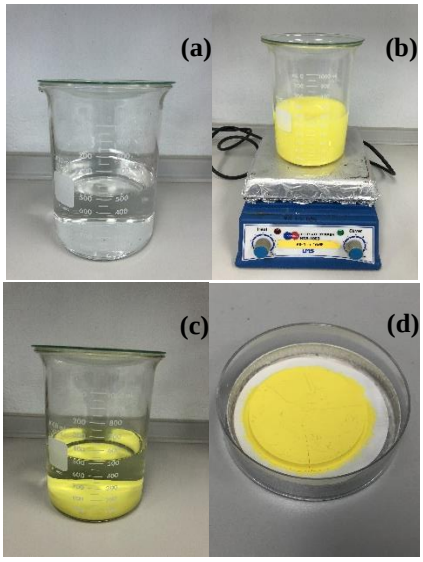

Fig. 2 Analysis of ^{134}Cs and ^{137}Cs with AMP pre-concentration technique (a) The 500 ml aliquot, (b) The AMP precipitation (c) The precipitate after settling down and (d) The caesium-AMP precipitate samples for direct gamma-ray counting using gamma-ray spectrometer

D. ^{90}Sr Determination Method

Sr-90 analysis was developed from [5]-[8]. Liquid extraction technique using di-(2-ethylhexyl) phosphoric acid (HDEHP) to separate and purify yttrium and Cherenkov counting to determine ^{90}Y in secular equilibrium with ^{90}Sr was applied.

1. Chemicals and ^{90}Sr Reference Solution

HDEHP, HNO_3, HCl, NH_4OH, citric acid, phenolphthalein, $Y(NO_3)_3$, sodium acetate, xylenolorange, KNO_3, NaOH, toluene and Titriplex III used were analytical grade. The secular equilibrium ^{90}Sr/^{90}Y reference solution used to prepare calibration source was purchased from Eckert and Ziegler Isotope Product.

2. Sample Preparation and Analysis

The three 0.5-L aliquots were acidified to pH 1-1.5 with conc. HCl was then added to 10 mg of yttrium carrier. Yttrium in the solutions was extracted with 50 ml of 10% HDEHP in toluene. The toluene phases were washed twice with 50 ml of 0.08 M HCl. In yttrium separation step, yttrium was extracted by 50 ml of 3 M HNO_3. Yttrium was purified by hydroxide precipitation where the solutions were added with NH_4OH until pH 9-10. The precipitates were separated by centrifuging and dissolved with 1 ml of conc. HNO_3. The purified samples were transferred into 20 mL polyethylene LSC vials and then diluted with DI water to a 15 ml volume for the Cherenkov counting using LSC. After the Cherenkov measurement, chemical recovery yields were determined by titrating the solutions with Titriplex III. The solutions were added to 1.5 g of sodium acetate pulsed 100 mg of xylenolorange mixed with KNO_3 and then diluted with DI water to a 50 ml volume. Before the titration, the samples were adjusted to pH 5-6 with 6 M NaOH and then titrated with Titriplex III until the solution colour was changed from red to orange.

3. Calibration Source Preparation

The reference solution contained 1.649 ± 0.051 Bq of ^{90}Sr

in secular equilibrium with ^{90}Y in 15 ml of HNO_3 solution was transferred into 20 ml polyethylene vials for Cherenkov counting using LSC.

4. Counting Equipment and Measurement Method

A liquid scintillation counter was made from the PerkinElmer model Tri-Carb 3180 TR/SL. QuantaSmart software was used for the Cherenkov counting. The calibration source was counted for 30 min in energy range of 0 - 50 keV to determine Cherenkov counting efficiency from ^{90}Y. Please note that ^{90}Sr and ^{90}Y have very different Cherenkov counting efficiencies i.e. about 1%, and 60% efficiencies for ^{90}Sr and ^{90}Y respectively [9]. Cherenkov counting from ^{90}Sr therefore could be negligible which means that the prepared ^{90}Sr/^{90}Y calibration source could be directly used to determine Cherenkov counting efficiency from ^{90}Y Cherenkov counting. The samples were then counted at the same condition and using the system as those of the calibration source. The pictures of ^{90}Sr determination method are shown in Fig. 3.

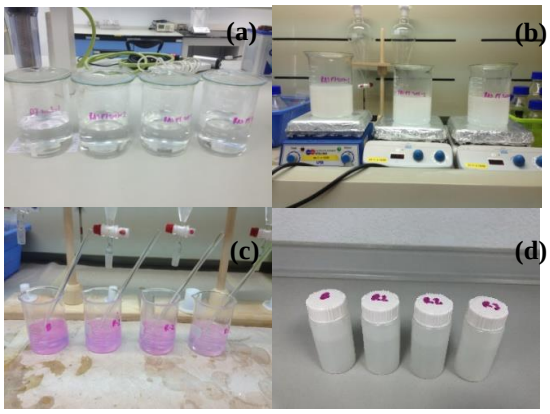

Fig. 3 Analysis of ^{90}Sr (a) The 500 ml aliquots and blank sample (DI water) (b) Liquid extraction using 10% HDEHP in toluene (c) Yttrium hydroxide precipitation and (d) The concentrated yttrium samples in 20 mL polyethylene vials for Cherenkov counting

E. Data Evaluation of Proficiency Test

Results were analysed according to IAEA criteria using different statistical evaluation such as accuracy, precision and trueness [10], [11] as follows:

The Accuracy, was determined from **relative bias (RB)** which $Value_{Measured}$ was compared with $Value_{Taget}$ as a percentage according to (1).

$$RB = \frac{Value_{Measured} - Value_{Target}}{Value_{Target}} \times 100 \qquad (1)$$

$Value_{Target}$ and its associated uncertainty, unc_{Target}, were the values provided by the IAEA.

If the relative bias was equal to or less than the Maximum Accepted Relative Bias (MARB) value, the result was considered "Accepted" for accuracy. The MARB in relation to the level of the radioactivity and the complexity of radioanalytical methods used for the evaluation can be seen from Table I.

The precision, P, was related to the combined uncertainty as a percentage described in (2).

$$P = \sqrt{\left(\frac{unc_{target}}{Value_{target}}\right)^2 + \left(\frac{unc_{Measured}}{Value_{Measured}}\right)^2} \times 100 \qquad (2)$$

The precision was compared to the Limit of Accepted Precision (LAP) which is shown in Table I. The result was scored as "Pass" when:

$$P \leq LAP \qquad (3)$$

The trueness, T, was scored as "Pass" when:

$$|RB| \leq \frac{Value_{Measured}}{Value_{Target}} 2.58\, P \qquad (4)$$

The resulting final score can be summarised according to the detailed evaluation as follows:

- "Accepted (A)" when accuracy, precision and trueness were "Passed".
- "Not Accepted (N)" when the accuracy was "Failed".
- "Warning (W)" when accuracy was "Passed", but either precision or trueness was "Failed".

TABLE I
MARB AND LAP FOR EACH ANALYTE

Nuclide	MARB	LAP
^{60}Co	20	20
^{134}Cs	20	20
^{137}Cs	20	20
^{90}Sr	25	25

III. RESULTS AND DISCUSSION

The analysis results of ^{60}Co, ^{134}Cs, ^{137}Cs and ^{90}Sr are shown in Tables II and III.

TABLE II
RESULTS OF ^{60}CO, ^{134}CS AND ^{137}CS ANALYSIS

Nuclide	Activity concentration (Bq/kg)	
	Direct gamma counting technique	Radiochemical technique
^{60}Co	0.150 ± 0.013	-
^{134}Cs	0.168 ± 0.013	0.173 ± 0.014
^{137}Cs	0.278 ± 0.016	0.298 ± 0.017

Since the ^{134}Cs and ^{137}Cs determination had two methods, i.e. direct gamma counting technique and radiochemical technique, the results from the two techniques had quite similar values. The direct counting technique gave slightly lower values than those of the radiochemical one. In terms of ^{90}Sr analysis, the three repeated results had quite similar values which should indicate good precision. However, performance evaluation can be analysed according to the data evaluation criteria as seen from Table IV.

TABLE III
RESULTS OF ^{90}SR ANALYSIS

Nuclide	Individual activity concentration (Bq/kg)			Mean activity concentration (Bq/kg)
	1	2	3	
^{90}Sr	0.310 ± 0.018	0.256 ± 0.015	0.261 ± 0.016	0.276 ± 0.016

TABLE IV
PERFORMANCE EVALUATION

Nuclide	^{60}Co	^{134}Cs[a]	^{137}Cs[a]	^{134}Cs[b]	^{137}Cs[b]	^{90}Sr
Target value	0.1613	0.1946	0.3082	0.1946	0.3082	0.2754
Target unc	0.0006	0.0008	0.0019	0.0008	0.0019	0.0019
MARB	20	20	20	20	20	25
Mea value	0.150	0.168	0.278	0.173	0.298	0.276
Mea unc	0.013	0.013	0.016	0.014	0.017	0.016
Rel bias	–7	-14	-10	-11	-3	0
Accuracy	P	P	P	P	P	P
LAP	20	20	20	20	20	25
Precision	P	P	P	P	P	P
P	8.5	8.2	5.6	7.6	5.6	6.0
$\frac{\text{ValueMeasured2.58 P}}{\text{ValueTarget}}$	20	19	14	17	13	15
Trueness	P	P	P	P	P	P
Final score	P	P	P	P	P	P

[a]results from direct gamma counting technique and [b]results from radiochemical method.

All results passed the three criteria i.e. accuracy, precision and trueness which obtained "Accepted" scores. It could be concluded that the direct gamma counting to determine ^{60}Co, ^{134}Cs and ^{137}Cs, AMP pre-concentration technique to determine ^{134}Cs and ^{137}Cs and liquid extraction technique to determine ^{90}Sr were verified.

In the case of caesium determination, the two techniques gave slightly different values. The direct gamma counting technique seemed to obtain lower values and accuracies than those of radiochemical ones. These may be due to highly different counting efficiencies when using a 1-L cylinder shape bottle (Eckert and Ziegler Isotope Product No.1954-6-2) for direct counting technique and 2 mm thick coin shape compressed filter paper (NPL no. X09083) for AMP pre-concentration technique. For instance, the counting efficiencies of ^{137}Cs at 661.657 keV were 0.00274 and 0.02515 for the 1-L bottle and the filter paper, respectively. It could be assumed that the filter paper calibration source gave potentially better counting efficiency and better accuracy. However, the performance of the two techniques was validated, and we obtained the results within the MARB (±20%).

For ^{90}Sr determination, the liquid extraction technique using HDEHP and Cherenkov counting measurement was proven to be successful to analyse ^{90}Sr. From Table III, the three repeated results had similar activity concentration values which gave mean values of 0.276 ± 0.016 Bq/kg. And this mean value was very accurate, obtaining 0 % RB from MARB of 25%. Possibly the liquid extraction technique to separate and purify ^{90}Y was fairly selective. Also, the Cherenkov counting measurement to determine ^{90}Y was effective due to less interfering from other beta particles.

IV. CONCLUSION

The determination of ^{60}Co, ^{90}Sr and ^{134}Cs and ^{137}Cs in IAEA-RML-2017-01 proficiency test samples, i.e. 5-L seawater was proven to be successful, where all results passed accuracy, precision and trueness criteria and obtained "Accepted" status. To determine ^{60}Co, ^{134}Cs and ^{137}Cs, the direct gamma counting technique used was satisfactory to obtain an "Accepted" score which could be applied for emergency situations when time is limited. Also the AMP pre-concentration technique to analyse ^{134}Cs and ^{137}Cs was greatly effective with slightly higher accuracy due to higher counting efficiency when using small geometry source. In terms of ^{90}Sr analysis via its daughter ^{90}Y, liquid extraction technique to separate and purify ^{90}Y and Cherenkov counting to measure ^{90}Y was greatly successful with 0 % RB. It could be concluded that our methodology to analyse ^{60}Co, ^{134}Cs and ^{137}Cs using direct gamma counting was validated. Moreover, radiochemical techniques such as AMP pre-concentration technique to analyse caesium and liquid extraction technique to determine ^{90}Sr via its daughter ^{90}Y were verified. These results confirm the data quality from the OAP environmental radiation laboratory to monitor radiation in environment.

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Cross-Validation of the Data Obtained for ω-6 Linoleic and ω-3 α-Linolenic Acids Concentration of Hemp Oil Using Jackknife and Bootstrap Resampling

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***Abstract*—**Hemp (Cannabis sativa) possesses a rich content of ω-6 linoleic and ω-3 linolenic essential fatty acid in the ratio of 3:1, which is a rare and most desired ratio that enhances the quality of hemp oil. These components are beneficial for the development of cell and body growth, strengthen the immune system, possess anti-inflammatory action, lowering the risk of heart problem owing to its anti-clotting property and a remedy for arthritis and various disorders. The present study employs supercritical fluid extraction (SFE) approach on hemp seed at various conditions of parameters; temperature (40 - 80) °C, pressure (200 - 350) bar, flow rate (5 - 15) g/min, particle size (0.430 - 1.015) mm and amount of co-solvent (0 - 10) % of solvent flow rate through central composite design (CCD). CCD suggested 32 sets of experiments, which was carried out. As SFE process includes large number of variables, the present study recommends the application of resampling techniques for cross-validation of the obtained data. Cross-validation refits the model on each data to achieve the information regarding the error, variability, deviation etc. Bootstrap and jackknife are the most popular resampling techniques, which create a large number of data through resampling from the original dataset and analyze these data to check the validity of the obtained data. Jackknife resampling is based on the eliminating one observation from the original sample of size N without replacement. For jackknife resampling, the sample size is 31 (eliminating one observation), which is repeated by 32 times. Bootstrap is the frequently used statistical approach for estimating the sampling distribution of an estimator by resampling with replacement from the original sample. For bootstrap resampling, the sample size is 32, which was repeated by 100 times. Estimands for these resampling techniques are considered as mean, standard deviation, variation coefficient and standard error of the mean. For ω-6 linoleic acid concentration, mean value was approx. 58.5 for both resampling methods, which is the average (central value) of the sample mean of all data points. Similarly, for ω-3 linoleic acid concentration, mean was observed as 22.5 through both resampling. Variance exhibits the spread out of the data from its mean. Greater value of variance exhibits the large range of output data, which is 18 for ω-6 linoleic acid (ranging from 48.85 to 63.66 %) and 6 for ω-3 linoleic acid (ranging from 16.71 to 26.2 %). Further, low value of standard deviation (approx. 1 %), low standard error of the mean (< 0.8) and low variance coefficient (< 0.2) reflect the accuracy of the sample for prediction. All the estimator value of variance coefficients, standard deviation and standard error of the mean are found within the 95 % of confidence interval.

***Keywords*—**Resampling, supercritical fluid extraction, hemp oil, cross-validation.

Agent Based Air-Traffic Simulation and Its Applications

Han-Sung Lee, Bong-Gyu Yoon

***Abstract*—**Control of air-traffic controller's fatigue and coordinat ion of control areas for air traffic control are essential element in flight safety. However, due to the nature of quantitative data and the limitation of infrastructure for data analysis, domestic researches have not progressed actively. In order to overcome these limitations, We proposed an Agente-based model for simulating the amount of control generated as a result of interaction between aircraft (agent). The designed model simulated the fatigue of the controller task considering the three factors of control quantity, control area, and air-traffic density. The data of the population were based on the amount of traffic generated during the morning, afternoon, and evening flight through the flight plan, and the traffic volume caused by mutual contact between the aircraft (agent). Real-time work fatigue calculations are made possible by measuring the landmark density using the number of flight aircraft.

***Keywords*—**Agent-based model, NetLogo, t-test, ANOVA, K-means clustering, Principal component analysis (PCA), Linear Regression, Boot strap.

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Selection of Suitable Reference Genes for Assessing Endurance Related Traits in a Native Pony Breed of Zanskar at High Altitude

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***Abstract*—**High performance of endurance in equid requires adaptive changes involving physio-biochemical, and molecular responses in an attempt to regain homeostasis. We hypothesized that the identification of the suitable reference genes may be considered for assessing of endurance related traits in pony at high altitude and may ensure for individuals struggling to potent endurance trait in ponies at high altitude. A total of 12 mares of ponies, Zanskar breed, were divided into three groups, group-A (without load), group-B, (60 Kg) and group-C (80 Kg) on backpack loads were subjected to a load carry protocol, on a steep climb of 4 km uphill, and of gravel, uneven rocky surface track at an altitude of 3292 m to 3500 m (endpoint). Blood was collected before and immediately after the load carry on sodium heparin anticoagulant, and the peripheral blood mononuclear cell was separated for total RNA isolation and thereafter cDNA synthesis. Real time-PCR reactions were carried out to evaluate the mRNAs expression profile of a panel of putative internal control genes (ICGs), related to different functional classes, namely *glyceraldehyde 3-phosphate dehydrogenase (GAPDH), β_2 microglobulin (β_2M), β-actin (ACTB), ribosomal protein 18 (RS18), hypoxanthine-guanine phosophoribosyltransferase (HPRT), ubiquitin B (UBB), ribosomal protein L32 (RPL32), transferrin receptor protein (TFRC), succinate dehydrogenase complex subunit A (SDHA)* for normalizing the real-time quantitative polymerase chain reaction (qPCR) data of native pony's. Three different algorithms, geNorm, NormFinder, and BestKeeper software, were used to evaluate the stability of reference genes. The result showed that *GAPDH* was best stable gene and stability value for the best combination of two genes was observed *TFRC* and β_2M.

In conclusion, the geometric mean of *GAPDH, TFRC* and β_2M might be used for accurate normalization of transcriptional data for assessing endurance related traits in Zanskar ponies during load carrying.

***Keywords*—**Endurance exercise, *GAPDH, TFRC,* β_2M, High altitude, Zanskar ponies, Reference gene.

Cinematic Xi'An: A Thirdspace of Contesting the Mainstream Representation of Chinese Cities

Hongyan Zou

Abstract—This paper aims to investigate cinematic Xi'an, the capital city of Shaanxi province represented in two urban films Back to Back, Face to Face [Beikaobei, Lianduilian] (dir. Huang Jianxin, 1994) and Weaving Girl [Fangzhi guniang] (dir. Wang Quan'an 2009). As the most important economic, political and cultural centre of north-western China, Xi'an is broadly symptomatic of the contemporary economic, social and cultural situations of the north-western China. The cinematic representation of Xi'an configures an alternative image of urban China in contrast to that of Beijing and Shanghai, showing the uneven post-socialist conditions in China in the reform era. This paper draws on Edward W Soja's discussions on the trialectical relation between space, social relations and history — particularly the 'Thirdspace' (based on Lefebvre's Production of space), which combines material, physical and mental or cognitive spaces into a conceptual site that includes the knowable and the unimaginable and the unconscious, the disciplined and the transdisciplinary. This paper argues that the voice and image of this north-western city have long been marginalised by the more developed eastern coastal area due to its geographical isolation, economic backwardness and prevail socialist inheritance. My investigation sets out to delineate a brief introduction to the concept and evolution of Chinese western cinema, and show how the two directors reject traditional themes and aesthetics deployed by previous Chinese western cinema to better contextualise their realistic representation of the city. It will then examine the cinematic city as an enclosed space of political inertia and a capsule of the socialist China, which problematize the glamourised images of technocratic metropoles designed to stimulate tourism and national power found in cinematic Beijing and Shanghai.

Keywords—Chinese western cinema, Cinematic Xi'an, urban space, spatial relation

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Selective Conversion of Biodiesel Derived Glycerol to 1,2-Propanediol over Highly Efficient γ-Al_2O_3 Supported Bimetallic Cu-Ni Catalyst

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Abstract**—**During past two decades, a considerable attention has been given to the value addition of biodiesel derived glycerol (~10wt.%) to make the biodiesel industry economically viable. Among the various glycerol value-addition methods, hydrogenolysis of glycerol to 1,2-propanediol is one of the attractive and promising routes. In this study, highly active and selective γ-Al_2O_3 supported bimetallic Cu-Ni catalyst was developed for selective hydrogenolysis of glycerol to 1,2-propanediol in the liquid phase. The catalytic performance was evaluated in a high pressure autoclave reactor. The formation of mixed oxide indicated the strong interaction of Cu, Ni with the alumina support. Experimental results demonstrated that, bimetallic copper-nickel catalyst was more active and selective to 1,2-PDO as compared to monometallic catalysts due to bifunctional behavior. To verify the effect of calcination temperature on the formation of Cu-Ni mixed oxide phase, the calcination temperature of 20wt.% Cu:Ni(1:1)/Al_2O_3 catalyst was varied from 300°C-550°C. The physicochemical properties of the catalysts were characterized by various techniques such as specific surface area (BET), X-ray diffraction study (XRD), temperature programmed reduction (TPR), and temperature programmed desorption (TPD). The BET surface area and pore volume of the catalysts were in the range of 71-78 m^2g^{-1}, and 0.12-0.15 cm^3g^{-1}, respectively. The peaks at the 2θ range of 43.3°-45.5° and 50.4°-52°, was corresponded to the copper-nickel mixed oxidephase [JCPDS: 78-1602]. The formation of mixed oxide indicated the strong interaction of Cu, Ni with the alumina support.The crystallite size decreased with increasing the calcination temperature up to 450°C, further the crystallite size was increased due to agglomeration. Smaller crystallite size of 16.5 nm was obtained for the catalyst calcined at 400°C. Total acidic sites of the catalysts were determined by NH_3-TPD and the maximum total acidic of 0.609 mmol NH_3 $gcat^{-1}$ was obtained over the catalyst calcined at 400°C. TPR data suggested the maximum of 75% degree of reduction of catalyst calcined at 400°C among all others. Further, 20wt.%Cu:Ni(1:1)/γ-Al_2O_3 catalyst calcined at 400°C exhibited highest catalytic activity (>70%) and 1,2-PDO selectivity (>85%) at mild reaction condition due to highest acidity, highest degree of reduction, smallest crystallite size.

Further, the modified Power law kinetic model was developed to understand the true kinetic behaviour of hydrogenolysis of glycerol over 20wt.%Cu:Ni(1:1)/γ-Al_2O_3 catalyst. Rate equations obtained from the model was solved by ode23 using MATLAB coupled with Genetic Algorithm. Results demonstrated that the model predicted data were very well fitted with the experimental data. The activation energy of the formation of 1,2-PDO was found to be 45 kJ mol^{-1}.

Keywords**—**Glycerol, 1,2-PDO, calcination, kinetic.

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The Economic Challenges Faced by the Sri Lankan Women Entrepreneurs

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Abstract—The focus of this paper is to view and examine the various economic challenges encountered by the Sri Lankan women entrepreneurs and to explore how the women entrepreneurs in Sri Lanka contribute to the economic development of the country. What are the economic challenges faced by the women entrepreneurs in Sri Lanka? What are the competencies they demonstrate to overcome those challenges? What is the importance of women entrepreneurship on the economic development in Sri Lanka? These are the questions that this paper attempts to answer. In many parts of Sri Lanka, women play a crucially important role in social and economic production. However, the constraints of poverty, combined with poor infrastructure and minimal resources, limit entrepreneurial possibilities. Nonetheless, Sri Lankan women entrepreneurs use enterprise to try to improve their lives. There is a thought that significant differences exist in the general entrepreneurial behavior and performance between men and women in Sri Lanka and the obstacles they face when doing business differs. This paper is aimed at increasing understanding on whether these differences are brought about by the cultural and social attributes, rather than physical and psychological differences. In summary the outcomes of this paper will identify that the intrinsic motivator for women entrepreneurs is to provide for their family, to give their children a better life than what they experienced, and to escape the entrapments of poverty. This paper shows that women entrepreneurs face a unique set of economic challenges when doing business, and they have adopted an equally unique set of management methods to succeed in their respective business. Finally, the paper has also found that the women entrepreneurship will positively affect the economic development of Sri Lanka. Key Words: Women Entrepreneurs, Economic Challenges, Sri Lanka

Keywords—Economic Challenges, Development, Sri Lanka, Women Entrepreneurs

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Geriatric Home Care for Multimorbidity: A Singaporean Provider's Experience

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Abstract—Introduction: *Geriatric home care* (GHC) services have emerged as an area of interest and necessity worldwide. Yet despite piloting in 1954, there is scarce information on GHC in Singapore. The aim of this study is twofold. Firstly, the study seeks to describe the geriatric home care experience at Organization X (X), by providing the rates of uptake, utilization, and death. It draws references to a similar Singapore Medical Journal study on paediatric home care in Malaysia. Secondly, the study seeks to identify associations between sociodemographic and utilization variables with multimorbidity and/or death. Significant associations may have implications for more efficient triage and thereby, improving access to care. Such information will help service providers and clinicians gain a deeper understanding of GHC service delivery in Singapore, so that some common structure may be established across the multiple providers. Methods: The study collected data on patients (n = 694) who had been referred to X's GHC services across the city between Q3 2015 to Q3 2017. Statistical and numerical analyses were conducted on patients who had used the services only (n = 522). Results: The study cohort showed a 75% utilization (n = 522). On a yearly basis, home nursing (HN) and home therapy (HT) were the most frequently utilized sub-services, while multimorbidity management (MM) and physiotherapy were the most frequently utilized clinical interventions. For cases with multimorbidity, there was a significant difference in score means and proportions for age, length of utilization, and time to treatment. Conclusion: This paper provides a deeper understanding of the GHC services landscape in Singapore by offering explanations on high service uptake and utilization rates. Our analyses suggest a need to scale HT, which has strong upward trends in uptake and utilization and is expected to enhance the effectiveness of other sub-services. In practice, we were unable to draw any conclusive statements for more efficient triage, despite significant associations. However, it is likely that an integrated, upstream management approach to caseloads may improve access to care. To deal with multimorbidity, providers and clinicians will need to improve existing structure and processes to deal with 'wicked' problems like case mix variability.

***Keywords*—**Geriatrics, home care, multimorbidity.

Introduction

Geriatric care is a public health concern because of rising health and social costs, valued at SGD49B annually (1). Broadly speaking, these rising costs are exacerbated by three sweeping narratives. Firstly, the *macroeconomics* narrative: Against global destabilization (e.g. 'Brexit', Eurozone crisis etc.), countries' expenditure on health and social care have grown significantly beyond the rate of economic growth (2). Singapore has doubled its expenditure over the past 5 years (3,4,5), even amid slowing international trade, rising inflation and unemployment, and wage stagnation (6,7); and its bias for 'co-payment' and 'self-care' (8,9,10). Secondly, the *sociodemographic* narrative: On the one hand, rising elderly populations (i.e. 900,000 by 2030, of whom 20% have disability, dementia or are vulnerable), and rising age dependency and life expectancy; on the other, downward trends for old-age support (10,11,12,13,14). But perhaps more salient are the changes in family structure and perceptions of 'piety', which have engendered legislative safeguards like the Maintenance of Parents and Vulnerable Adults Acts (5,12,14,15). Lastly, the *policy* narrative, where key questions are no longer about *who* to regulate and *who* pays (17,18): Rather, *how* will financing keep up with new social compact (11,18), *how* will access and delivery become more effective (18,19,20), and *how* can what is effective be scaled and replicated upstream (8,21,22)? These are complex, interdependent narratives with implications for service providers and clinicians, albeit simplified for the purposes of this paper.

Over the past two decades, *geriatric home care* (GHC) has emerged as a viable solution to rising costs, above (23,24,25). Relative to institutionalization, it trades complex coordination and roles for a direct advantage in cost-effectiveness, personalization, and patient convenience (18,23). Like the United Kingdom, Singapore's geriatric care is structured into *residential* and *non-residential* services, and across a *continuum* that spans upstream to end-of-life services (8,10,26). GHC falls under the umbrella of *non-residential community care*, where clinicians and allied health professionals (AHP) provide health and social care within patients' homes (8,26,27). Its primary objective is for patients to *"avoid institutionalization for as long as possible"* (28, p.1). Whereas a secondary objective is to offset social costs (e.g. disability, social exclusion of caregivers etc.), in line with the expanding foreign domestic workforce and nursing home infrastructure (19,29,30). Singapore's first state- and community-run GHC services were piloted by Kandang Kerbau Hospital and Home Nursing Foundation in 1954 and 1976, respectively (31,32). 40 providers later, Homage and Jaga-Me came onboard as the first social enterprises in 2016 (1). Nevertheless, there is scarce information on GHC beyond identifying the service uptake rate of 4% and utilization rate of between 35% to 51% nationwide (8,18,27). Such scarcity of information contrasts with Europe, where GHC mapping spans 30 countries (24). Yet the counterargument is that our geriatric care is so fragmented (i.e. state vs. community, institution vs. home, health vs. social etc.), that mapping is near impossible (8,10).

This study fills a gap in understanding the GHC services landscape in Singapore, by offering insights on a single provider's *rates of uptake*, *utilization* (i.e. services, sub-services, clinical interventions), and *death*. The study draws references to a similar Singapore Medical Journal study on paediatric home care in Malaysia (33), in analyzing GHC data from a single provider's perspective in Singapore. Our

findings will help providers and clinicians gain a deeper understanding of GHC service delivery, so that some common structure may be established across the multiple providers. In addition, the study seeks to identify *associations between sociodemographic and utilization variables with multimorbidity and/or death*. In theory, significant associations should contribute to more efficient triage and thereby, improve access to care for Singaporeans needing GHC services. To ensure a representative sample, the study population was pooled from Organization X (X), which receives centralized referrals through Agency for Integrated Care (AIC) for both geriatric day care and GHC services across the city. In Q3 2015, X piloted GHC following the observation that many of its center-based patients would eventually need health and social care within their homes, over periods of acute emergency or rapid deterioration. Home medical (HM) and home nursing (HN) formed the first group of sub-services, while home therapy (HT) was piloted in Q3 2016. When patients are referred to X *vis-à-vis* AIC, they are re-screened for suitability by a registered nurse, who advises on the appropriate sub-services (*Table I*) and individual care plans (ICP), following Ministry of Health (MOH) guidelines (28). Following this, 3 doctors, 6 nurses, and 2 AHPs are centrally deployed for service delivery.

Table I. Provider's overview of sub-services and clinical interventions

	Home medical	**Home nursing**	**Home therapy**
Health education or stoma care	X	X	
Mixed procedures		X	
Medication packing		X	
Multimorbidity with procedures	X		
Intermittent and indwelling catherization		X	
Nasogastric intubation		X	
Wound care		X	
Physiotherapy			X
Multimorbidity management	X	X	

Methods

Participants

The study collected data on patients who had been referred to X between Q3 2015 to Q3 2017 (n = 694), over a period of two calendar years.

Instruments

Administrative data was obtained from a digital database. The study tracked sociodemographic variables, including age, gender, regional clusters, and subsidies. In addition, it tracked utilization variables, including referral source, length of utilization, and time to treatment.

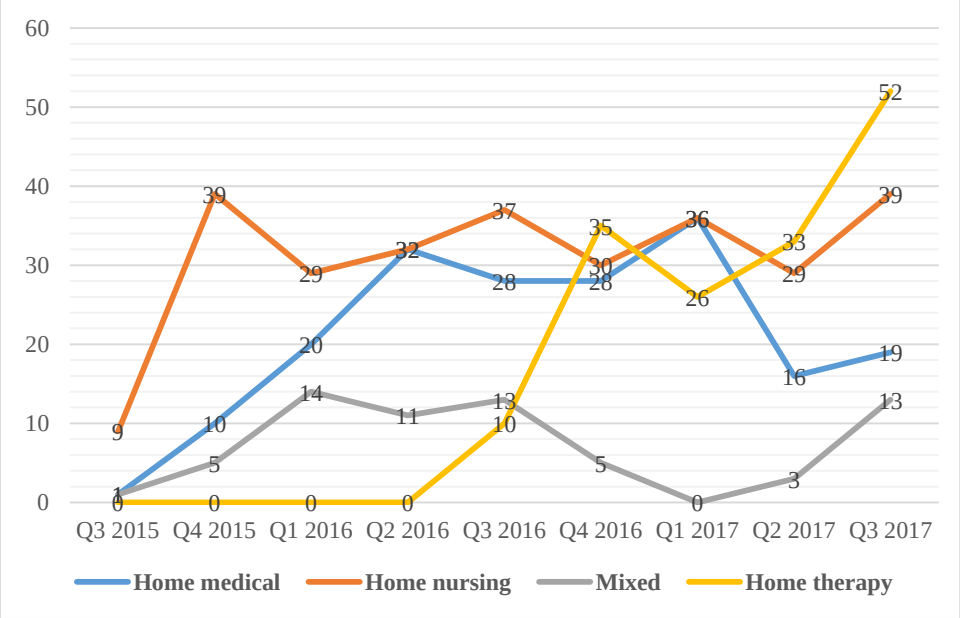
Statistical Analysis

Data was analyzed with STATA 15.

Results

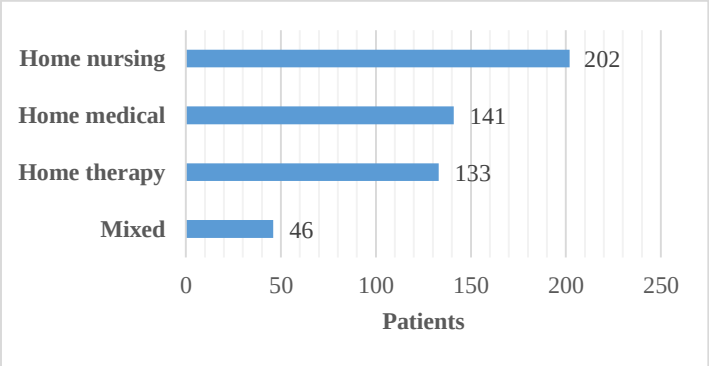
The study cohort showed uptake of 694 patients, and a utilization rate of 75% (n = 522; *Fig. 1*).

Fig 1. Patients' uptake of sub-services



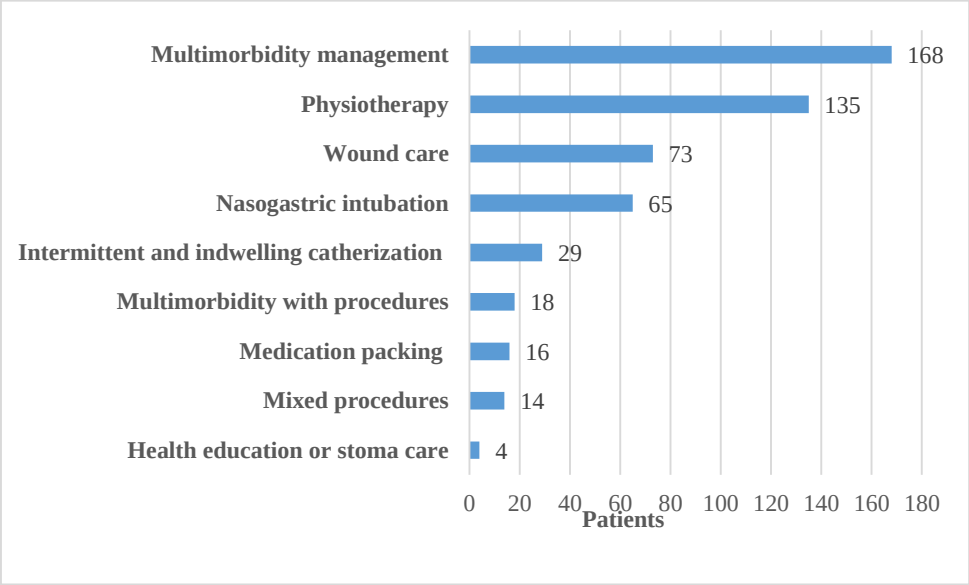
The two most frequently utilized sub-services were HN and HM, with utilization rates of 39% (n = 202) and 27% (n = 141), respectively (*Fig. 2*).

Fig 2. Patients' utilization of sub-services



While multimorbidity management and physiotherapy were the two most frequently utilized interventions, at 32% (n = 168) and 26% (n = 135), respectively (*Fig. 3*).

Fig 3. Patients' utilization of clinical interventions



Death occurred for 19% of patients in-service (n = 97), over the course of utilization.

For multimorbidity, chi-square test of independence and t test were performed to examine differences in score proportions and mean differences across sociodemographic and utilization variables. There were significant differences for patients' *age*; $\chi^2(1) = 21.00$, $p = < .001$ (*Table II*); $t(520) = 4.56$, $p = < .001$.

Table II. Proportion of multimorbidity for age

		Frequency (%)		Total
		Multimorbidity	Other	
Age	Young-old and below	17 (15%)	99 (85%)	116 (100%)
	Medium-old and above	151 (37%)	255 (63%)	406 (100%)

Similarly, there were significant differences for patients' *length of utilization*; $\chi^2(1) = 25.87$, $p = < .05$ (*Table III*); $t(520) = 5.90$, $p = < .001$.

Table III. Proportion of multimorbidity for length of utilization (days)

		Frequency (%)		Total
		Multimorbidity	Other	
Length of utilization	Acute care	58 (22%)	206 (78%)	264 (100%)
	Non-acute care	111 (43%)	147 (57%)	257 (100%)

Lastly, there were significant differences for patients' *time to treatment*; $\chi^2(1) = 5.86$, $p = < .05$ (*Table IV*); $t(520) = 4.24$, $p = < .001$.

Table IV. Proportion of multimorbidity for time to treatment (days)

		Frequency (%)		Total
		Multimorbidity	Other	
Time to treatment	Within 1 week	153 (31%)	333 (69%)	486 (100%)
	Above 1 week	18 (50%)	18 (50%)	36 (100%)

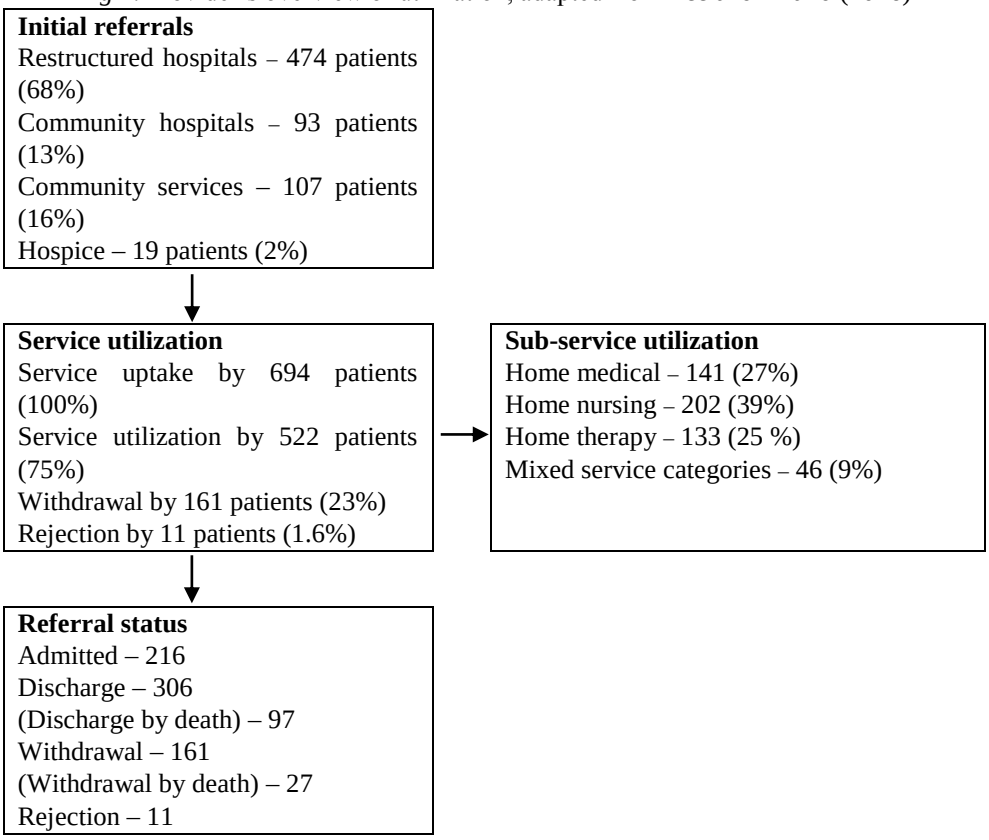
For in-service death, chi-square test of independence and t test were similarly performed to examine differences in score proportions and mean differences across

sociodemographic and utilization variables. There were no significant differences across the variables.

Discussion

For the first aim of this study, we present our analyses in four areas: *services*, *sub-services*, *clinical interventions*, and *death* (*Fig. 4*).

Fig 4. Provider's overview of utilization, adapted from Lee and Khalid (2016)



With *services*, GHC was utilized by 75% of referred patients (n = 522), double the rates reported by AIC (18). The typical patient profile was an old-old female with low socioeconomic status (SES), referred from a restructured hospital for a 99-day clinical intervention (*Table V*).

Table V. Provider's overview of utilization (sociodemographics), adapted from Lee and Khalid (2016)

Parameter	No.
Gender	
Male	161
Female	361
Age	
Less than 60	25
60 to 64	13
65 to 69	38
70 to 74	40
75 to 79	87
80 to 84	90
85 and above	229
Subsidies	
80%	219
75%	55
60%	40
50%	17
30%	37
15%	1
0%	153
Total	**522**

With *sub-services*, HM and HN had the highest utilization, with HN accounting for over half of all utilization. But where utilization is adjusted to an annual average to account for HT's short runway, it is HN and HT with the highest utilization and demand. Indeed, HT's uptake showed strong upward trends (*Fig. 1*); physiotherapy was also required for 26% of patients within a year (n = 135), as both an adjunct and independent clinical intervention. This observation is consistent with GHC's secondary objective in offsetting the social costs of disability, and affirms the growing importance of 'community-based physiotherapy' across service life cycles in community and transitional care (34,35,36).

With *clinical interventions*, multimorbidity management (MM) and physiotherapy had the highest utilization. MM consists of advance care planning, conservative treatment, cross-referrals, health education, and monitoring. Typical conditions include cerebrovascular disease, diabetes mellitus, and heart and hypertensive disease; principle causes of death amongst Singaporeans (12,37). Finally, *death* occurred for 19% of patients in-service (n = 97), with an absence of associations confirming multifactorial etiology, as observed over practice.

For the second aim of this study, significant differences in score means and proportions for *age* and/or *length of utilization* with multimorbidity were inconclusive and indicative of similarities between MM and typical patient profiles (i.e. old-old, 99-day clinical intervention etc.), above. The finding is consistent with the observation on *time to treatment* for MM patients, where indeed 93% of all patients (n = 486) had access to care within a week. Thus in practice, we were unable to draw any conclusive statements for more efficient triage.

Nevertheless, it was interesting that the proportion of MM utilization in the North was higher than all other regional clusters by at least 4 percentage points (*Table VII*). The North is not a cluster with high GHC demand, since it has neither the highest population and proportion of elderly (i.e. East/West and Central, respectively; 12), nor a high proportion of GHC providers (i.e. West). Nor is this a case for epidemiology: Rather, the observation boils down to directly improving *access to care*. A referral to GHC *vis-à-vis* AIC first requires an initial *touchpoint*, which can be inaccessible to elderly who have disability, dementia or are vulnerable. And the North's high proportion of MM utilization was matched by a similarly high proportion of *upstream services* (e.g. community health centres, 'Wellness Kampungs' etc.) that were *integrated across multiple touchpoints* (e.g. acute and primary care, grassroots etc.). Such integrated, upstream management approach to multimorbidity is shown to improve access to care (38,39), and is an area that could benefit from realist evaluation. For Singapore, forming a support network between providers and clinicians may be a potential substitute to GHC mapping.

Table VI. Provider's overview of utilization (length of utilization)

Parameter	Days	
Sub-services	**(Median)**	**(Mean)**
Home medical	199	222
Home nursing	104	166
Home therapy	48	69
Mixed service categories	85	206
Referral source		
Restructured hospitals	106	169
Community hospitals	101	152
Community services	71	133
Hospice	70	154
Subsidies		
80%	102	167
75%	76	139
60%	90	187
50%	144	158
30%	112	176
15%	102	102
0%	99	149
Total	**99**	**161**

There were also observations with implications for the *structure* and *processes* of GHC delivery, especially pertaining to MM (2). Firstly, we found *high variability* in the MM case mix, ranging from type of multimorbidity to symptom complexities. This variability is hard to coordinate (i.e. information-sharing, visits), and was further exacerbated by the practice of having one, even multiple, ICPs *per condition*. One possible alternative is to replace ICPs with *integrated care pathways* that consolidate delivery and outcomes for multiple conditions into *one treatment plan*, across the service life cycle (2,38,40). This will enable more holistic GHC service delivery, while minimizing non-value administration arising from multiple ICPs. Secondly, and related to the above, was poor *clinical integration* for MM. This is an area that continues to lag behind acute care (26). Indeed, an absence of cross-referrals between and amongst clinicians and AHP was indicated by the less than 1% of patients (n = 46; *Figure 2*) who utilized mixed sub-services. Thirdly, there was a need for *social care competencies*, which are inseparable from the GHC context (26). Significant *financial strain* would have been experienced by 52% of patients (n = 274) from the bottom SES quartile, and for MM patients overall (i.e. old-old, high length of utilization; *Table V, VI; 3*). Such strain can influence compliance to interventions and disease trajectory. On the end of GHC provision, clinicians may need support in *self-care* to deal with the 19% of in-service deaths (n = 97). Anecdotally, clinicians reported role strain in seeking emotional closure and coping with their losses (e.g. attending wakes, speaking to colleagues etc.)

Conclusion

This paper provides a deeper understanding of the GHC services landscape in Singapore by offering explanations on high service uptake and utilization rates. Our analyses suggest a need to scale HT, which has strong upward trends in uptake and utilization and is expected to enhance the effectiveness of other sub-services. In practice, we were unable to draw conclusive statements for more efficient triage, though it is likely that an integrated, upstream management approach to caseloads may improve access to care. To deal with multimorbidity, providers and clinicians will need to improve existing structure and processes to deal with 'wicked' problems of case mix variability, poor clinical integration, and lack of social care competencies. Correspondingly, a redesign of workflows and processes is underway with Nanyang Technological University.

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Lean in Commmunity Care: An Integrated Approach to Infrastructure and Process Redesign in Singapore

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With a focus on improving flow and reducing waste, Lean is a popular process improvement method in healthcare. In acute care, there is growing interest in an integrated approach to infrastructure and process redesign (integrated Lean), which takes a whole system architecture perspective to patient-centric value and processes. Yet neither Lean nor integrated Lean have been widely explored in community care, whose peculiarities present challenges for Lean thinking and implementation (e.g. closed systems with variability, different flow units), and local translation (e.g. enablers differ across the continuum of care). Our action research seeks to understand how integrated Lean can be adapted to community care service operations. In this paper, we study two similar community care facilities in Singapore and document the process of integrated Lean implementation at one facility. Cognizant of the peculiarities of community care and conceptual difficulties set out in our introduction, we put forward a 5-step systematic approach for adapting integrated Lean to community care operations: (1) identifying values, (2) identifying constraints, (3) standardized categories of delivery activities, (4) adapting tools, and (5) taking stock of enablers in local translation. Overall, Lean thinking helped us align redesign to our output-driven definition of patient value (e.g. direct care). Beyond this, we borrowed heavily from other theories and tools, and had to 'think across' and 'think again' for sense-making. Providers seeking alternatives to integrated Lean need not and should not be constrained by Lean theory, and will need to experiment with new ways of working around the peculiarities of community care.

1. Background

If the central insight of economics is that scarce resources are best rationed by prices [1-3], the central problem of healthcare is that it is poorly rationed by lead times [2]. These spill over into firms and actors [1-4]. They also interact with informational failures unique to healthcare [2-3], causing mismatch in supply and demand and driving up costs. Today, costs of health and social care around the world have far exceeded the rate of economic growth [5].

In turn, health systems are under pressure to raise effectiveness and efficiency at the same time [5-7]:

> "… *achieving the best outcomes at the lowest cost* … from a supply-driven health care system … toward a patient-centered system … from the volume and profitability of services provided … to the patient outcomes achieved. And we must replace today's fragmented system … to deliver high-value care." [7, p.1]

While a determinate optimistic future seems to achieve the best of both worlds through systemic innovation and/or integration [5-12], that future is far away. Healthcare is notoriously resistant to change [2,12]. Still, it has embraced process improvement (PI) to raise *efficiency*: better output and quality of care, while containing costs [13-14], in the broad sense of the term. A key area of focus has been cost containment through improving *flow* in direct care [13-15].

Such is the promise of *Lean*, described as "… the most significant operations and supply management approach of the past 50 years" [13, p.347]. It is used by 75% of British and Canadian health systems [16-17], and comprises 35% of PI literature, where the United States leads in action and applied research [18]. Singapore's National Healthcare Group (NHG), one of three health systems in the country, considers Lean an important aspect of patient-centred care [19].

Lean in healthcare represents

> "…a patient-centred, multi-faceted approach to organizing and delivering healthcare. Lean is a set of operating philosophies, tools and management activities that help … by *reducing the sources of waste in a process* … [and] reduce waste and enhance productivity through *reconfiguring organizational processes*." [17, p.2]

In improving flow, the five principles of Lean take a dual approach to patient-centric *value* and *processes* [13,20-22]:

> "… *how this resource integrates with other elements of the system* ... For instance, if the focus at a hospital is to optimize the use of operating theatres … without considering how the surgical department is connected to the wider hospitals system, the overall service time for the patient will be longer." [23, p.1]

One example of Lean in healthcare is Virginia Mason Medical Centre (VMMC), an American acute care hospital [23-25]. Its commitment to Lean extends to mandatory employee training in tools like Rapid Process Improvement Weeks (RPIW). The outcomes of RPIW initiatives alone are impressive: In two years, they raised output by 36% and reduced lead times by 65%. Lean also contained USD10M in capital costs that would have come from new infrastructure [25].

Our paper presents the question: How can Lean and an integrated approach to infrastructure and process redesign (integrated Lean) be adapted to community care service operations? To date, this has not been explored in Singapore, although interest is growing. We expect our answers to provide some proof-of-concept, and actionable recommendations or alternatives for providers seeking to raise efficiency with Lean thinking and implementation.

2. Introduction

2.1 Lean thinking in community care

With health services, Lean is established in acute care [13-14,16,18,23,26], especially surgery [26-28]. Surgery has always been a fit for PI: the work is easily broken down [12,29]. By contrast, there is scarce information on Lean thinking and implementation in community care, which is relatively nascent [16,18]. The benchmarks for effectiveness and efficiency are only just emerging in the United Kingdom [8-9,30-31], with PI waiting in the backseat.

Community care helps community-dwelling elderly manage disability, frailty, and multimorbidity [30-32]. We ground this paper in centre-based care (CBC) [32-33], where community-based facilities provide case management and "… a variety of activities … for a range of people with differing levels of needs" [31, pp. 2-3]. Here, the objectives are better quality of life and delaying institutionalization. This presents peculiarities with implications for Lean thinking.

Firstly, CBC is a *closed system with variability*. Staff and patients rarely interact beyond the centres [11], even as the processes extend far beyond. Nor are infrastructure and patient types very variable [34-35]. Paradoxically, patients' needs are, yet it is near impossible to organize delivery around non- condition-specific needs [5-7,22]. Thus, the *law of variability* holds: work is not transparent or easily broken down, and there are long lead times [15,36].

Secondly, CBC has a different *flow unit*, staff who move patients across space and activities. In acute care, most patients do the moving, e.g. taking an X-Ray, paying, seeing the doctor [13,15]. Seen this way, staff difficulties take away from direct care provision and thereby, patient-centric value. Thus, the *law of bottlenecks* and *Little's Law* holds: when what is variable work is repeated to serve diverse, broad needs, there is new waste and longer lead times [15].

Lean's systems predecessor, Theory of Constraints (TOC), defines waste as *resource* (where demand exceeds capacity), *policy* (where capacity is limited by rules) and *market* constraints (where capacity exceeds demand) [37]. The former are salient to community care, where demand is high and capacity is low; market constraints are extremely unlikely, if not non-existent. Unlike Lean, TOC also relates constraints directly to business-level efficiency [13,36].

Resource constraints are more commonly known as bottlenecks. However, they are further categorized into *peak time* bottlenecks that only occur during periods of high demand, and *capacity* bottlenecks that are close to happening [36-38]. By comparison, policy constraints include operating policies and practices, including informal culture and group norms, that contribute either to overall inefficiency, lower capacity, or the various bottlenecks in themselves [37].

Conceptually, integrated Lean in community care seek to utilize TOC for its performance management capabilities [36-37], it must first establish *standardized categories of delivery activities* to objectively evaluate service operations [36-37]. In particular, there must be a basis for 'apples to apples' comparisons between CBC operations that relates beyond day-to-day efficiency and less waste, to better margins and productivity [13,36].

What does this mean for Lean thinking in community care? To manage a closed system with variability, it must first identify *constraints*, or waste that is clearly defined in terms of efficiency and performance [36]. To manage the flow unit, tools must be able to track flow of a staff cohort at any point in time. Lastly, implementation must consider possibilities and processes, but also the people who make them real [39-41]. This is discussed in the next section.

2.2 Integrated Lean implementation

Today, integrated Lean is emerging in healthcare [41-44], where the end-to-end process involves "… designing both the social and technical systems together, so they are aligned" [39, p.4]. Integrated Lean requires a *whole-system architecture* perspective (WSA), which puts the substance questions first: What is our work? Why do we do this at all? What are the people, possibilities, and processes? Where are we going from here [39-41]?

One example is the Northeast Transformation System (NETS), an independent body working across two British acute care hospitals [42-44]. Building on VMMC, it reduced lead times by 60% for 23,000 annual patients [42]. NETS's experience suggests that WSA is critical for flow in non-surgery services, which like CBC, are closed systems with variability [42,44]. Thus, principles and rules have to 'wrap around' patient-centric value and processes [44].

Yet, NETS does not explain success in terms of these principles and rules, but Lean's overarching *values* [13,20-22]:

> "… 'the creation of a process to help stakeholders to design in Lean principles when developing new, or refurbishing existing, healthcare facilities.' … None of it would have been possible if we didn't *break down those silos* which so often exist … we also had many meetings with different organisations ..." [42, pp.7-8]

WSA is only possible when everyone approaches shared understanding with *respect* and *teamwork* [42-47], as in participatory design [46-49]. Else high capital costs for infrastructure will continue to be committed by stakeholders without the overall picture on patient-centric value and processes, or the interdependence of infrastructure, processes, and actors [13,41-45]. To VMMC and NETS, infrastructure approached this way was as good as redundant [25,42].

What does this mean for integrated Lean implementation? We echo earlier studies in suggesting the need for identifying values in driving project teams [17,22,39-40]. They are needed to enable the exchange of difficult questions arising from WSA, regardless of status quo. In turn, this helps the process of creating transparent, practical knowledge: "Based on this clear picture they can make decisions about how, together, they can score a goal" [22, p.133].

2.3 Enablers in local translation

As we move from Lean thinking to implementation, then, we face the problem of *translation*:

> "Some impediments are rather obvious … within healthcare: the dissection between producing cars and giving care, the profound gap between evidence-based

> medicine and quality improvement storytelling, and the varying ability of hospitals to identify an idea, assimilate it, and exploit it to fulfil their own needs." [50, p.6]

Lean implementation is always different, since translation is complex, social, and involves multiple touchpoints: as many fail as they succeed, and in very different ways [16-18,23,38,50]. In turn, *realist evaluation* has been adapted into a conceptual framework for understanding Lean as WSA hits the ground: "WHAT is it about this kind of intervention that works, for WHOM, in what CIRCUMSTANCES, in what RESPECTS and WHY [51, p.31]?"

In short, this means having to take stock of *enablers in local translation*, or 'pull factors' for implementation:

> "… domain[s] of the intervention … *context* covered the setting in which the intervention is deployed, *content* referred to the characteristics of the intervention itself, *application* related to the process through which the intervention was implemented, and *outcome* covered the results and maintenance phase ...." [50, p.2]

It is a case of appropriation: Realist evaluation is used in policy and services delivery, where we need to understand how or why implementation works and fails in 'black box' scenarios [17,51-52]. By comparison, experimental design is used in clinical treatment, where the concern is whether or not treatment works. In Singapore, there are growing calls for realist evaluations in community care [52], where the work is peculiar and not easily broken down, above.

What does this mean for local translation? It means that we will need a shift in thinking to make sense of, and to adapt integrated Lean to community care, given its contextual peculiarities and the conceptual difficulties with implementation. We must also take stock of enablers to ensure that we "…capture the right balance between … *tailoring lean to local needs, and at the same time staying true to lean as a philosophy of change.* [50, p.8]"

3. Method

3.1 Setting

To answer our questions, we studied CBC facilities operated by Organization X, a community care provider in Singapore. The company is publicly funded with 350 staff and 2,000 annual patients. In 2017, it became the largest CBC provider in the country, incurring a gain of SGD4M (19% of sales). CBC services are due to expand by 56% this year. In 2020, patient volume is expected to double as the company enters active ageing hub and nursing home markets.

Led by its CEO, the company renewed its focus on innovation and PI: 32 events are documented, of which 40% were led by the author. CEO felt that Lean would inform possibilities and provide staff with experiential WSA. The first author led the project from CEO Office, the second author performed data collection and helped with analyses, while an external Lean consultant was engaged from the University to provide domain expertise [23,53-55].

This paper documents our action research, which is "… concerned with generating knowledge about a social system, while at the same time, attempting to change it" [52, p.173]. In general, it is appropriate to WSA and health services delivery [52,53]. It also helped us make sense of Lean thinking and implementation over our learning journey at the CBC facilities. Throughout, we used Lean Six Sigma's DMAIC model to guide the implementation process [56-58].

The two CBC facilities we studied, *F1* and *F2*, were located in public housing estates and due for expansion. F1 was chosen to prototype Lean services delivery and integrated Lean, while F2 was used for cross-comparison. Both facilities had approximately 20 staff and 120 patients daily. This volume was constant. Two patient flows occurred for senior care (SCC) and day rehabilitation centres (DRC) within the facilities, which were thus, mapped separately.

3.2 Data collection

We identified data collection tools through a literature review on time studies, noting the peculiarities and implications of community care, above. To identify constraints, we adapted a semi-structured interview (SI) for staff of F1 and F2 [61], in addition to bottleneck analysis (BA) post-time study. We also created 4 standardized categories of delivery activities – *production, reception, setup, wind-down* – with up to 10 standardized activities per category (*Table 1*).

Table 1. Standardized categories of delivery activities for senior care centre only

Categories	Activities
Production (direct care)	Patient activity (group), patient assessment or activity (individual), serve food
Reception	Coordinate arrivals and attendance, enquiries and payments, general engagement, other assessments, patient administration, prepare and provide nametags, pick patients from dropoff point, store wheelchair and aids, welcome patients
Setup	Prepare food, seat patients, transport patients to sessions, setup centre or activities, team meet
Wind-down	Clear food, close centre or activities, general cleaning

To manage the *flow unit*, we adopted path process chart (PPC), which helped us track flow of the staff cohort across processes, space, tasks, and time [62]. PPC was developed for domestic work, yet another closed system with variability that "… involves a multitude of diverse activities each requiring a different skills set. The workplaces are also not so well defined … a family member can, without any previous notice, walk in to give a hand" [62, p.6476].

Both tools were used over a period of 7 days per facility in November and December 2017. We coded SI data into themes and onto an Ishikawa diagram to understand how perceived constraints led to long lead times in operations. We also coded PPC data into standardized categories and activities, above, and onto a process map for each SCC and DRC. Data was then subject to BA, which listed constraints in order of occurrence, and workflow or activity.

In addition, we conducted several site visits for observations, as well as two focused group meetings pre- and post-analyses. The focused groups were attended by stakeholders involved in redesigning F1's infrastructure:

CEO, an architect, HQ services, HQ operations, and F1 and F2's managers and staff. BA items were presented with an option for redesigning infrastructure and/or processes, with CEO deciding on the option to pursue or discuss further.

4. Results and discussion

4.1 Overview of efficiency and constraints

Overall, there were large output differences in spite of similar staff and patient volumes: F1's output in man-hours was 3 times that of F2 (*Table 2*). There were also differences in efficiency relating to patient-centric value and processes: 27% F1's man-hours were spent in *production* or direct care, compared to 72% of F2's man-hours. An arbitrary calculation of operating costs suggests that F2 delivered 4 times more in relative value per man-hour.

Table 2. Man-hours spent on categories of delivery activities for F1 and F2

	F1 SCC	F1 DRC	F1 total	F2 SCC	F2 DRC	F2 total
Production	5.8	11.0	16.8	6.6	19.1	25.7
Reception	16.2	12.0	28.2	2.4	4.3	6.7
Setup	5.3	1.5	6.8	1.4	0.4	1.8
Wind-down	35.4	25.5	60.9	1.0	0.4	1.4
Total	**62.7**	**50.0**	**112.7**	**11.4**	**24.2**	**35.6**

Overall, resource constraints, or bottlenecks occurred in the *reception* category of delivery activities, which took up 46% and 20% of F1 and F2's man-hours, respectively. In addition, both CBC facilities had bottlenecks in operational processes (occurring throughout day), SCCs shared bottlenecks in general cleaning (4 man-hours/day), while DRCs shared bottlenecks in administrative processes/activities (4 man-hours/day) and therapy activities (7 man-hours/day).

60% of bottlenecks were due to infrastructure, and only 40% were due to processes. Through SI, SCC staff surfaced lack of functional storage space, while DRC staff surfaced bottlenecks in their administrative processes. They also highlighted *policy* constraints in choosing site materials, which created new needs in general cleaning (e.g. many windows, high ceiling fans, tiled floors etc.), and in selecting the right equipment to manage case loads and mixes.

With F1, most bottlenecks occurred within the first 3 hours of operations, with repercussions for the rest of the day. To cope with this, some staff turned up an hour ahead of opening hours to prepare reception activities. The main bottleneck was arrival workflows, where patients came in two waves. Nevertheless, this was overcome by F2 using best practices in operations that encapsulated Lean rules (*Table 2*), which we later adapted to some of F1 bottlenecks.

4.2 How can Lean and integrated Lean be adapted to the operations of community care services?

Overall, Lean's values, principles and rules (*Tables 3-4*) had some guiding function for WSA and sense-making across disciplines and domains. Correspondingly, we adapted integrated Lean at F1 using a 5-step systematic approach in (1) *identifying values*, (2) *identifying constraints*, (3) *standardized categories of delivery activities*, (4) *adapting tools*, and (5) *taking stock of enablers in local translation.* These are discussed in detail below.

Table 3. Lean principles and implications, adapted from Womack and Jones (1996a; 1996b)

Principle	Project implications
Identify clients and specify value	Patient-centric value meant raising *production*, or direct care activities and throughput.
Identify and map the value stream	Identified 50 stakeholders, 20% of whom were not involved in F1 and F2 operations.
Create flow by eliminating waste	Better flow in direct care by reducing difficulties in indirect care, including those from infrastructure.
Respond to client pull	Matched processes to patient demand, ensuring continuity in direct care where possible.
Pursue perfection	Continuously pursued perfection in Lean and integrated Lean.

Table 4. Lean rules, adapted from Spear and Bowen (1999)

Rule	Project implications
All work is specified in terms of content, sequence, timing, and outcome	Standardized categories of activities and the activities themselves, before working further.
Every client-supplier connection must be direct	Established 'as-is' conditions from the outset, including roles and time of availability.
The pathway for every product must be simple and direct	Eliminated waste in direct care, as simply as possible, including those from infrastructure.
An improvement must be made in accordance with the scientific method, at the lowest possible level of the organization	Carried out scientific method and objective analyses across F1 and F2, engaging ground staff through the end-to-end process.

4.2.1 Identifying values

Like NETS, we found that Lean's overarching values were needed for WSA, and preceded principles and rules:

> "Respect and teamwork are clear conditions for the creation of an efficient flow. Respect is about doing everything to be able to understand each other. Teamwork is about stimulating personal and professional development, sharing opportunities … maximising individual and group achievement." [22, p.142]

These went beyond suggestions that values contribute to culture [22]. Most saliently, they enabled us to explore WSA and exchange difficult questions with stakeholders, despite the novelty of Lean in the organization, initial doubts on feasibility, and a very short runway imposed by building and tender deadlines. (Nevertheless, respect and teamwork are core values of the company, on which staff are self- and manager-rated during a biannual performance appraisal.)

For instance, our focus groups saw good exchange over bottlenecks in general cleaning. Some stakeholders felt that infrastructure had been a recurring problem, while others

felt these 'problems' were part of open concept design. Eventually, we generated 3 man-hours in cost savings through a compromise between efficiency and patient experience: appropriated windows, ducted airflow over ceiling fans, and removal of hard-to-clean materials altogether.

4.2.2 Identifying constraints

While Lean principles helped with a fuzzy definition of waste (*Table 3*), other theories were needed to adapt integrated Lean. Conceptually, we had already used TOC to distinguish between resource and policy constraints. For instance, DRCs not having enough equipment to manage case loads and mixes was a resource constraint that was resolved immediately, while not being able to select the right equipment was a policy constraint tabled for discussion.

In practice, however, more categorization was needed for an actionable BA (*Table 5*). Thus, we applied *category of delivery* (*Table 1*), *type* (e.g. infrastructure or process-workflow-activity), *5Ms* [63], and *proposed solution* (e.g. capacity or streamline) to all our bottlenecks. Of these, Toyota Production System's 5Ms were particularly useful for highlighting broad, actionable areas to the architect and facilities teams for discussion, short of being prescriptive.

Table 5. Bottleneck analysis for F1

Bottlenecks	Category of delivery	Type	Waste	5Ms	Proposed solution	Patient volume	Lead time (min)	Throughput (min)
Operations**	NA	Infrastructure, Process	Over production	NA	Identify perceived constraints	80	NA	NA
Transport	NA	Infrastructure, Process	Over production	NA	NA	80	NA	NA
Patient arrivals (circled)	Reception, Setup	Infrastructure, Workflow	Transport, Movement, Waiting	**Materials**, **Medium**, Method	Streamline	80	119	1.49
Serve food (circled)	Reception, Setup, Wind-down	Workflow	Waiting, Over processing	Method	Streamline	80	118	1.48
Patient nametags	Reception	Activity	Inventory, Waiting	Method	Streamline	80	124	1.55
Patient blood pressure	Reception	Activity	Movement	**Materials**, Method	Capacity	40	69	1.72
Patient administration	Reception	Activity	Over processing	**Medium**, Method	Streamline	80	121	1.51
General cleaning	Wind-down	Infrastructure, Activity	Over processing	**Materials**	Capacity	NA	181	NA

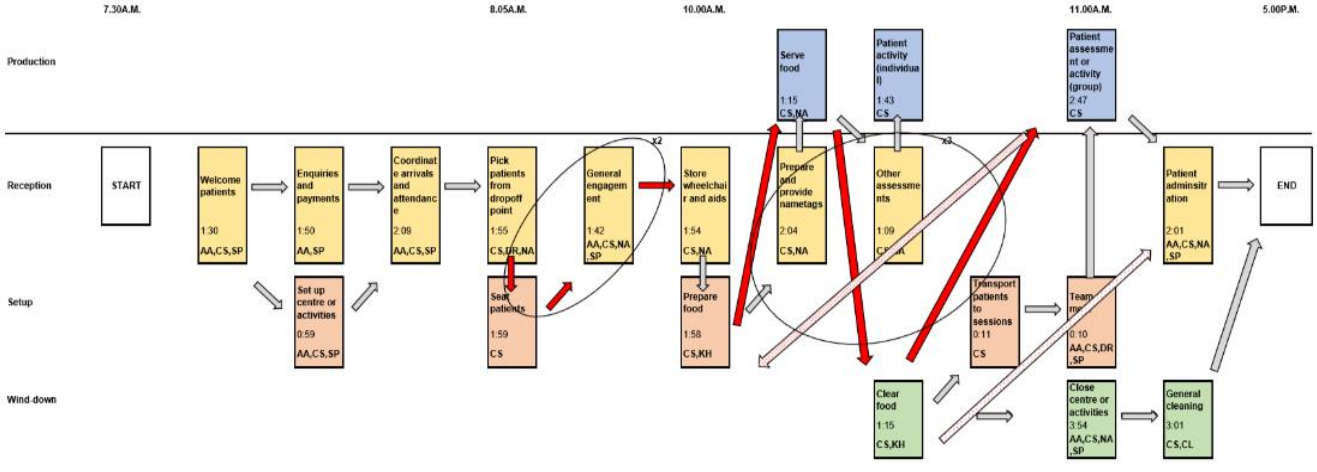
While these categorizations added depth to our overview of efficiency and constraints (*Table 2*), the somewhat narrow focus on lead times was a key limitation of Lean thinking [64]. A more holistic approach to PI would have examined *inventory* (or 'bench') [37] and *operational expenditure*, which combined with *throughput*, have direct effects on local cash flow, net profits, and return on investment, and are better overall measures for efficiency [36-37].

4.2.3 Standardized categories of delivery activities

Earlier, we mentioned *standardized categories of delivery activities* to objectively evaluate services delivery (*Table 5*) and to enable 'apples to apples' comparisons between CBC operations. We made sense of these activities through coding PPC data, engaging staff, site observations, and conceptualizing service design with a "*line of visibility*" [13, p.210] between direct and indirect care (*Figure 1*), in line with our definition of patient-centric value (*Table 3*).

Though simple, it was important to visualize 'as-is' delivery activities occurring at the CBC facilities, which were also cost centres for the company. In turn, the line of visibility, adapted from manufacturing, provided an impetus for change (*Figure 1*). Initial doubts on the feasibility of Lean, or its irrelevance to 'models of care' went out the window as it became clear that F1's patients were not receiving as much direct care as had been imagined.

Figure 1. F1s process map with a line of visibility



4.2.4 Adapting tools

Adapting tools also helped us work around the peculiarities of community care, and the relative weaknesses of Lean, which would have otherwise remained a philosophy of change. These tools consisted of *DMAIC*, *RAPID*, *PPC*, and *SI*. Mostly, DMAIC (*Table 6*) provided the methodology to guide the project team from 'as-is' to 'to-be' conditions [65-66]. It also helped us start all interaction with reiterations of the fundamentals like problem and goal statements.

Table 6. DMAIC, adapted from de Koning and de Mast (2006)

Stages	Steps
Define	Identify and map relevant processes, identify stakeholders, determine and prioritize customer needs and requirements, make a business case
Measure	Select one or more critical-to-quality (CTQ) factors, operationalize and measure CTQs, assess 'as-is' process capability, define objectives
Analyze	Identify potential influence factors, select vital causal influencing factors (X)
Improve	Quantify relationships between CTQ and X, design action to modify process or settings of X, conduct pilot of improvement actions
Control	Determine 'to-be' process capability, implement control plan

In line with literature, DMAIC complemented Lean through its focus on reducing variation, and identifying the relationships between *critical-to-quality* (CTQ) and *causal influencing factors* (X) [64-66]. This was necessary after defining the various constraints. For instance, we were able to identify 4 man-hours in direct care (CTQ) lost to food processing (X), and table the possibility of outsourced 'bento boxes', at a simple trade-off of $27 per month.

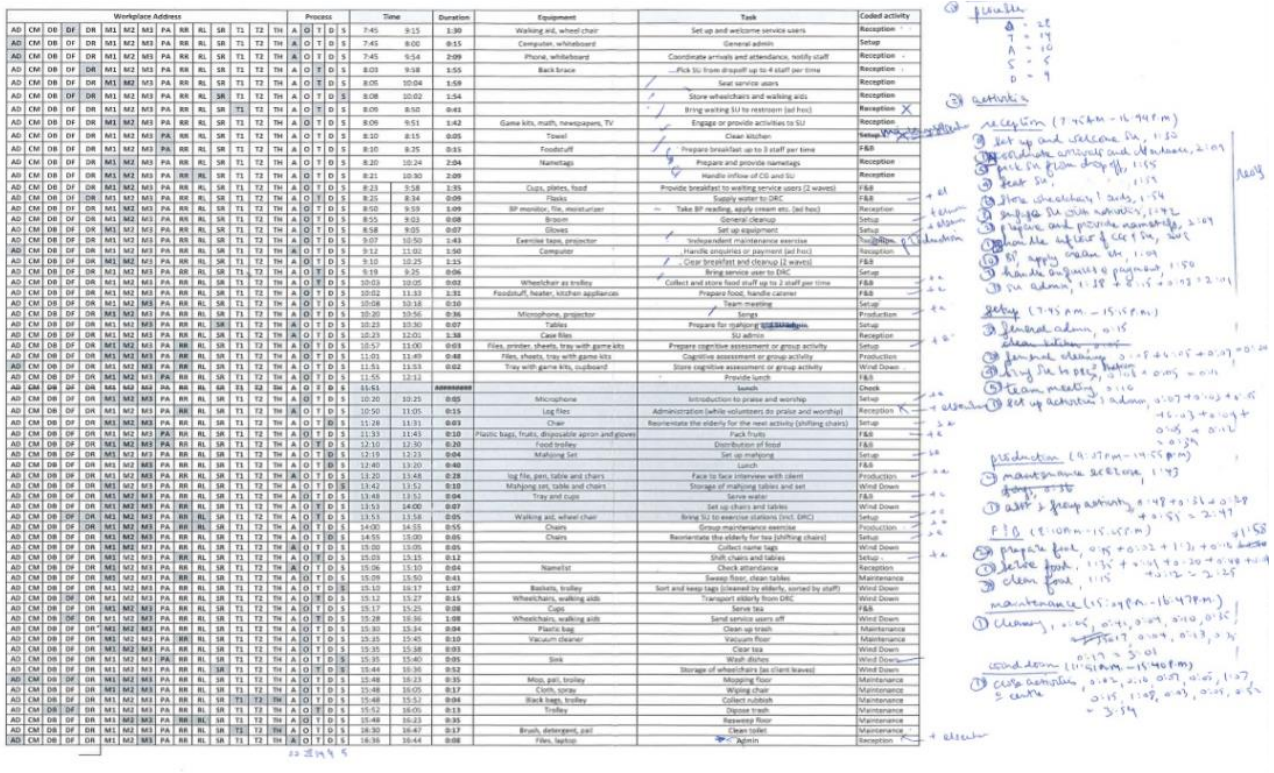
By comparison, Bridgespan's RAPID tool helped to clarify roles and responsibilities [67], in a way stakeholders were already familiar with. On the outset, it was necessary to delimit decision-making to CEO (*decide*), project leadership to the first author (*recommend*), and domain expertise to the consultant (*agree*). This was made transparent through reiterations and circulation, such that despite resistance, we could reference the tool and follow through as planned.

PPC and *SI* were adapted specifically for the time study portion. The suitability of PPC has been discussed earlier:

> "It is also a "*simple paper and pen technique* that does not need elaborate equipment … makes it possible to study both the process of work … and the way the workplaces are used … [and] to study simultaneously the work performed by two workers at the same or different workplaces." [62, p.6467]

Using PPC, we faced initial difficulties coding variable, repetitive, and non-standardisable tasks into delivery activities (*Table 1*; *Figure 2*), with tasks changing daily. This is where SI, adapted from process redesign in acute care [61], helped to contextualize information with regards to case loads and mixes, and staffs' perceived constraints. Ratings from staff and a senior trainer, who had run F2 prior, also helped us objectively assess the efficiency of F1 and F2.

Figure 2. Path process chart and the coding process



4.2.5 Taking stock of enablers in local translation

In retrospect, we identified enablers for local translation (*Table 7*) from a series of enablers defined over a study on local translation in a Canadian hospital [50]. Pre-translation, we found important enablers in: *external support* through the consultant, *adaption* or adaptation of various theories and tools, above, *staff involvement* across the value chain, and various *measurement* of output and processes, however broad or simple they may have been in our pilot attempt.

Table 7. Enablers for local translation of Lean content to F1, adopted from Andersen and Rovik (2015)

	Context	**Content**	**Application**	**Outcomes**
Pre-condition	External support	Adaption	Staff involvement	Measurement
Local	Need for change Anchoring in department	Visual and simple, less resource remanding	Sufficient participation	Realism and patience

With local translation *context*, *need for change* or "perceived need, potential for improvement" [50, p.4] and *anchoring* in CEO Office was important. While a participatory design experience was favoured [40-45], this was moderated given the novelty of Lean and a general lack of awareness about PI. Only 2 of the 50 stakeholders had had some encounter with PI. Despite initial doubts, they privately approached the first author to offer information and support.

With *content*, *visual and simple* was key, as discussed with regards to *Figure 1*: Processes and waste were made clear to laymen. As project leaders, it was important that we "… collect and display locally relevant data using techniques such as data walls, and to design quality improvements to address the problems identified through their data" [17, p.12]. The project was also *less resource demanding*, with little to no action required on the part of all stakeholders.

With *application*, *sufficient participation* was an enabler for the end-to-end process. Much of this participation was due to the second author, who had interned for the project. F1 and F2 staff were more open to sharing perceived constraints, which they might not have been willing to share with the other authors in their formal capacity. Indeed, through the second author, *value*s issues quickly surfaced for F2, despite its relative efficiency and best practices.

Lastly, with *outcomes*, *realism and patience* were critical, in particular, the "distinct mandate" from CEO as decision-maker, and "demarcation" with RAPID [50, p.4]. These were aspects of the project not open to change. Nevertheless, we took a very flexible approach with Lean thinking, implementation, and translation. With process redesign, we were also open in considering input from staff, who would ultimately be most affected by the project.

Beyond enablers, studies on Lean leadership shed light on a potential barrier in community care, with regards to

> "... a *top-down attempt to build bottom up processes of improvement*. This, in turn, creates inherent tensions .... On the one hand, … implementation is non-negotiable … On the other, they are encouraged to empower … [these tensions] require a degree of *sophistication and skill to manage*, as well as … *cultural mores*" [17, p.14]

Indeed, it is likely that a lack of cultural sensitivity and soft skills will be a barrier to adapting integrated Lean to community care. For instance, we faced resistance from a stakeholder who approached the first author prior to the post-analyses focus group, seeking to review documents with instructions to abstain from infrastructure discussions. This was circumvented with considerable tact and buy-in from the architect and other stakeholders.

5. Conclusion

Our findings suggest a 5-step systematic approach that providers may take to adapt integrated Lean to community care: (1) *identifying values*, (2) *identifying constraints*, (3) *standardized categories of delivery activities*, (4) *adapting tools*, and (5) *taking stock of enablers in local translation*. Post-values, and ceterus paribus, our experience suggests that *identifying constraints* and *standardized categories of delivery activities* are critical for WSA and sense-making.

In answering our research question, we made substantial, though expected, revisions to Lean:

> "What happens when popular management ideas, like lean, travel into and within an organisation? We conclude that lean, being introduced by the management, taught and communicated by the internal consultants, and used in practical improvement … is *transformed and translated more than once* on its way ..." [50, p.4]

Indeed, a critical reading of this paper may conclude that this was not, in fact, a Lean project, since Lean thinking and implementation stopped at the rules. Beyond this, we borrowed heavily from other theories and tools, independently of our consultant. This part of our action research surfaced a criticism of Lean in healthcare, where there is lack of evidence for direct application, or consensus on what (integrated) Lean implementation is in direct care services [15,17, 40,42-43].

Neither the *process* of time studies, process mapping, and a broad view of constraints, nor *requisites* of project leadership like soft skills and team dynamics were native to Lean or any other PI method [28]. Rather, we had to *think across* disciplines, domains, and personal bias to 'cut through the noise' for WSA and sense-making, to overcome peculiarities and conceptual difficulties, and to distil our findings into transparent, practical knowledge.

Regardless, Lean thinking was useful in getting us to work through its principles (*Table 2*). For instance, we defined value in *production* or direct care activities, in line with an output-driven view of service operations [37]. Using this, we could *think again* on the various processes involved in service delivery, compare between CBC operations, and examine the options for infrastructure and process redesign (*Figure 3*), on the basis of the scientific method.

Figure 3. Partial action list for F1's SCC

Bottleneck	Item	Program implication	Action	Space implication	Action
Operations	Main door (i.e. located away from dropoff, opens outward)			Move door closer to dropoff	M
Operations				Wide, sliding door	N
Operations	Materials (e.g. ceiling fans, high lights, tiled floors, too many windows, unprotected walls)			Reduce ceiling fans	Y
Operations				Laminate flooring	Y
Operations				Reduce windows facing HDB blocks	M
Operations				Laminate beams and some walls	Y
Operations	Lack of storage space (i.e. files, wheelchairs)	Relook filing system	Y	Built-in central shelving	M
Operations				Secured, outdoor storage shack for wheelchairs	Y
Operations	Lack of medical space (i.e. sensory room, sick bay)			Room, partition or detachable walls	M
Operations	Lack of staff space (i.e. conducive administrative area, eating space)			Room or partition	M
Operations	Lack of toilets and sinks			More toilets and sinks	Y
Operations	Layout of space			(...)	Y
Operations	Lack of ventilation			Route airconditioner	Y
Operations	Payments system (i.e. 'black boxes in bills, CBCIT)	Fix CBCIT			
SU arrivals				Move door closer to dropoff	M
				Install CCTV at dropoff junction	M
				Secured, outdoor storage shack for wheelchairs	Y
				Reception area	Y
SU food		Outsource (approx. +$27/month)			
		Self-service (most) and dementia-friendly trolleys			
SU nametags		Relook nametag system	Y	Nametag wall	M
SU BP etc.		Subsume into arrivals with new BP machine	Y		
SU admin		Designate central enquiries line	M	Conducive administrative area	Y
		Designate internal communications time	M		

Providers seeking alternatives to integrated Lean may consider adapting or improving upon these steps for overcoming *closed system with variability* and *flow unit* peculiarities and implications (see *Introduction*). However, the best starting point may well be to move away from a PI lens, and define value in line with an outcome-driven view of service operations [5-9], such that infrastructure and processes relate better to desired health and social care outcomes.

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The Effect of "Trait" Variance of Personality on Depression: Application of the Trait-State-Occasion (TSO) Modeling

Pei-Chen Wu

***Abstract*—**Both preexisting cross-sectional and longitudinal studies of personality-depression relationship have suffered from one main limitation: they ignored the stability of the construct of interest (e.g., personality and depression) can be expected to influence the estimate of the association between personality and depression. To address this limitation, the Trait-State-Occasion (TSO) modeling was adopted to analyze the sources of variance of the focused constructs. A TSO modeling was operated by partitioning a state variance into time-invariant (trait) and time-variant (occasion) components. Within a TSO framework, it is possible to predict change on the part of construct that really changes (i.e., time-variant variance), when controlling the trait variances. 750 high school students were followed for 4 waves over six-month intervals. The baseline data (T1) were collected from the senior high schools (aged 14 to 15 years). Participants were given Beck Depression Inventory and Big Five Inventory at each assessment. TSO modeling revealed that 70~78% of variance in personality (five constructs) was stable over follow-up period; however, 57~61% of variance in depression was stable. For personality construct, there were 7.6% to 8.4% of the total variance from the autoregressive occasion factors; for depression construct there were 15.2% to 18.1% of the total variance from the autoregressive occasion factors. Additionally, results showed that when controlling initial symptom severity, the time-invariant components of all five dimensions of personality were predictive of change in depression (Extraversion: B= .32, Openness: B = -.21, Agreeableness: B = -.27, Conscientious: B = -.36, Neuroticism: B = .39). Because five dimensions of personality shared some variance, the models in which all five dimensions of personality were simultaneously to predict chang in depression were investigated. The time-invariant components of five dimensions were still significant predictors for change in depression (Extraversion: B = .30, Openness: B = -.24, Agreeableness: B = -.28, Conscientious: B = -.35, Neuroticism: B = .42). In sum, the majority of variability of personality was stable over 2 years. Individuals with greater tendency of Extraversion and Neuroticism have higher degrees of depression; individuals with greater tendency of Openness, Agreeableness and Conscientious have lower degrees of depression.

***Keywords*—**Assessment, Depression, Personality, Trait –State-Occasion Model.

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Adaptive Load Balancing Strategy for Data Parallel Applications Heterogeneous Distributed System

Kalim Qureshi

Abstract—In this paper, we present an Adaptive Load Balancing (ALB) strategy for data parallel applications to balance the workload effectively on distributed system. We study the impact on matrix multiplication application, which is a extensive computational demanding application. The ALB strategy has many good features such as, i) selection of stable performance nodes, ii) pre-task assignment to each node, iii) adaptive task sizing for each node, iv) adaptive sizing of buffer for each node and incorporation of excellent load balancing components. The ALB strategy reduce the node's idle time, interprocess communication and momentous improvement in speed up as compared to Run Time task Scheduling strategy.

Keywords—Task partitioning and Performance evaluation, Load balancing, Heterogeneous distributed systems, , Matrix multiplication

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Emerging Facets in Pakistan-Saudi Ties in Recent Years

Bilal Bin Liaqat

***Abstract*—**Pakistan maintained a close cordial relationship with Saudi Arabia has been a pillar of its foreign policy. In recent years, she has a unique relationship under PML (N) tenure due to close ties of Sharif family with the Saudi Royal Family. However, Islamabad adopted pragmatic approach towards maintaining the traditional posture of neutrality in Middle Eastern affairs as in the case of Yemen crisis, in which Islamabad showed a cold shoulder towards Saudi Arabia to maintaining its non-interference policy in Middle Eastern politics. In that scenario, this strategic shift in Islamabad's attitude mainly driven by the regional security imperatives, that include friendly ties with her neighbor's, especially keeping balanced relationship with Iran for economic & security connectivity. However, the embracing of the well-adjusted approach towards Riyadh in recent times also includes Saudi-India cooperation in defence related matters that create apprehensions in the Pakistani policy circles. However, these steps will not undermine the strategic ties between Islamabad and Riyadh in the coming future.

***Keywords*—**Pakistan, Saudi Arabia, Iran, Yemen.

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Flood Risk Analysis by Use of Risk Curves in Nairobi, Kenya

Gitonga James Kinyua, Toshio Fujimi

***Abstract*—**Flood Risk Assessment and Analysis is essential to solving the degree of damage and loss because of natural disasters. Urban Flooding causes a major economic loss and casualties, at Mathare residential area in Nairobi Kenya. High population caused by rural-urban migration, Unemployment and unplanned urban development are among factors that increase flood vulnerability in Mathare area. This study aims to analyse flood risk using risk curves in Mathare based on scientific data, research data that includes the Rainfall data, River mathare discharge rate data, Water runoff data, field survey data and questionnaire survey through sampling of the study area have been used to develop the Risk curves. Four structural types of building were identified in the study area, Vulnerability and risk curves were made for these four structural types by plotting the relationship between flood depth and damage for each structural type. The results indicates that the structural type with mud wall and mud floor is the most vulnerable building to flooding while the structural type with stone walls and concrete floor is least vulnerable. The vulnerability of building contents is mainly determined by the number of floors and the resilience of the building, therefore more than 80% of the residential buildings including the property in the building are highly vulnerable to floods consequently exposed to high risk. The value at risk increases with the decrease in the exceedance probability, where the total economic loss in the region is 124,800 USD. This research concludes that flood awareness, warnings and observing the building codes will enable reduce damage to the structural types of building, deaths and reduce damage to the building contents. A policy to mitigating the flood risk is essential which will include replacing the mud house with masonry house.

***Keyword*—** Economic loss**,** Flood Loss, Mathare Nairobi, Risk curve analysis.

I. Introduction

URBAN cities are more frequently exposed to natural hazards, to flooding. Surprisingly flood is considered as one of the hazards making most impacts on human beings [1-2] Stated also that floods claim over 20,000 lives and seriously affect around 75, million people worldwide annually. This statement does not include the loss of material, property and economic loss during the flood event.

In developing countries people living in floodplain areas are poor as they cannot afford to buy legal land, they occupy vacant riparian land along the river banks. When flooding occur, not only people who live in the floodplain areas but also neighboring areas do experience flood since the plain as been expanded (Saut Aritua 2006).

KENYA is in east Africa with a population of 42 Million census 2009, Kenya has not experienced many natural hazards apart from floods and drought. Kenya covers approximately 591,140 square kilometers, it is divided into 47 counties and each county is governed by the county governor. Flooding are most occurring natural disasters in Kenya this is caused by the high rainfall received in most cities, for example in May 2017 average rainfall received in Nairobi daily was 230mm.

According to the hazard map of Kenya (figure.1) Nairobi floods takes the highest percentage where most of the floods are concentrated in the Nairobi areas with high population due to low cost housing.

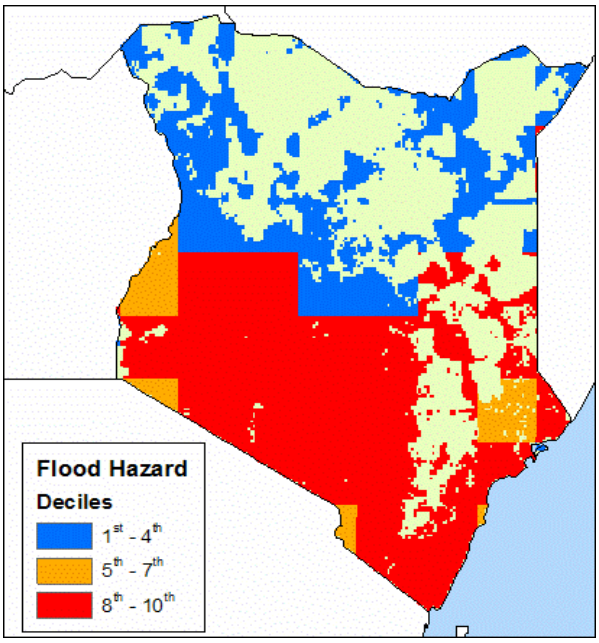

Fig.1 flood Hazard Map of Kenya. Source: [15]

Although flood is the main hazards in Kenya less attention has been paid, from 1963 the occurrence of flooding has resulted to high economic loss

PROBLEM STATEMENT

Nairobi's Mathare valley is in the floodplain of river Mathare, the region faces risks due to flooding every time there is rainfall. There is significant increase in vulnerability of the land due to uncontrolled growth of the city, the growth is attributed to the construction industry that includes the structures like roads, buildings, and pavements which has led to decrease in the infiltration of the rain water consequently increasing the runoff water that leads to floods. This is in addition to improper and poor maintenance of the drainage systems which due to blockage by sediments and debris leads to accumulation of storm water thus flooding in mathare valley.

OBJECTIVES

The main objective of this study is

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1. To identify and analyze structures at risk from floods in the residential area by use of risk curve
2. To assess the Economic damage on structural types of buildings and building contents

2. TARGET AREA

(A) Nairobi-Kenya

Nairobi as the capital city of Kenya is geospatially located between latitudes 1.163˚S and 1.283˚S and longitudes 36.817˚E and 37.104˚E with approximately 700 square kilometers and a population of 3.2million people. It is an African savanna city characterized by lowland terrain with the highest point being 1637 meters above sea level while the lowest point is 832 meters above mean sea level. Flooding has been unprecedented because proper planning has been undermined over many years.

From (figure 2) the climatic conditions of Nairobi are an evident that the region receives high rainfall in the months of April/May and Nov/Dec. Therefore such rains poses immense danger to the residents not only Mathare valley area but also the whole of Nairobi region, hence a quick response to this disastrous hazard is necessary.

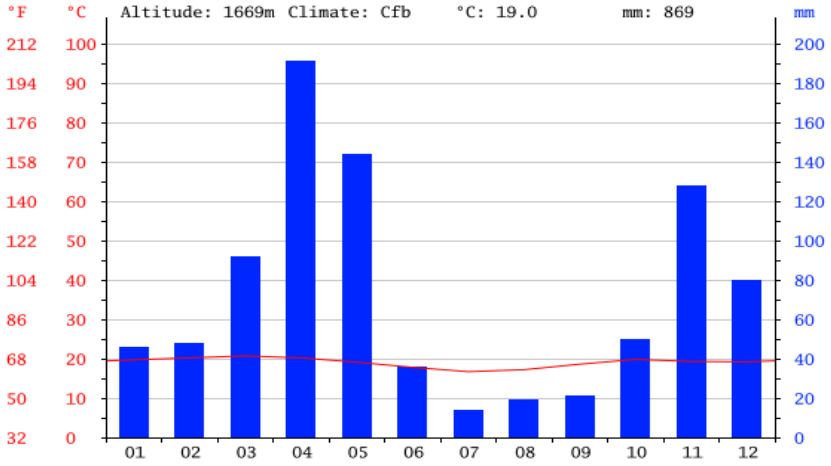


Fig.2 Monthly climatic conditions of Nairobi. Source|: (14)

(B) Mathare-Valley

This is a mainly residential estates for low income earners barely living below one dollar per day. It is located in North east of Nairobi about 4 kilometers from central business district. The entire valley measures approximately 250 acres spanning on both sides of River Mathare which indicates that the area is less than 1.5 sqarekilometer.

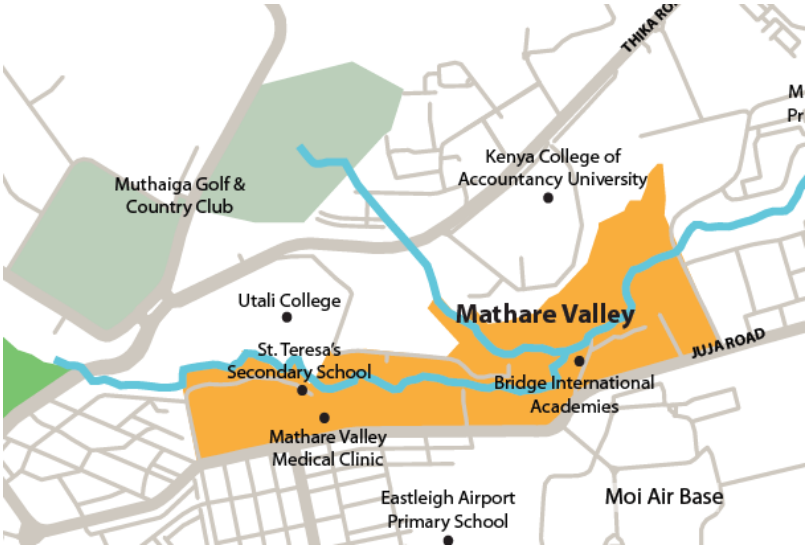


Fig.3 showing Mathare Valley and Mathare River. Source: [14]

The region has population of about 400,000, Due to population pressure 95% of the area occupied by Residential structures where the predominant type of house is the terrace housing, built end –to-end joining of rental rooms. The material used in the construction of the residential dwelling structures vary from Iron sheets, Mud structures and few masonry structures as observed from table.1, such structural houses are very much vulnerable to even small amount of rainfall that leads to swelling and overflow of river Mathare including environmental and health risks.

Table.1 type of structural houses design in mathare valley. Source: field survey and sampling 2017 Sep

Structural type	Structural Materials		Percentage
	Wall	Floor	%
Mud house	Earth and wood	Earth Material	26
Iron sheet	Iron sheet	Concrete	48
Timber	Timber	Timber	16
Masonry	Bricks/stones	concrete	10

The most affected are usually the vulnerable poor who do not have access to areas that are physically well planned with drainage structures etc. poor physical planning have assumed a worrying alert in this region hence needs a comprehensive research and mitigation factors.

From (fig 4 a and b) during the April 1998 Elnino rains where the region received an average of 280mm per day for two months many houses were destroyed, and lives were lost in mathare area.

a)

b)

Fig.4 a and b Flood scenario of river mathare April 2017 flood. Source: [9]

3. METHODOLOGY

(A) RISK CURVE

Natural hazard is a probability of occurrence, within a specific period in a given area of a potentially risky and damaging natural phenomenon.

Risk =Vulnerability x Hazard x Exposure, defined as expected number of life's lost, persons injured, damage to property, and disruption of economic activities, due to a particular natural phenomenon and consequently the product of specific risk and elements at risk. Elements at risk includes the population, buildings, public services, utilities and infrastructure. Furthermore risk always has a negative consequences and we are more likely to estimate or calculate it based on probability and severity of outcome. To evaluate risk, we need to take many factors into consideration. Generally, disaster risk is factored in relation to hazard, vulnerability and exposure as it is illustrated in figure 6.

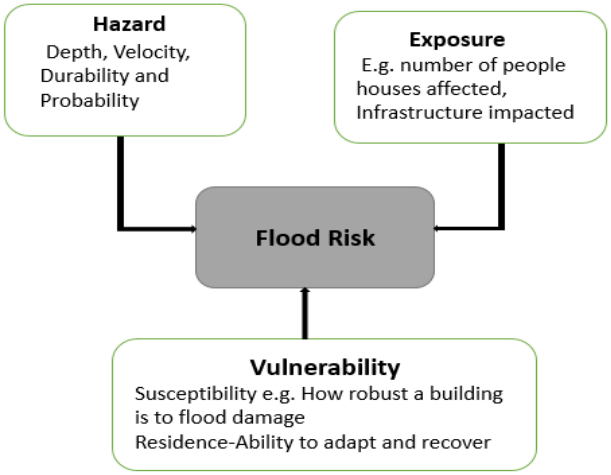


Fig 5. Conceptual disaster risk framework

The extent of disaster risk will increase when the population as an element at risk start to construct poor structural buildings with the cheapest materials that cannot withstand floods and the proliferation of underdeveloped urban areas without observation to urban construction regulations set by the national construction authority and national environmental management authority. Increasing concentration of population in such regions, the vulnerability, exposure and hence risk can dramatically increase.

It is noticeable that decreasing the vulnerability in flood areas and limiting the exposure through construction of flood resistance structural buildings, avoiding occupation of the riparian areas like water ways and floodplains less assets will be exposed to flood water therefore reducing the vulnerable elements to flood.

Risk is evaluated using a "risk curve." A risk curve is a loss exceedance probability (EP) curve that shows a correlation between two variables where the probability of exceedance is represented on the vertical axis and damage to element at risk along the horizontal axis.

Exceedance probability is defined as the Time to failure analysis, it involves the length of time (T in years) that a system/structure remains operational until experiencing a failure (i.e., exceedance) event.

As a probabilistic risk analysis such loss EP curves illustrate the calculation of all potential losses and the probability that it will occur in a specific area, In other words the risk curves show how often the occurrence of an event such as flood may have consequences such as economic loss and casualties, indicating the level of loss with different return periods. Such risk curves are generally used by decision makers, county governments, and civil disaster managers, to make plans for risk countermeasures as illustrated by figure 8 of a conceptual flood risk curve.

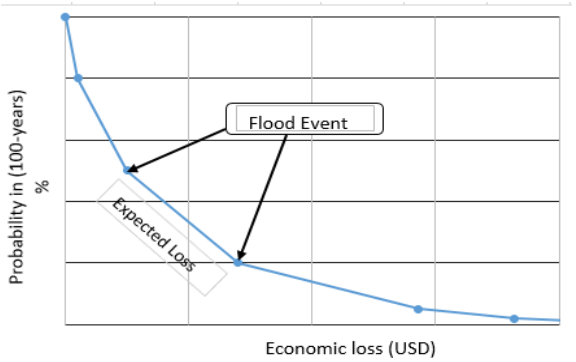


Fig .6 conceptual flood risk curve model

The area under the risk curve shows the expected loss, which in this case is economic loss. To calculate the risk in terms of expected economic loss, we combined published literature containing flood hazard surveys and vulnerability curves together with our own field survey of mathare valley. Each point on the risk curve stands for a specific level of damage such as economic loss and casualties with a specific probability of exceedance in 100 years, i.e., for a specific flood depths or velocity of flood water

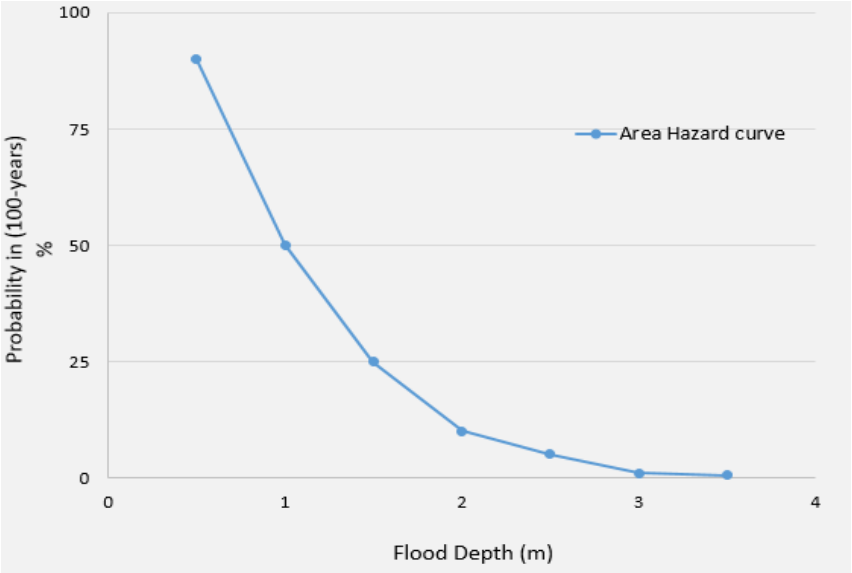


Fig.7 Flood hazard curve of Mathare valley

(B) HAZARD CURVE

Hazard is source of danger and potentially harmful to the exposed elements. The severity of flood hazard which is the depth and the velocity of the flood water can be determined in different probabilities of exceedance in 100 years through hazard curves. In other words hazard curves are a correlation of probability of occurrence of an incident in a region for a period of time. The flood scenario is made by interpolating and deriving the values of flood depth, versus the various probabilities of exceedance in 100 years.

As observed from the figure .8 the hazard curve of Mathare valley the probability in 100-years decrease with an increase in flood depth therefore that shows that example there is a probability of 100% for a certain flood depth say 2.5m to reoccur in 1 year. Hence measures and policy need to be implemented

(C) VULNERABILITY CURVE

This shows the degree of loss of a given element at risk or a set of such elements resulting from the occurrence of a natural phenomenon of a given intensity or magnitude in this case flood, on a scale from 0 (no damage) to 1 (total damage). Pelling 2003 states physical vulnerability denotes the exposure to risk and inability to avoid or absorb potential harm in the built environment, where built environment includes human settlements, infrastructure and people's property. [5] indicates the method involves assessing the potential losses as the expected results from the even specific severity based on generalized relationship between certain flood characteristics and physical damage, but the results tend not to be actual since the actual damage experienced by the residents in real time events is more due to different factors like the flood plain.

The most certain method for this research for undertaking the vulnerability is based on collection of actual flood damage information which is reported after the flood event, [6] this method was applied by white in 1967 USA. The merit of this method is that it deals with real time events, based on field interviews and questionnaires on damage to properties and level of injury to people due to floods however the respondents might exaggerate the data, but it is the most appropriate for this study because it is achievable and the respondents usually experience the flood regularly.

In this research the definition of structural type of building refers to the damage to the walls and floor parts of the building typologies considered, without considering other parts of the building for instance the structural columns, roof, and ceiling.

Vulnerability of structural type of building only takes in consideration the damage to wall and floor materials as those are used as elements at risk (see table 1 on exposure) It is determined by the percentage of damage for wall and floors from the occurrence of floods.

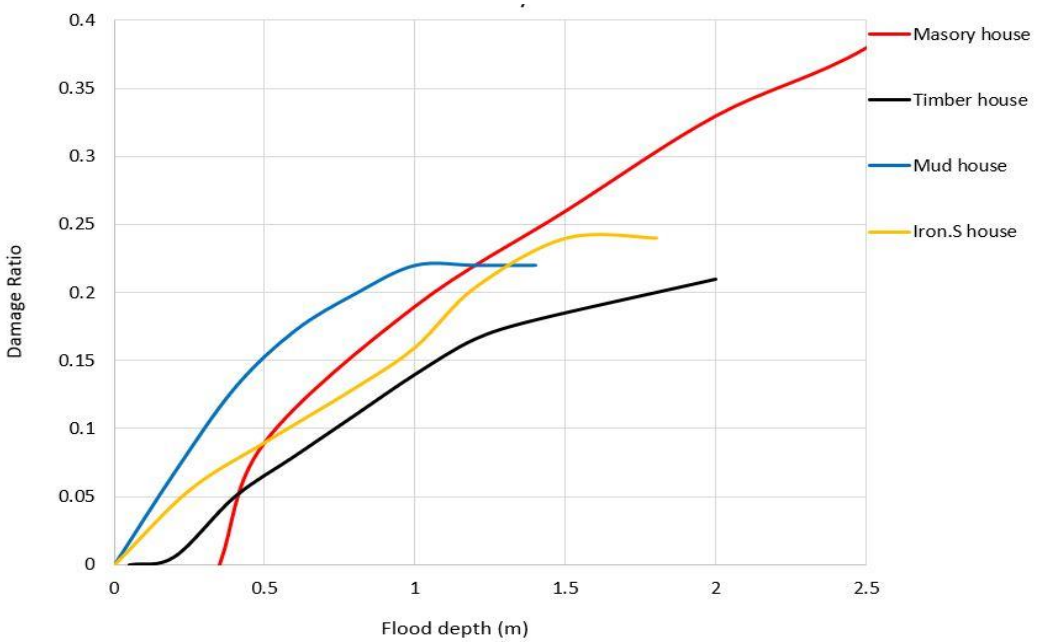


Fig.8 Vulnerability functions for each structural type of house
Source. Data analysis

It is observed that for mud house the damage ratio increases steadily as flood depth increase until 1Meter when the house is fully damaged, also looking at the Masonry house up to 0.30m there is no damage ratio meaning that the flood depth of water starts to impact this house at 0.4m also the damage ratio increases slowly as the depth increase quickly. This implies that the masonry type house is resilient to floods and mud house is very vulnerable.

RESULTS

Calculation of risk for residential buildings

The exceedance probability curves figure 9 (a) show the that the decrease in the probability in 100-years increases the damage ratio. At any point for the mud house the damage ratio is the highest if you compare with the other houses especially the masonry which has the least damage ratio, this means that more risk is expected in the mud house to the other three types of houses and the masonry house expects very little risk.

(b) Risk curve in terms of Economic loss for each residential
Building

From figure 9 (b) the risk curve in terms of economic loss of the residential houses we can easily observe that mud type of house has the largest damage and masonry has the least, the increase in damage corresponds to a decrease in the probability of exceedance in 100-years of the houses.

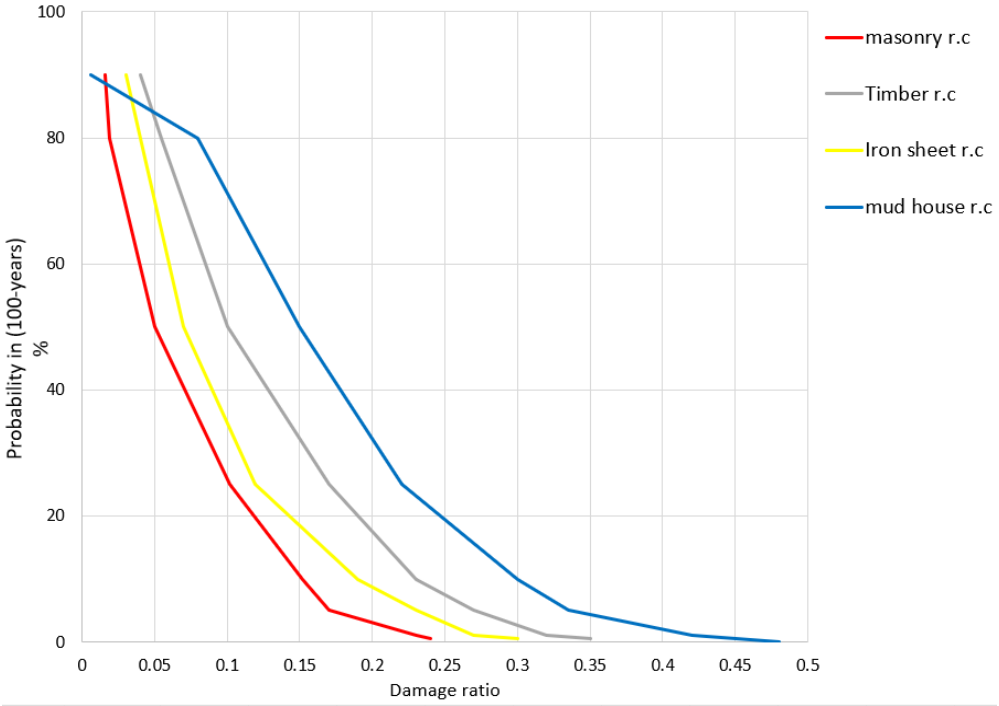
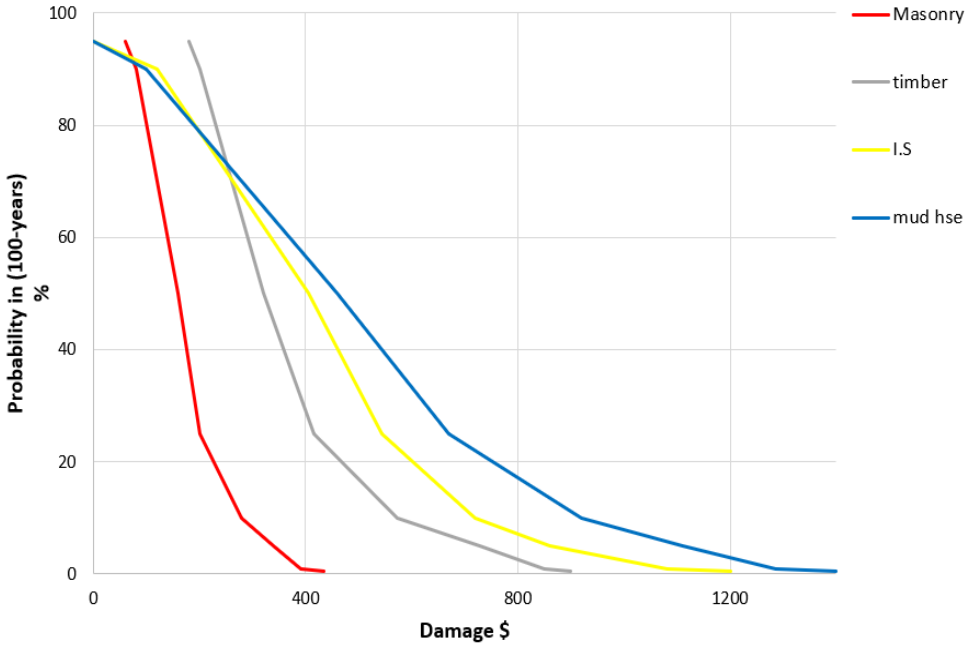
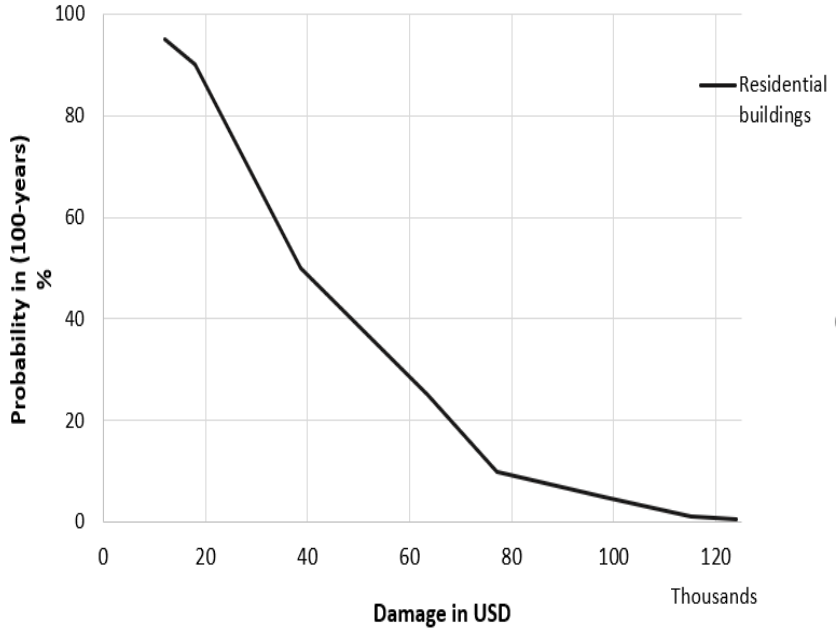


Fig 9 (a) Exceedance Probability curves in terms of damage ratio for each residential building



(b)) the risk curve in terms of economic loss for each residential building



(c) Risk curve in terms of economic loss for the target area

The risk curve shown on figure c is for the expected total loss in the target area, we expect a total economic loss of 124,830 thousand USD in the area for the number of houses sampled. The value at risk increases with decrease probability in 100-years. For instance, a 90% value at risk that means its 10% probability the economic loss is 74,400 while the 95% VAR which is 5% probability is 98,300 USD.

Table.2 (a) Value at Risk

Vhhalue at risk kkk(VAR)	**Probability in 100-years**	**nomic Damage (USTD) Thousands**
90%	10%	78.4
95%	5%	98.3

Therefore, the area is under high economic risk to floods and therefore a strong mitigation policy needs to be implemented to reduce the risk.

Table 2 (b)Total economic loss

	Economic loss (Thousands USD
Expected Loss in 100 years for all residential buildings	124.83

Discussions

- The calculated flood risk curves are concaved style that shows the expected economic loss at different flood depths and probabilities in 100-years.
- Damage dramatically increases as probability decreases, this implies that as a measure the policy is required to be implemented to reduce the sudden increase in damage when probability decrease by small margin
- Mud house is the weakest structural building followed by iron sheet structural building but expected economic loss (area under risk curve) for mud house is greatest, this concludes that one of

the lasting measures is replacing the mud house typology with masonry house which are more resilient and less vulnerable to floods.

Conclusions

- Risk Analysis of Flood physical vulnerability in Mathare valley was done by using risk curve
- Based on the results residential buildings are at a high risk of flooding, mud house and iron sheet has
- more influence on that, this includes the assets and the property in the respective households.
- Masonry house structure is the least vulnerable in Mathare valley followed by timber, although for timber the effects of floods is severe with time.
- To reduce the effects of economic loss in Mathare valley we should replace the mud house structure with the more flood resistance and resilient houses like masonry.

Appendix 1. Definition of Damage Ratio

Flood damage in this study was calculated by the formula

$$F_d = V_a \times (d,\ t,\ v) \qquad \boldsymbol{Eq.1}$$

Where: F_d - flood damage in monetary terms;

V_a - values of elements at risk [USD]; d- water depth [m]; t - flood duration [hr]; v - flow velocity [m s-1]

$$Dr = \begin{cases} 0.09 & d < 0.5 \\ 0.19 & 0.5 < d < 1.0 \\ 0.26 & 1.0 < d < 1.5 \\ 0.33 & 1.5 < d < 2.0 \\ 0.38 & 2.0 < d < 2.5 \\ 0.46 & 2.5 < d < 3.0 \\ 0.58 & d \geq 3.0 \end{cases} \qquad \ldots \textbf{Eq.2}$$

Where: *Dr* - damage ratio (-); d- water depth (m) [13]

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Assessment of Impact of Physiological and Biochemical Risk Factors on Type 2 Diabetes

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***Abstract*—**Introduction: Non-communicable diseases are emerging diseases in India. Government of India launched National Programme for Prevention and Control of Cardiovascular Diseases, Cancer and Stroke during the year 2008. The aim of the programme was to reduce the burden of non communicable diseases by health promotion and prompt treatment.

Objective: The present study was intended to assess the impact of National Program for prevention and control of Cardiovascular diseases, Diabetes, Cancer and Stroke Programme (NPCDCS) on biochemical and physiological factors influencing Type 2 diabetes in Kalaburagi District.

Material and Method: NCD Clinic was established at District Hospital during April 2016. All the patients attending District Hospital Kalaburagi above the age of 30 years are screened for Non Communicable Diseases under NPCDCS Programme. A total sample of 7447 patients attending NCD Clinic situated at Kalaburagi district were assessed in this study. Pre structured and pretested schedule seeking information was obtained from all the patients by the counselor working under NPCDCS programme. All the Patients attending District Hospital were screened for Diabetes using Glucometer at NCD clinic. The suspected cases were further confirmed through Biochemical investigations like Fasting Blood glucose, HBA1c, Urine Glucose, Kidney Function test. SPSS 20 version was used for analysis of data. Chi square test, P values and odds ratio was used to study the association of factors.

Results: A Total of 7447 patients attended NCD clinic during the year 2017-18 were analyzed, Diabetes was seen among 3028 individuals were as co morbidities along with Hypertension was seen among 757 individuals. The Mean Age of the population was 50 ± 2.84. 3440(46.2%) were males whereas Female constituted 4007(53.8%) of population. The incidence and prevalence of Diabetes being 8.6 and 12.8 respectively. Diabetes was more commonly seen during the age group of 40 to 69 years. Diabetes was significantly associated with Age group 40 to 69 years, Obesity and female gender ($p<0.05$). The risk of developing Hypertension and co morbidity conditions of hypertension and Diabetes was 1.224 and 1.305 times higher among males, whereas the risk of diabetes was 1.127 higher among females as compared to males.

Conclusion: The screening for NCD has significantly increased after launching of NPCDCS programme. NCD was significantly associated with obesity, female gender, increased age as well as co morbid conditions like hypertension and Tuberculosis.

***Keywords*—**Non communicable diseases, NPCDCS programme, Kalaburagi, Diabetes, Hypertension.

Security Challenges of Electronic Voting

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ABSTRACT-In electron-voting system, different attacks and threats may be carried out depending on the operational environment in which the system is used. Voting systems can be easily exposed to attack from different serious threats of denial of service and a Man-in the-Middle attack. Cryptographic techniques like fingerprint sensor and digital signature scheme can be used in electronic voting. Combining two techniques like digital signature and blind signature or fingerprint may be the best solution for a secured electronic voting system. The purpose of this paper address the scope of electronic voting system, and examine the main security problems in electronic voting systems, particularly security threats related to electronic voting systems, the criteria of using electronic voting systems, and solutions to security threats.

Keywords: Electronic Voting System, E-Voting Security, Cryptography, Threats, and Attacks

1. INTRODUCTION

Electronic voting refers to voting through electronic channels. With the fast advancement of technology innovation, the use of computers has turned out to more helpful for ballots through using different means such as the Internet, telephone and a private computer network. Utilizing these means can offer many advantages in voting process electronically like, cost reduction, quickness of implementation, accessibility for disabled voters, and simplicity. However, electronic voting systems have limitations in security where voting process is vulnerable to serious attacks. Without appropriate security and successful control methodology, noxious performers may instantiate a scope of risk activities, with effects varying from a "denial of service" which sabotage electronic voting and stop election in the polling station and alter the results.

Barriers to electronic voting resides in "lack of common voting system standards, election laws, cost of certifying a voting system, security and reliability of electronic voting, access to Internet voting, skills, and need for security and election experts"[3].

Voting Environment: Electronic voting environment involves voters, authentication server to authenticate the Voters and grant Voting Tickets, voting servers to collect voting tickets from voters, and a "Ticket Counting Server (TCS)", with "Trusted Certificate Authority/Authorities (CA)" [1]. Authentic and secret communications between voters and servers are based on asymmetric key cryptosystems. Therefore, voters and servers do not share any secret.

Voting scheme has following common requirements [1-6]:

- Anonymity of Voters: Identities of voters must not be revealed to other voters and Voting Server. The authentication server cannot map any voting ticket to the corresponding voter's identity, unless the voter has double voted.
- Secrecy of Voting Tickets: The contents of a voting ticket should be secret and must be protected from unauthorized disclosure; while the contents are in the clear to Voting Servers.
- Authentication between Voters and AS: AS should know that the voters are legitimate for the given election and voters should know that AS is the authority which is issuing the voting tickets.
- Validation of Voting Tickets: Voting Server S is able to check the validity of voting tickets.
- Double Voting: It should not be possible for a voter to vote more than once1; if this occurs, then this can be detected and the identity of the voter revealed.

Technical Components of Electronic Voting System are define in [1, 2, 6]

- Elections Calling
- Voters & Candidates Registration
- Polling list Preparation
- Votes Counting
- Auditing, Reviewing, and Follow-up

Criteria for E-Voting System Design is define in [1, 5, 7]

- Authentication: Only authorized voters can vote
- Uniqueness: only one vote for each voter
- Accuracy: by recording votes errorless
- Integrity: not modifying votes without detection.
- Verifiability: that votes are correctly counted for in the final stage
- Auditability: a reliable and authentic election records
- Secrecy: Only voters know how they vote
- Convenience: Voters can vote with "minimal equipment and skills"
- Verifiability: Systems should be testable against essential criteria
- Transparency: Voters must understand voting process
- Cost-effectiveness: Systems should be affordable and efficient

- Reliability: Systems should work robustly

Technologies for Electronic Voting System Security is define in [3, 4, 6]

- Cryptography: like digital signatures, blind signatures, Trusted Third Parties, digital certificates, etc.
- Antiviral software
- Firewalls
- Biometrics (e.g. fingerprint sensor)
- Smart cards

2. OTHER RESEARCHER WORKS

Researchers' efforts are exerted to find ways of tailoring electronic voting technologies that meet the needs of legal regulations, technical advances, and the dynamics of social and psychological contexts. To that end, new application areas of voting technologies arise, such as proxy voting, mobile voting, or spontaneous and secure decision-making voting in small communities. These new directions, however, also pose new challenges like identifying and defining usability and practical feasibility.

A number of papers were selected for this issue, each of which makes a significant contribution to the debate on new directions in electronic voting. The work by Abba et al. [1] addresses the question of the extent to which privacy of an election is at risk due to unanimous voting. The author applies his theoretical investigation to a real-world election in USA. In 2016, some states in USA called for recounts for general elections due to suspicions in voting systems security. The paper examined the "current and future risks and perils to the security of elections" [1]. With these citizens are willing to vote, vulnerabilities can be significantly reduced only if appropriate and adequate measures are taken and implemented in every election, at all levels [1]. The work of from Craig et al. [5] & Pan et al. [3], connects to the work of [1]. by discussing security problems for e-voting by exploring E-voting systems with their empirical studies. In [5], surveyed and deployed an E-voting system for Victoria State in Australia using open source software, while [3] built a new system, based on previous works, referred to as "Enhanced Name and vote separated E-voting system". "Enhanced Name and vote" used a protocol and a "watchdog hardware device" to ensure confidentiality and accuracy. The "watchdog device" records all voting activities during the election to prevent any disputes or any other malicious behaviors [3, 5]. The messaging protocol is based on XML. Thereby the authors build the foundation for defining an adequate trade-off between secrecy of the votes and enforcing the public nature of the elections.

In Abo Samra et al. [2], and Nisha et al. [4] addressed new approach for online voting system and mitigate risks with anti-phishing implementation like Visual Cryptography Technique. Visual Cryptography technique can find out whether voter is in phishing site or original site easily. This can improve further voting process especially for abroad, old, and disables voters. Like any secured system, design of electronic voting requires great care and evaluation of its environment. Analysis from a "system perspective" has provided valuable insight into consideration during the design and evaluation phases, and then there should be every reason to suppose that cryptographic voter verifiable voting schemes could provide high assurance elections. A threat model for E-voting test and risk mitigation can measure more like a simulation model in order to have a uniform, confidential, secure, and verifiable E-voting system.

To conclude, the papers included in this special issue contribute by highlighting the challenges of electronic voting from a number of different perspectives. They also provide an overview of the challenges, risks, and barriers with proposed solutions (theoretically and empirically) in the domain of voting technology. Table (1) summaries the related works for this research paper.

3. CHALLENGES FOR E-VOTING SYSTEM SECURITY

Studies revealed four elements that are acting as the source of threats and attacks which can threaten the integrity of elections and undermine confidence in democratic processes as well. For example, malfunction of electronic equipment, errors in software programming, delete of ballots or manipulated by privileged actors, and undermining of voters' privacy.

The technical areas that pose problems in electronic voting security are [6]:

- Denial of service attacks where hackers overload a system with requests of information. This can prevent voters from casting their ballot.
- Viruses/malicious software which corrupt voting software installed on voter's equipment, therefore affect casting process.
- Servers' Hackers, which can affect the integrity of the voting counts (e.g. breaking the computer systems to alter, copy or damage data records and software).
- System capacity Limitations which should cope with heavy demands during voting period.

Voting protocols are important for voters' privacy. It is a process of using authentication means to prevent non-eligible voters from voting, and to prevent eligible voters from re-voting. Likewise results must keep secret to the end of election in order not to affect people who have not yet voted. Other essential voting protocols are verifiability which provides voters with the "ability to verify that their votes have been treated correctly"[7]. Table (2) show voters' IPO (input/process/output) for voters' privacy and authentication.

4. ATTACKS ON ELECTRONIC VOTING & SOLUTIONS

Even though electronic voting systems have a great number of advantages like cost reduction, flexibility, and convenience, several problems can associate democratic voting process electronically. Table (3) & Table (4) present attacks and security threats on Electronic Voting and their effects [6, 9, 10].

Table 1: Summaries of the recent research works

Empirical studies conducted on E-voting security:		
Paper Reference No. and Year	**Finding**	**Remarks**
[5], 2016 [3], 2014	Both papers conducted a survey and proposed a deployment for E-voting. For [5] used open source for Victoria State-Australia voting system, while [3] presented improved E-voting based on previous works with a new protocol design and a watchdog hardware device to ensure confidentiality and accuracy.	The findings of both studies deployed a new E-voting system to ensure voter's confidentiality, candidate privacy, and voting accuracy, using encryption and shuffling of the candidates' names on the ballot for additional protection to secure the privacy and fairness of the election.
Cryptography proposal models for E-voting:		
[4], 2016 [2], 2017	Both studies focus on the problems of security on online voting system, and proposed a new approach for online voting system with anti-phishing implementation like Visual Cryptography Technique. Also how to mitigate risks.	The findings of both studies emphasized on using proposed approach to improve voting process and especially that some citizens are living abroad and others are disabled or old. Electronic voting should be uniform, confidential, secure and verifiable. It appears that security features are only one premise underlying a system's acceptance among the electorate. There exist a few cryptographic schemes which fulfill a wide range of e-voting requirements.
Descriptive studies that focuses on vulnerabilities and E-voting security:		
[1], 2017	The paper is descriptive for E-voting system phases and the importance of security in E-voting systems. The paper examines some states in USA where calls for recounts in the 2016 general elections were requested due to suspicions in voting systems security. It analyzed the risks and perils to the security of elections, and vulnerabilities that will be confronted in the future.	The paper presented recommendations about how to lessen risks associated with E-voting, and concluded that vulnerabilities can be significantly reduced if appropriate and adequate measures are taken and implemented at all levels of election.

5. ELECTIONS AND VOTING EQUIPMENT SECURITY PLAN

A security plan for voting equipment's can define measures and standards in each of the following aspect [8]:

(a) The storage of election equipment hardware and software and related election materials, including maintaining the following:
- A list of all personnel with keys and access to the election equipment storage area;
- An access log including sign in and out times and dates of all personnel given access to the storage area;
- A list of all equipment by serial number and quantity; and
- An inventory record of each piece of voting equipment, including serial number, a history of repairs, replacements, and upgrades, Log details, etc.

(b) The storage and tracking of paper ballots, and a record of all security seal numbers used to seal ballot containers and tabulators [8].

(c) The processing and storage of voter registration and voting records in the clerk's office [7, 8].

(d) "Password administrator" to issue passwords, maintains a master list of all passwords issued, and reissues all passwords on a periodic basis [8].

(e) A checklist for precinct election officers to follow for opening and closing the precincts on Election Day, including:
- A procedure to "count and verify all paper and provisional ballots, and election supplies prior to the opening of the polls" [8];
- A procedure to validate the number of voter activation devices after the polls have closed and secure the devices for transport back to the county clerk's office; and
- A procedure for securing and accounting for all voting equipment after the closing of the polls;

(f) Securing and storing the voting equipment after "Election Day and in between elections and maintenance of election materials for the period required pursuant to the law" [8]. Table 5 presents solutions to security problems related to E-voting system.

Table 2: Input/Process/Output (IPO) related to voters [8]

Input	**Process**	**Output**
Voter ID	Check if on electoral roll Check if already voted Retrieve candidates from endorsed candidates file	"Not allowed to vote" "Already voted" List of endorsed candidates
Vote, candidate name	Update voter's record with 'voted flag = 1\Retrieve candidates record Increment count in candidates record and rewrite.	Update voter's record Updated candidates record 'Thank you for voting'
Candidates file	Read in each candidates record to an array of records Sort these records into descending order of votes	Report of results showing candidate name, number of votes.

6. A SIMPLE PROPOSAL FOR E-VOTING

The concern for voter privacy is still a challenge, even for secure systems. Most audit techniques involve going through logs and determining who performed which tasks. Therefore, designing is important for a secured system to allow for anonymous votes. For example when a server receives a vote, it stores it securely until the time when all votes are counted. Also, votes are encrypted with a public key of authorized entity and decrypted with the corresponding private key.

Finger print is a simple technique can be proposed for the security of voters and votes. This technique is fingerprint sensor. Fingerprint sensor is a practical way for Electronic voting process and economical. The process consists of scanning voter's thumb to provide high performance and security to the voting counter via displaying the data-base of the voter.

As the voter pressed thumb on the finger print sensor, the sensor scans the image of the fingerprint and its unique pattern then generates a digital signal in ones and zeros. The digital output is stored against voter's database, whom the fingerprint is related, at a local center.

During the election, and as the thumb is pressed, checked, and match with the record data base with user figure print then and then only the overall system allows to voter to vote his/her respective party at that same instant screen (like LCD) displays the name of party you vote for. If the fingerprint is not matched then system displays "Data is not found" or "rejected" in case the voter tries to vote for a second time. Figure 1 illustrate system sequence diagram of e-voting.

Table 3: Important Attacks on Electronic Voting System

	Voter (with forged smartcard)	Poll Worker (with access to storage media)	Poll Worker (With access to network traffic)	Internet Provider (with access to network traffic)	OS Developer	Voting Device Developer
Vote multiple times using forged smartcard	•	•	•			
Access administrative functions or close polling station	•	•			•	•
Modify system configuration		•			•	•
Modify ballot definition (e.g., party affiliation)		•	•	•	•	•
Cause votes to be miscounted by tampering with configuration		•	•	•	•	•
Impersonate legitimate voting machine to tallying authority		•	•	•	•	•
Create, delete and modify votes		•	•	•	•	•
Link voters with their votes		•	•	•	•	•
Tamper with audit logs		•	•	•	•	•
Delay the start of an election		•	•	•	•	•
Insert backdoors into code					•	•

Table 4: Security Threats to Internet Voting Systems [9-12]

Threat Type	**Meaning & Effect**
Denial of Service Attacks (DoS)	DoS when an attacker makes the server unavailable for use. This prevents voters from accessing election web. There are four patterns of DoS attacks: - flood the election web server with a series of messages to "obstruct the network and prevent voters from accessing election web". - "disconnect connections between two computers" to prevent access to the election web. - make the election web "unreachable to a particular system or a legal user". - prevent "a specific person" from accessing the election web. As a result of such DoS attacks, serious security problems can lead to influence the justice of the election.
Virus Infestation and Malicious Software	Malicious code is known as malware that "threats using the Internet voting system". This software damages computer systems and is "distributed through Trojan horses, viruses and worms". The two malicious codes for the Internet voting systems are: - Plant malicious software into the election web server by "developers to destroy the vote data". - "Distribution of malicious software into voters' computers", thus affecting the election process. Such malicious software may be difficult to detect, because some anti-virus programs cannot detect new viruses; therefore, affect the voting process without the voters' knowledge and changing the voter's data or dropping votes.
Spoofing Attacks	Spoofing attacks is deceiving voters that they are communicating with the real election web server (Man-in-the, Middle) by redirecting the voter to fake election web server. Therefore, tamper with votes in favor of a particular preferred

	candidate and also invade voters' privacy through mining the personal information.
Phishing Attacks	Phishing attacks start with an e-mail or an advertisement on the world wide web to tempt the user into clicking a link. The link leads to a website where the attack takes place and asking the user to enter a password or disclose credit card number, or attack the user's browser directly to spy on the user's future online activities. With e-voting, an attack, a voter visits a copy of the E-voting website which has been "created by attackers". On the site, the voter is asked to enter identification code and may even be taken through a bogus voting process where vote cast would never find the way into the official ballot box.

Table 5: Solutions of Security Problems [9, 10]

Solutions	Meaning
The Use of Open-Source Software	Open-source software is a source code released to the public to be tailored based on their needs, e.g. Linux. An open-source code enables developers to discover errors and modifications in the voting results. However, there is no guarantee that the code source, which has been inspected, "is the same code source used in electronic voting systems. It may also, be exploited by hackers to change the software's code source".
Using Voter Verifiable Audit Trails (VVAT), also known as a Voter Verified Paper Audit Trail (VVPAT)	The lack of a VVAT (known as VVPAT) is a fundamental security problem of using electronic voting systems. The use of VVPAT can "preserve electors' votes as a backup paper system in case of exposure to attacks" such as DoS attack or recover from modifications in the voting results.
Using Layer (SSL) Protocol	Secure Socket Layer (SSL) protocol may mitigate the threat and prevent a third party from manipulating the voting results. The key feature of using the SSL Protocol is to "distinguish between a SSL election web and a non-SSL election web". However, SSL protocol is vulnerable to hacking through the "decrypting of transmitted data". Voters, beside cryptographic methods like SSL, are responsible to raise their awareness when browsing a legal election web address and should know the difference between a real election web server and a malicious one from "web address (https – Hypertext Transfer Protocol)".
Using a digital signature scheme	Digital signature verifies that input data comes from an authorized voter. As a result, prevents unauthorized users/attackers/ illegitimate voters, from accessing the election data centre. A digital signature can prove voter's eligibility, but cannot keep voter's vote confidential and voter's privacy over the internet. For this, blind signature with digital is effective solution. A blind signature "conceals the content of a vote while verifying that the voter is eligible".

6. CONCLUSION

Voting systems are vulnerable to attacks like denial of service and a Man-in-the-Middle attack, and phishing. Also, electronic voting hardware and software can have flaws that affect the security process of any electronic system. For the security of E-voting, cryptographic techniques, like fingerprint and digital signature, are methods that can improve security environment, especially when combining two and more cryptographic technique, in addition to using a Voter Verifiable Audit Trail (VVAT).

Security issues in electronic voting reside in two main areas, the technical security and the procedural. Even though there are limitations with the technical security, enhancing the level of procedural side of it is important. Saying this, this research has concluded that threats can be as a result of:

- Insufficient and lack of detailed procedures to control specific activities prior and during the election
- Unclear procedures to control government officials' tasks with undefined responsibilities.
- Inadequate measures of procedural security that can cover all aspects of the electoral process.
- Lack of compliance to standards and requirements.
- Design problems and inadequate staff training to use the system
- Ignoring testing plans, and auditing

For future scope, empirical studies using other cryptographic techniques can improve the voting process over internet. Biometric advances can be implemented in this regards especially for illiterate and disability people. Finally, to make the voting process more secure, reliable and confidential, electronic voting systems must meet the current generation security requirements.

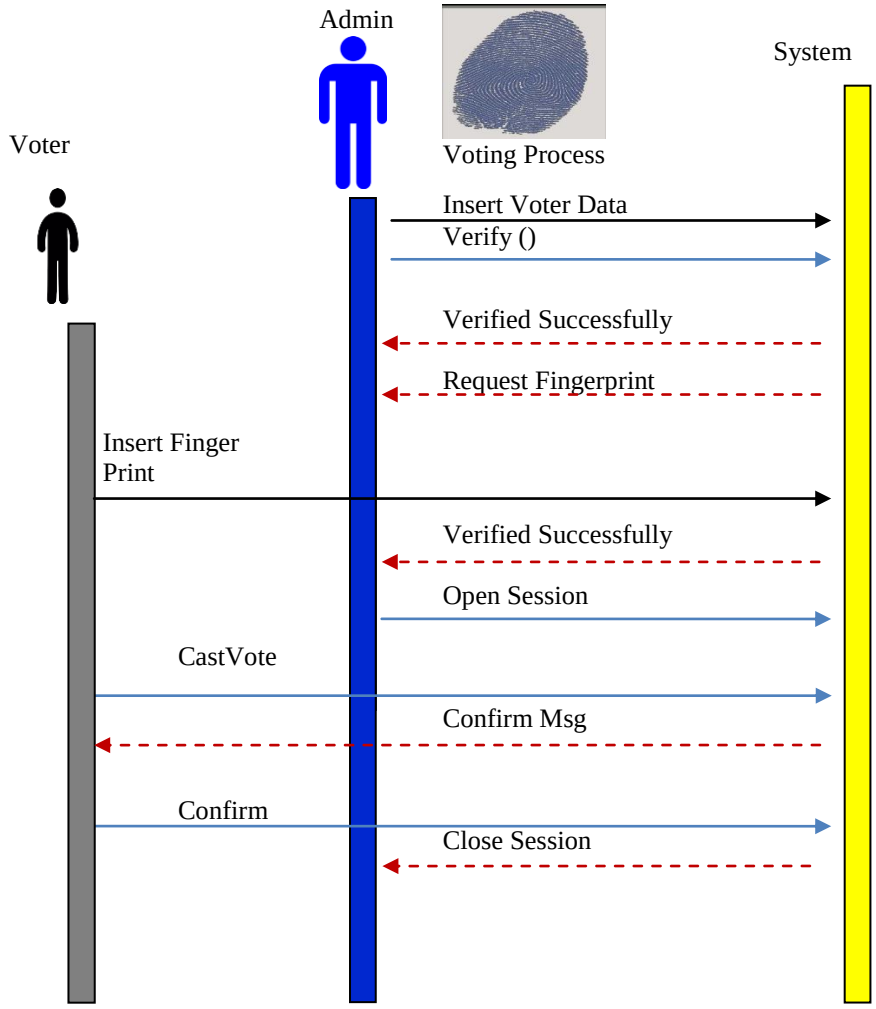

Figure 1: E-voting System Sequence Diagram.

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Mandarin Chinese Language Maintenance among Children from Chinese Immigrant Families in Saskatchewan

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***Abstract*—**Canada is a linguistically and culturally diverse nation, where First Nations, Canadian citizens, immigrants, refugees, and temporary visitors from different parts of the world are constantly remaking the fabric of society. With the dramatic growth of immigration in the last quarter of the 20th century, language is known to be the foremost issue that immigrants have to face in their new surroundings. The proficiency in at least one official language of Canada is essential for socioeconomic success; however, maintaining and passing one's mother tongue on to the next generation is considered as a significant part of immigrants' personal well-being.

The prestigious status of Mandarin in China as the language of education and government is reflected in Canada not only in the growth of the number of Mandarin speakers, but also in the highest retention rates of the language as compared to other Chinese languages spoken by Canadian immigrants. However, Mandarin Chinese language teaching in schools, community centers and churches as well as the support of Chinese languages in mass media are less pronounced in Saskatchewan than in British Columbia and Ontario in Canada. According to Statistics Canada 2011 and 2016, Mandarin use at home has been decreasing in Saskatchewan during the last two decades, especially among age groups from 5 to 14.

Therefore, one of the major inspirations for this study is to investigate the reasons for the language shift among children from Chinese-speaking immigrant families in Saskatchewan. Moreover, each family and each child is a platform where the negotiation of identities, languages and life goals unfold, thus investigating these individual platforms of language attitudes vs. the overall picture is the second major inspiration for this study.

The methodology employed in this study focuses on analyzing the oral language proficiency parameters from audio-recordings of a picture description task in the speech of 5-10-year-old bi/multilingual children. In addition, to investigate the relationship between language attitude and exposure and language proficiency, this study conducted both parents' questionnaire and children's interview. A statistical analysis of language attitude and exposure by parents and their children are measured with language proficiency parameters. The study results indicate that language attitude and exposure correlate with children's language proficiency.

This study results are summarized as recommendations for Chinese immigrant families in terms of their Chinese language's home education practices, and for Chinese language classes and schools regarding their Chinese language's teaching strategies in Canada.

***Keywords*—**Children from Immigrant Families, Language Maintenance, Mandarin Chinese, Saskatchewan Canada.

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Effect of USSP Duration on Low Cycle Fatigue Behavior of 7075 Aluminium Alloy

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***Abstract*—**Ultrasonic Shot Peening (USSP) is a novel process of refinement of surface grain to nanoscale and inducing compressive residual stress in surface region of metallic materials. The effect of USSP is studied on microstructure and low cycle fatigue (LCF) behavior of peak aged 7075 aluminium alloy, in the present investigation. The microstructure in surface region of the USSPed specimens is found nanostructured. Phase stability, crystallite size, and lattice strain resulting from USSP are analyzed by X-ray diffraction (XRD). The effect of surface roughness and the compressive residual stress induced by USSP is examined on LCF behavior of the material. Enhancement in LCF life is observed by USSP treatment up to the duration of 180 s, however, fatigue life is reduced from longer duration of USSP for 300 s. The enhancement in LCF life is from combined effects of the surface nanostructure and the associated compressive residual stresses.

***Keywords*—**Ultrasonic shot peening, Surface nanostructuring, Residual stress, Low cycle fatigue.

Wet Chemical Synthesis for Fe-Ni Alloy Nanocrystalline Powder

Neera Singh, Devendra Kumar, Om Parkash

***Abstract*—**We have synthesized nanocrystalline Fe-Ni alloy powders where Ni varies as 10, 30 and 50 mole% by a wet chemical route (sol-gel auto-combustion) followed by reduction in hydrogen atmosphere. The ratio of citrate to nitrate was maintained at 0.3 where citric acid has worked as a fuel during combustion. The reduction of combusted powders was done at 700°C/1h in hydrogen atmosphere using an atmosphere controlled quartz tube furnace. Phase and microstructure analysis has shown the formation of α-(Fe,Ni) and γ-(Fe,Ni) phases after reduction. An increase in Ni concentration resulted in more γ-(Fe,Ni) formation where complete γ-(Fe,Ni) formation was achieved at 50 mole% Ni concentration. Formation of particles below 50 nm size range was confirmed using Scherrer's formula and Transmission Electron Microscope. The work is aimed on the effect of Ni concentration on phase, microstructure and magnetic properties of synthesized alloy powders.

Keywords—Combustion, Microstructure, Nanocrystalline, Reduction.

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