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| WASET | | WORLD ACADEMY OF SCIENCE, ENGINEERING AND TECHNOLOGY | |
|--|-----------|--|-------|
| International Journal of Science, Engineering and Technology | | | |
| Conferences | Article # | International Journal of Social and Human Sciences 6 2012 | Page# |
| Committees | 1 | Taiwan Public Corporation's Participation in the Mechanism of Payment for Environmental Services <i>Wan-Yu Liu, Chun-Cheng Lin</i> | 1 |
| Publications | 2 | Stress, Perceived Social Support, Coping Capability and Depression: A Study of Local and Foreign Students in the Malaysian Context <i>Shamirah-Farah Faleel, Cai-Lian Tam, Teck-Heang Lee, Wai-Mun Har, Yie-Chu Foo</i> | 8 |
| Manuscripts | 3 | Confronting the Uncertainty of Systemic Innovation in Public Welfare Services <i>Harri Jalonen</i> | 15 |
| Submission | 4 | A Case Study on Product Development Performance Measurement <i>Liv Gingnell, Evelina Ericsson, Joakim Lillieskold, Robert Lagerstrom</i> | 25 |
| Membership | 5 | Semantic Web as an Enabling Technology for Better E-Services Adoption <i>Luka Pavlic, Marjan Hericko</i> | 35 |
| Information | 6 | User Experience Evolution Lifecycle Framework <i>Maissom Qanber Abbasi, Philip Lew, Irfan Rafique, Zhang Li</i> | 39 |
| | 7 | Factors of Effective Business Software Systems Development and Enhancement Projects Work Effort Estimation <i>Beata Czarnacka-Chrobot</i> | 46 |
| | 8 | Malaysian General Election 2008 – Key Issues That Influenced the Permatang Pauh Parliamentary Constituency Voting Behavior <i>Sivamurugan Pandian, Norazli Daud</i> | 54 |
| | 9 | Developing ESL Students' Writing <i>Esmaeil Hassannejad</i> | 59 |
| | 10 | Level of Concentration in Banking Markets and Length of EU Membership <i>Ivan Pavic, Fran Galetic, Tomislava Pavic Kramaric</i> | 67 |
| | 11 | KM Practices in Service SMEs <i>K. Cormican, G. Coppola, S. Farina</i> | 73 |
| | 12 | Effects of Market Share and Diversification on Nonlife Insurers' Performance <i>M. Pervan, T. Pavic Kramaric</i> | 81 |
| | 13 | Firm Ownership and Performance: Evidence for Croatian Listed Firms <i>M. Pervan, I. Pervan, M. Todoric</i> | 89 |
| | 14 | The Determinants of Corporate Cash Holdings in Nigeria: Evidence from General Method of Moments (GMM) <i>Sunday E. Ogunidipe, Rafiu O. Salawu, Lawrence O. Ogunidipe</i> | 96 |
| | 15 | Bail-in Capital: The New Box <i>Manu Krishnan, Phil Jacoby</i> | 103 |
| | 16 | Assessing and Managing Intellectual Capital to Support Open Innovation Paradigm <i>Michele Grimaldi, Livio Cricelli, Francesco Rogo, Alessia Iannarelli</i> | 108 |
| | 17 | Determinants of Enterprise Risk Management Adoption: An Empirical Analysis of Malaysian Public Listed Firms <i>Nargess Mottaghi Golshan, Siti Zaleha Abdul Rasid</i> | 119 |
| | 18 | Business Intelligence and Strategic Decision Simulation <i>S. Sabbour, H. Lasi, P. von Tessin</i> | 127 |
| | 19 | Statistical Study of Drink Markets: Case Study <i>Seyed Habib A. Rahmati, Arash Haji Karimi, Reza Saffari, Zeeya Rashwan</i> | 135 |
| | 20 | The Importance of Class Attendance and Cumulative GPA for Academic Success in Industrial Engineering Classes <i>Suleiman Obeidat, Adnan Bashir, Wisam Abu Jadayil</i> | 139 |
| | 21 | Working Capital Management, Firms' Performance and Market Valuation in Nigeria <i>Sunday. E. Ogunidipe, Abiola Idowu, Lawrence. O. Ogunidipe</i> | 143 |
| | 22 | Researches on Duopolistic Price Competition under the Diffusion of Price Comparison Technology <i>Xudong Lin, Quan Wang, Hanyang Luo</i> | 148 |
| | 23 | Middle East towards Incubator Benefits: Case Studies <i>Hanadi Mubarak AL-Mubarak, Michael Busler</i> | 153 |
| | 24 | Comparing Academically Gifted and Non-Gifted Students' Supportive Environments in Jordan <i>Mustafa Qaseem Hielat, Ahmad Mohammad Al-Shabatat</i> | 157 |
| | 25 | A New Framework to Model a Secure E-Commerce System <i>A. Youseef, F. Liu</i> | 162 |
| | 26 | Motivation among the Managers in Construction Companies <i>A. Marisa, Nor'Aini Yusof</i> | 169 |
| | 27 | Target and Kaizen Costing <i>Alireza Azimi Sani, Mahdi Allahverdizadeh</i> | 174 |
| | 28 | Internal Accounting Controls <i>Alireza Azimi Sani, Shahrnam Chaharmahalie</i> | 181 |
| | 29 | An E-learning System Architecture based on Cloud Computing <i>Md. Anwar Hossain Masud, Xiaodi Huang</i> | 185 |
| | 30 | The Impact of Colours on Online Marketing Communications <i>Chai-Lee Goi</i> | 190 |
| | 31 | Evaluation of the Contribution of Starting Pitchers in a Professional Baseball Team by Grey Relational Analysis <i>Chih-Cheng Chen, Yung-Tan Lee, Shih-Yang Lee, Shih-Kuei Huang, Tien-Tze Chen, Qiu-Jun</i> | 195 |
| | 32 | Publishing Curriculum Vitae using Weblog: An Investigation on its Usefulness, Ease of Use, and Behavioral Intention to Use <i>Chng Pei Eng., Mah, Boon Yih., Chng Pei Cheng</i> | 199 |
| | 33 | Accessible Business Process Modelling <i>D. D. Vaziri, D. DeOliveira</i> | 205 |
| | 34 | Leadership Branding for Sustainable Customer Engagement <i>Fauziah Sh. Ahmad, Rosmini Omar, Siti Zaleha Abdul Rasid, Muslim Amin</i> | 217 |

| | | |
|----|---|-----|
| 68 | A Meta-Analytic Path Analysis of e-Learning Acceptance Model <i>David W.S. Tai, Ren-Cheng Zhang, Sheng-Hung Chang, Chin-Pin Chen, Jia-Ling Chen</i> | 439 |
| 69 | Developing a Research Framework for Investigating the Transparency of ePortfolios <i>Elizabeth Downs, Judith Repman, Kenneth Clark</i> | 443 |
| 70 | School Homework and its Relationship with Student Academic Achievement in Malaysia <i>F.P., Chew, M. H., Teong, Z. Ishak</i> | 446 |
| 71 | Dependence of Virtual Subjects Reflection from the features of Coping Behavior of Students <i>F.S.Tashimova, A. Mirzabekova, Z. Ismagambetova, Y. Massanov, Z. Gabit</i> | 450 |
| 72 | A Game Design Framework for Vocational Education <i>Heide Lukosch, Roy Van Bussel, Sebastiaan Meijer</i> | 453 |
| 73 | Robust Human Rights Governance: Developing International Criteria <i>Helen P. Greatrex</i> | 458 |
| 74 | Collaborative Web Platform for Rich Media Educational Material Creation <i>I. Alberdi, H. Iribas, A. Martin, N. Aginako</i> | 461 |
| 75 | The Cognitive Neuroscience of Vigilance – A Test of Temporal Decrement in the Attention Networks Test (ANT) <i>M. K. Zholdassova, G. Matthews, A. M. Kustubayeva, S. M. Jakupov</i> | 467 |
| 76 | State Programs Analysis and Social Crisis Management in the Republic of Kazakhstan: A Descriptive Study <i>Madina Kenzhegaranova, Aibol Mukhsiyonov, Houman Sanandaji</i> | 473 |
| 77 | Ecotourism, Expansion, alongside with Dominant Function of Khark (kharg) and Kharko Islands <i>Maral Mohamadi Zanjani</i> | 478 |
| 78 | Interaction at a Distance – An Approach for Redesigning for Distance Education <i>Martin Henkel</i> | 482 |
| 79 | Poverty Measurement by Islamic Institutions <i>Mohamed Saladin Abdul Rasool, Arifin Md Salleh, Mohd Fauzi Mohd Harun</i> | 489 |
| 80 | Cross-cultural Analysis of the Strategy of Tolerance in the Republic of Kazakhstan <i>N. K. Satybaldina, A. G. Karabayeva, Z. N. Ismagambetova</i> | 492 |
| 81 | Awareness of Reading Strategies among EFL Learners at Bangkok University <i>Nuttanuch Munsakorn</i> | 497 |
| 82 | Psychological Structure of "Aitys" as a Process of Oral Creative Competition in Kazakh Traditional Folklore <i>S. K. Berdibayeva, Z. Z. Beissenova, A. Z. Ayaganova</i> | 501 |
| 83 | A Follow up Study on the Elderly Survivors' Mental Health Two Years after the Wenchuan Earthquake <i>Ting Wang, Huiqin Yang, Buxin Han</i> | 504 |
| 84 | Family Bonding and Self-Concept: An Indirect Effect Mediated by School Experiences among Students <i>Z. Ishak, F.P Chew</i> | 513 |
| 85 | The Effect of e-learning on the Promotion of Optoelectronics Technology and Daily Livings Literacy among Students in Universities of Technology <i>Chin-Pin Chen, David W.S. Tai, Wen-Jong Chen, Hui-Min Lai</i> | 517 |
| 86 | E-Learning Platform with SPICE web Service <i>A. Braeken, L. Sterckx, A. Touhafi, Y. Verbelen</i> | 522 |
| 87 | Empowering Communications Challenged users using Development Kits <i>Winsky P.S. Dissanayake, Chandana P. W. Prasad, Ashutosh K. Singh</i> | 526 |
| 88 | The Correlation between Peer Aggression and Peer Victimization: Are Aggressors Victims Too? <i>Glenn M. Calaguas</i> | 531 |
| 89 | Citizenship Norms and the Participation of Young Adults in a Democracy <i>Samsudin A. Rahim, Latiffah Pawanteh, Ali Salman</i> | 536 |
| 90 | The Intuitionistic Fuzzy Ordered Weighted Averaging-Weighted Average Operator and its Application in Financial Decision Making <i>Shouzhen Zeng</i> | 541 |
| 91 | Hubs as Catalysts for Geospatial Communication in Kinship Networks <i>Sameer Kumar, Jariah Mohd. Jan</i> | 548 |
| 92 | Social Aggravations during the Period of Medieval Wars in Europe <i>Nurmukhambetov Ardak</i> | 551 |
| 93 | Measuring Awareness of Waste Management among School Children using Rasch Model Analysis <i>N. Esa, M. A. Samsuddin, N. Yakob, H. M. Yunus, M. H. Ibrahim</i> | 555 |
| 94 | Novelist Calls Out Poemist: A Psycholinguistic and Contrastive Analysis of the Errors in Turkish EFL Learners' Interlanguage <i>Mehmet Ozcan</i> | 559 |
| 95 | Translation of Phraseological Units in Abai Kunanbayev's Poems <i>M. T. Kozhakanova, L.Zh.Mussaly, I.K.Azimbayeva, K.T.Abdikova</i> | 571 |
| 96 | U.S. Supreme Court Justices and Partisanship: Support for the President and Solicitor General <i>James Meernik, Joseph Ignagni, Rebecca Deen</i> | 596 |
| 97 | Cloud Computing's Software-as-a-Service (SaaS) Delivery Model Benefits Technical Courses in Higher Education <i>Janet L. Kourik, Jiangping Wang</i> | 581 |

Hubs as Catalysts for Geospatial Communication in Kinship Networks

Sameer Kumar, Jariah Mohd. Jan

Abstract—Earlier studies in kinship networks have primarily focused on observing the social relationships existing between family relatives. In this study, we pre-identified hubs in the network to investigate if they could play a catalyst role in the transfer of physical information. We conducted a case study of a ceremony performed in one of the families of a small Hindu community – the *Uttar Rarhi Kayasthas*. Individuals ($n = 168$) who resided in 11 geographically dispersed regions were contacted through our hub-based representation. We found that using this representation, over 98% of the individuals were successfully contacted within the stipulated period. The network also demonstrated a small-world property, with an average geodesic distance of 3.56.

Keywords—Social Networks, Kinship Networks, Social Network Analysis, Geospatial Communication, Hubs

I. INTRODUCTION

A social network is a set of individuals who have some kind of relationship existing among them. Relationships between individuals could be anything – from friendship, business relations, and kinship to animosity. In graph theory, individuals are referred to as nodes (or vertices) and relationships between them as edges. Social network analysis (SNA), a well established analysis method in Information Sciences, uses mathematical algorithms to analyze social networks [1]. Kinship networks have been extensively studied. Such studies have involved family rituals [2], family preservation [3], family functioning [4], and managing kinship over long distances [5], among others. Researchers who have quantitatively measured kinship networks using SNA have observed the interplay of nodes and edges, analyzed the pattern, and reported their findings. However, in this study, we took a different approach. Our aim was to pre-identify well-connected individuals and investigate whether they could play a catalyst role in faster dissemination of information in geographically dispersed regions. We carried out a case study of one of the ceremonies in an *Uttar Rarhi Kayastha* family. *Uttar Rarhi Kayastha* is a small Hindu community settled primarily in the states of Jharkhand and Bihar. Ancestors of this community belonged to the princely *Ghosh* dynasty. As for definition of kinship, due to the nature of this close-knit community, we included not only relatives but also close friends of the family.

II. MATERIAL AND METHODS

Since the primary purpose of our study was to understand whether hubs (popular individuals) could play a role in faster dissemination of physical information (i.e., invitation cards), we carried out an exploratory study.

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In this Hindu community, the last rites ceremony is a 12-day event, culminating in a grand feast (*Brahma Bhoj*). It is required for the family that is organizing the function (organizers) to invite relatives and close family friends to partake in the ceremony. The final three days of this ceremony are particularly important. Physical invitation cards are of ceremonial significance in this Hindu ritual. The card provides all the details about the last rites, vedic invocations, and contact details. Unlike other functions, such as the marriage ceremony, where the organizer has sufficient time to plan for the event and send out invitation cards, the last rite ceremony is abruptly organized. Invitation cards must reach the recipients in a week's time as the relatives who live in distant places need to organize their travel schedules to attend at least the last day of the ceremony. Organizers of this function have traditionally used the postal medium to send out these invitations, which has been not only cumbersome, resource intensive, and time-consuming, but also ineffective as, due to poor postal service in this region, many invitations arrive after the function is over. Moreover, due to organizers having out-of-date recipient addresses, several invitations always remain undelivered.

For this study, instead of following the traditional path (i.e., postal), we chose individuals we thought would know most of the people in a town. Eleven towns were identified: Patna, Bhagalpur, Bihpur, Marwa, Deoghar, Jamshedpur, Ranchi, Bokaro, Dumka, Delhi (the only town outside of Jharkhand and Bihar), and Naugachia. Ten individuals were identified as coordinators (hubs). In total, 168 individuals were identified (this includes the organizer as the main contact point) as recipients and coordinators, and a code sheet was prepared with the names of the coordinator, recipients, and the medium through which the coordinator received the invitation card pack for onward delivery to the designated recipients. Some of the coordinators were also recipients.

Social network analysis using NodeXL was used to map the distribution pattern of invitation cards and calculate the graph metrics [6, 7]. Geospatial coding and visualization was done using gpsvisualizer.com

For analysis, we calculated one global topology - geodesic distance - and two local metrics - degree and betweenness centralities. Calculation of geodesic distance determines the level of randomness of a network. Degree of a node is the number of nodes directly connected to the network. Degree of centrality, k_i of node i is defined as

$$k_i = \sum_{j=1}^n g_{ij} \quad (1)$$

where $g_{ij} = 1$, if there is link between vertices i and j and $g_{ij} = 0$, if there is no such connection. Betweenness centrality of node i was the fraction of geodesic paths that pass through i . Mathematically, betweenness centrality, b of node i , is expressed as