*G.J. MAAS (Convener).* ***Performance engineering for built environments.*** *Gerontechnology 2012;11(2):135;* doi:10.4017/gt.2012.11.02.144.00 **Participants**: *G.J. MAAS* (Netherlands), *R. FAVIE* (Netherlands), *G. ABDALLA* (Netherlands, Syria), *L. Abarca* (Costa Rica), *M. BRINK* (Netherlands) **ISSUE** In its 1948 constitution the World Health Organisation (WHO) defined health as: 'a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity'. Applied to architecture and building science these performance aspects would include: safety, security, and comfort, as well as the more societal aims of well-being, good communication, social integration, work satisfaction, economic stability, vitality preservation and disease prevention. These are infrequently taken into account in current building practices. WHO also gives clues as to a hierarchy of values by stating: "Sustainable development meets the needs of present generations without compromising the ability of future generations to meet theirs" In 'Vision 2030' the European Construction Technology Platform[1] stresses performance based engineering for building and lists three main goals to attain sustainability: (i) meeting client requirements focussing on the interaction of clients and built environments, (ii) improved interaction between natural and built environments, and (iii) transformation of the construction industry to strengthen its interaction with society and economy. Meeting client/user requirements includes striving towards a better quality of life, with improvement of indoor environment for all as one of its focal points. A better understanding of the principles guiding these phenomena opens the way to innovate building processes to better tune them to clients' needs. Tools[2] can be devised to validate expected performance in the design phase and to diffuse new knowledge in the building industry. **CONTENT** Criteria will be presented that make building process management fit for performance guarantees. **STRUCTURE** Ruben Favie will present statistics from the quality management system analysis linked to performance, Gaby Abdalla will present a statistical analysis of residents' behaviour and how it influences the performance of a home, Lilliana Guerrero Abarca will present global research on waste reduction and how waste reduction can influence the design phase, lastly Michiel Brink will introduce home automation to meet client's needs. Following the presentations there will be an open discussion led by Ger Maas. **CONCLUSION** In this symposium a performance approach of the building process will be presented as a prerequisite to meet client's requirements in the ageing society. Success criteria to manage this performance and the factors which influence the success criteria have been strongly linked to stakeholders including the user of house, office, or other facility. Apart from the traditional project success criteria the building process for the inclusive built environment will have a focus on dedicated performance criteria and factors.

**References**

1. ECTP. Strategic research agenda for the European construction sector: Achieving a sustainable and competitive Construction sector by 2030; 2005; www.ectp.org/documentation.asp#ECTP; retrieved December 23, 2005
2. http://sps.bwk.tue.nl; retrieved April 19, 2012

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*R. FAVIÉ.* ***Auditors' influence in infrastructural design-build projects.*** *Gerontechnology 2012; 11(2):135-136;* doi:10.4017/gt.2012.11.02.532.00 **Purpose** In the construction industry, the shift from traditional to integrated contracts, such as design-build, leads to different strategic choices for the client, to a new way of selecting and paying the supplier, and to different quality monitoring strategies. There are various ways to monitor and control the quality of a construction project. The use of integrated contract types, such as design-build, requires a different kind of quality control, causing a shift from product-quality check to process-quality control. The difference between product and process control is that product control is designed to detect problems with a product or service, and process control attempts to prevent problems from arising by tweaking

the production process so that it will reliably produce a quality product. In the Netherlands the General Directorate for Public Works and Water Management (Rijkswaterstaat) applies compliance auditing to assess the contractors' process quality. This system must ensure that the supplier detects defects in good time, takes corrective measures, and evaluates this process. The client's role shifts from monitoring the product quality to monitoring the quality system. Monitoring is implemented through audits conducted by the client's representatives. The objective of audits is to determine whether a supplier is competent enough to deal with the project. The audit results which represent the compliance of the suppliers are stored in a database and can be used to refine the audit strategy in order to improve control. The present research tests the influence of the auditors on the outcomes of the audits (the suppliers' compliance) within this monitoring system. **Method** To determine the auditors' influence on the outcomes, we collected empirical data from a large infrastructural project in the Netherlands. This project consisted of approximately 5,500 audit checks performed in the period 2006-2009 by 70 auditors in 57 different subprojects. Since the audit outcomes can also be influenced by other factors such as supplier-related factors, project-related factors and external factors, we enriched the data by collecting additional information about the 70 auditors, the 11 suppliers that were involved in the projects, the 57 subprojects and the external factors. This resulted in a database that we used to answer our research question. The analysis of our database started with bivariate analyses between the audit outcome and the auditor-related variables. This gave a first impression of the data and the possible factors related to the audit outcomes (compliance or non-compliance). For example, we found that there are differences between the different auditors in terms of their professional backgrounds. We did not find any influence if we looked at auditor's age, for example. To gain a deeper understanding of the bivariate findings we conducted a series of multivariate analyses (logistic regression) to investigate possible explanations for these findings with our data. **Results & Discussion** Our research showed that who the auditor is, does indeed make a difference. Auditors with a design background are generally more negative than other auditors. This could be explained by the nature of their work: designing never stops, it can always be improved. Another issue regarding the objectivity of the auditors concerns the number of audits that an auditor has already conducted in the project: auditors who conducted many audits have a higher proportion of positive evaluations. The more positive behaviour of 'experienced' auditors could be explained by the auditor's knowledge of the suppliers' work and vice versa. Another explanation could be that a certain type of relationship is formed between the auditor and the supplier resulting in a more positive assessment to maintain that good relationship. Although we did not study this in detail, we think these are plausible explanations for our empirical findings. The fact that there are differences between the auditors is an interesting and probably undesirable finding. Audit checks should be independent of who evaluates them, and this is apparently not the case.
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*G. ABDALLA, C.J.H. MIDDEN, G.J. MAAS.* ***Resident's influence on performance of energy saving technologies.*** *Gerontechnology 2012;11(2):136-137;* doi:10.4017/gt.2012.11.02.521.00 **Purpose** Technologies play essential roles in residents' energy consumption[1]. Residents' interaction with domestic technologies can strongly influence the actual performances of sustainable homes[2]. This research aims to elucidate how residents contribute to sustainable homes with regards to the performance of heat pump system for space heating and hot water supply. We mapped behavioural and demographical factors, including age and household size that can predict and influence residents' interaction with the system. **Method** A total of 135 interviews were conducted with residents in a sustainable residential district in the Netherlands. The theory of planned behaviour[3] was used to design the questionnaire. Data was imported into SPSS where statistic descriptions, Pearson correlations, factor analyses and regression analyses were performed. **Results & Discussion** This research revealed that only attitude and perceived behavioural control predict the intention to operate the heat pump system automatically. Social norms seemed to have no

influence. Environment and energy saving beliefs failed to predict residents' attitude toward using the heat pump system. Only beliefs related to space heating and having hot water are good predictors for attitude. Results showed also that only 'capacity for hot water', 'capacity for space heating' and 'maintenance' significantly contributed to the perceived behavioural control. These system characteristics can support or impede operating the heat pump system automatically. Residents prefer to an automatic heat pump system but they prefer to have control over their thermal environment. Knowledge about the heat pump system seemed to have no influence on residents' behaviour. The size of household has negatively correlation with attitude, perceived behavioural control, and intention. The bigger the household is, the more residents believe the heat pump system will not supply enough hot water and they behave accordingly. The heat pump system was positively evaluated by older residents which indicate the heat pump system fits living conditions for elderly people. This research suggested that the used approach can be applied for behavioural studies to use of new technologies for elderly people.

**References**

1. Midden CJH, Kaiser FG, McCalley TL. Technology's Four Roles in Understanding Individuals' Conservation of Natural Resources. Journal of Social Issues 2007;63(1):155-174; doi:10.1111/j.1540-4560.2007.00501.x
2. Stevenson F, Leaman A. Evaluating housing performance in relation to human behaviour: New challenges. Building research and information 2010;38(5):437-441; doi:10.1080/09613218.2010.497282
3. Fishbein M, Ajzen I. Predicting and changing behaviour. New York: Taylor & Francis; 2010

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*L. ABARCA GUERRERO, G.J. MAAS, A.J.D. LAMBERT.* ***Construction waste generation due to the design phase.*** *Gerontechnology 2012;11(2):137-138;* doi:10.4017/gt.2012.11.02.173.00 **Purpose** Construction waste is increasing worldwide. Few attempts have been made to address the effect of design practices on waste generation and most of them stem from high income economies. In this study the goal was to assess the contractors' perspectives, in a developing country setting, on the origins of waste due to the design phase. **Method** Information was collected per answer to 8 Likert-scale questions posed to 492 contractors. The respondents were asked to rate predetermined attributes according to their potential contribution to waste generation on site, based on their firm's experience[1,2]. Eighty-six questionnaires were completed in full. Descriptive and inferential statistical techniques were used to analyze the attributes for the significance of their contribution. The t-test hypothesis about means was used to draw conclusions on population parameters based on statistics observed in the sample[3]. **Results & Discussion** The analysis of the data shows that the respondents acknowledged eight attributes as having an impact on construction waste generation sources on site due to the design phase (*Table 1*). The t-student values allowed determining with 95% confidence levels that they were significant. The attributes are: building low quality products or materials selected by designers, design changes by the clients while the construction is in progress, designers not paying attention to dimensional coordination of products while designing, lack of information in the drawings, lack of knowledge about market standards, products in the market with incompatible sizes (cm, inches, varas), and designers unfamiliarity with alternative products and complexity of drawings that are difficult to read. These results compatible with the findings of Ekanayake and Ofori[3] and Osmani et al.[2] except for one that has not been reported in literature: 'Incompatible market standard sizes'. Some construction material suppliers are companies from USA that use the Imperial System units and a Spanish colonial heritage unit called 'vara' (84 cm) that is still used; these are not compatible with the SI-measures used in Costa Rica for example. Therefore extra waste is generated to fit all the pieces together. In conclusion, the methodology employed to analyse the causes of waste generation during the design phase could also be employed in studies related to aging-in-place

design issues. This study extends the knowledge about waste generation causes in a developing country.

*Table1. Causes of construction waste generation during design phases (respondents views)*

| Attribute | Sample | % positive answers |
|---|---|---|
| Low quality products selected | 86 | 86 |
| Design changes due to clients | 86 | 84 |
| No dimensional coordination of products | 87 | 91 |
| Lack of information in drawings | 86 | 80 |
| Lack of knowledge about market standard | 87 | 85 |
| Incompatible market standard sizes | 87 | 74 |
| Designers unfamiliar with alternative products | 87 | 83 |
| Complexity of drawings | 86 | 86 |

**References**

1. Bossink BAG, Brouwers HJH. Construction waste: quantification and source evaluation. Journal of Construction Engineering and Management 1996;122(1):55-60; doi:10.1061/(ASCE)0733-9364(1996)122:1(55)
2. Osmani M, Glass J, Price ADF. Architects' perspectives on construction waste reduction by design. Waste Management 2008;28(7):1147-1158; doi:10.1016/j.wasman.2007.05.011
3. Ekanayake L, Ofori G. Building waste assessment score: design-based tool. Journal Building and Environment 2004;39(7):851-861; doi:10.1016/j.buildenv.2004.01.007

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*M. BRINK, J.E.M.H. VAN BRONSWIJK.* ***Contribution of smart-home platforms to user acceptance.*** *Gerontechnology 2012;11(2):138-139;* doi:10.4017/gt.2012.11.02.274.00 **Purpose** Although smart-homes and home automation systems have great potential to support aging-in-place, they have not yet been widely introduced to older adult's homes[1]. One of the reasons is that the systems are not accepted by the end-users. Studies concerning user acceptance of smart-home technology exist[2], but the influence of smart-home platforms is not reported. These platforms integrate smart-home services and applications by sharing resources. It also supports the installation and adaptation of the system by offering support for plug-and-play applications in the user's home. The use of a dedicated smart-home platform would stimulate the widespread introduction of smart-homes, since it provides an open standard, speeds up the development of smart-home technology, and reduces costs[3]. The aim of this study is to discuss the theoretical contribution of smart-home platforms to user acceptance based on the Technology Acceptance Model (TAM) developed by the social sciences[4]. **Method** According to TAM, acceptance depends on how the user (i) perceives 'ease of use' and (ii) perceives 'usefulness' of the particular technology. To achieve widespread introduction of smart-home systems, new platforms are being developed, e.g. by the universAAL project[5]. We analyzed these platforms for the TAM-parameters perceived usefulness and perceived ease of use. **Results & Discussion** The platform's influence on perceived 'usefulness' of the smart-home system consists of the broad range of the applications it can support–e.g. both a simple community alarm and a fully equipped futuristic companion–and care robot. For these kinds of supports advanced (internet) protocols and complex forms of information exchanges (e.g. context awareness) are needed. The way a range of applications is supported by a smart-home platform has a direct influence on the usefulness of the whole smart-home system. Smart-home platforms influence perceived 'ease-of-use' in two different ways. First, the platform can simplify the installation and adaptation of connected technologies, for instance with automatic discovery of added services, auto-configuration leading to plug-and-play installation, and easy adaptation to changed user wishes or environmental conditions. Second, the platform can facilitate more complex technologies meant to support adaptive user-interfaces. This increases the ease of use of the smart-home system. Although technological smart-home platforms apparently play a key role in user's perceived usefulness and perceived ease of use, newly developing smart-home platforms, such as universAAL or Digital Home Compliance[6], did not evaluate these aspects. We conclude that perceived usefulness and ease of use of TAM

should be incorporated in the in the development of future smart-home platforms and in the assessment of existing ones.

**References**

1. Aldrich F. Smart Homes: Past, Present and Future. In: Harper R, editor. Inside the Smart Home. London: Springer London; 2003; pp 17-39; doi:10.1007/1-85233-854-7_2
2. Courtney KL, Demiris G, Hensel BK. Obtrusiveness of information-based assistive technologies as perceived by older adults in residential care facilities: A secondary analysis. Medical Informatics and the Internet in Medicine 2007;32(3):241-249; doi:10.1080/14639230701447735
3. Franchimon F, Brink M. Matching technologies of home automation, robotics, assistance, geriatric telecare and telemedicine. Gerontechnology 2009;8(2):88-93; doi:10.4017/gt.2009.08.02.007.00
4. Chen K, Chan A. A review of technology acceptance by older adults. Gerontechnology 2011;10(1):1-12; doi: 10.4017/gt.2011.10.01.006.00
5. universAAL Project; www.universaal.org; retrieved March 3, 2012
6. DH Compliant; www.dhcompliant.com; retrieved March 3, 2012

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