Using Web of System Performance Dimensions for the Evaluation of Social-Technical Systems

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Introduction

- IT primary survival factor for many organizations (Sylla and Wen 2002)
  - 50% of all new investment in organizations is in IT (Westland and Clark 2000)
  - In 2001, worldwide investment in IT > $1trillion (Seddon, Graeser et al. 2002)
- **Critical success factor in organizations** (Sylla and Wen 2002)
  - Increased productivity (Farbey, Land et al. 1993; Applegate, McFarlan et al. 1996)
  - Management support (Farbey, Land et al. 1993; Applegate, McFarlan et al. 1996)
  - Competitive advantage (Sylla and Wen 2002)
  - Business restructuring (Farbey, Land et al. 1993; Turban, Lee et al. 2000)
- **Need for evaluation of IS**
  - Many CEOs unconvinced on return on investment (Bidgoli 1996)
  - Majority of IS abandoned during/subsequent to development ($100B loss annually) (Fischoff 1989; Standish 1996)

User Acceptance Models

- System: purposeful collection of interrelated components for given purpose (Sommerville 2004):
- Two broad catergories in the area of Information Systems
  - Technical computer-based systems
  - Socio-technical systems
- Evaluation categories (Kumar 1990)
  - Formative
  - Summative
- User acceptance factors can be classified into (Hu, Chau et al. 1999):
  - Organizational characteristics (Orlikowski and Barley 2001), (Davis 1986; Davis, Bagozzi et al. 1989)
  - Individual characteristics (Janis and Mann 1977), (Kahneman, Slovic et al. 1982)
  - Technology's characteristics (Davis 1989)

Technology Acceptance Model (TAM)

- PU+PEOU ==> Attitude ==> Intention
- Successfully made usability a key application quality requirement
- Advantages relative to other models (Hu, Chau, Sheng and Tam, 1999) :
  - Applicable to diverse technologies, users, organizational contexts
  - Strong theoretical basis
  - Significant empirical support
  - IT-specific
  - Parsimonious

TAM (cont'd)

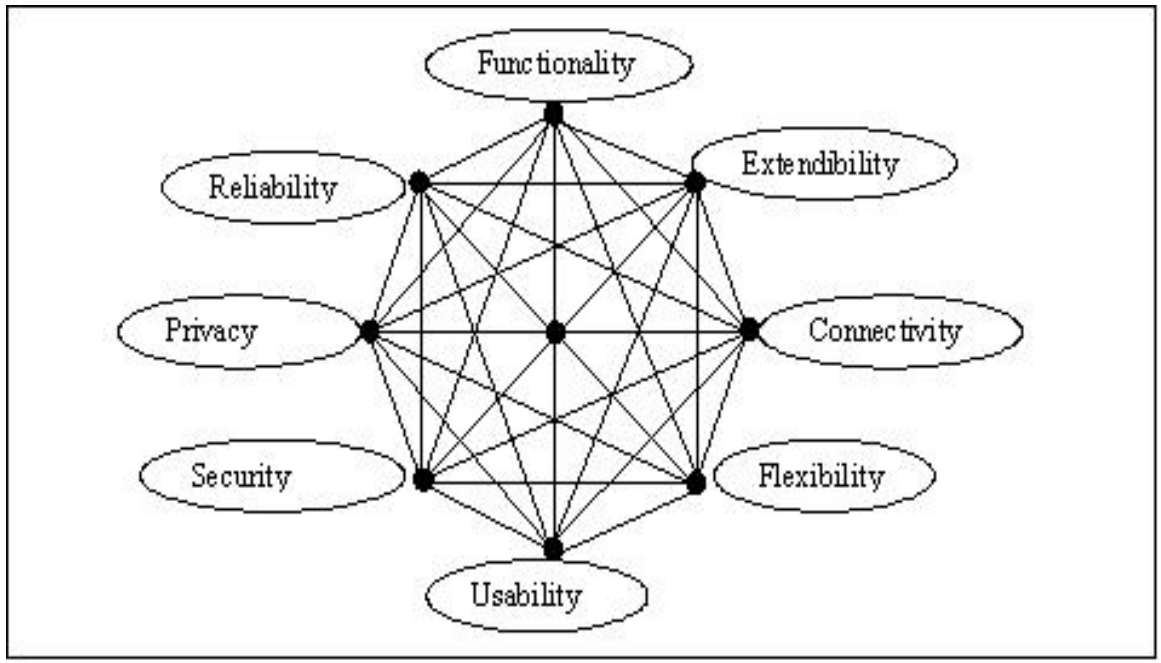
- Weaknesses:
  - Does not account for: flexibility (Knoll & Jarvenpaa, 1994); security (OECD,1996); reliability (Jonsson, 1998); extendibility (McCarty & Cassady-Dorion,1999); privacy (Benassi,1999); scalability (Berners-Lee, 2000), standards (Alter, 1999)
  - In one study (acceptance of telemedicine by physicians) (Hu, Chau, Sheng and Tam, 1999):
    - PU+PEOU==>37% variances in Attitude
    - PU+Attitude==>44% variances in Intention
- TAM is valid
- Is TAM complete?

WOSP Model

- Based on Systems theory
- IS are like any other systems in nature
- Performance defined by how successfully system interacts with its environment
  - involves many aspects
- Aspects grouped into 4 system elements, each with a dual role or subgoal:
  - **Effectors**: change external environment
    - **Functionality**: to act on environment
    - **Usability**: to reduce action costs
  - **Boundary**: determines what enters system
    - **Security**: to prevent entry
    - **Extendibility**: to use outside objects
  - **Structure**: Manages and supports system
    - **Reliability**: to perform the same despite internal change
    - **Flexibility**: To perform differently given external change
  - **Receptors**: Enable communication
    - **Connectivity**: to exchange social meaning
    - **Privacy**: to limit social meaning exchange

WOSP cont'd

- S+E+R+F+U+F+C+P= Sys. Performance
- Dimensions in a state of natural tension



Research Question

- WOSP particularly applies to social-technical systems (Whitworth and Whitworth, 2004)
  - These add a social level to system performance
  - e.g. email, browsers, bulletin boards
- Do users take account of the WOSP factors when assessing the performance of alternative information systems?

Evaluating WOSP model I: Experimental Software

- Browser (increasingly important):
  - Becoming universal platform for e.g. information searches; email; discussion groups; internet; intranet; and extranet application
  - Good example of a socio-technical system
  - Exist many different browsers and versions
  - Organizations likely to choose/recommend one for compatibility reasons

Evaluating WOSP model II: Analysis Method

- Multivariate dependence analysis
  - Dependent variable - Perceived performance
  - Independent (predictor) variables - WOSP factors
- The predictor variables are known
- Method of choice: CONJOINT ANALYSIS (Hair, Anderson, Tatham and Black, 1995)
  - People evaluate by adding up part utilities:
  - Widely used in marketing and agriculture
    - New to IS research

Evaluating WOSP model III: Experimental Design

- Subjects:
  - 28 grad students: 43% female, 53% male
  - Diverse cultural background
  - Av. browser usage: 8 years (23hrs/week in last 6 months)
  - Reasons for use: e.g. information search; online banking; online purchasing: email; taking courses

Evaluating WOSP model IV: Experimental Design

- Method
  - Preliminary priming phase:
    - Subjects asked to rate on 1-5 scale illustrative factor statements on *clarity, validity, importance*
  - Second phase: to evaluate each browser:
    - Grade as *strong, good, adequate, limited, weak*
    - Score each browser 1-100
    - Rank each browser 1-33 (no two with same rank)
    - Explain reasoning behind decisions
  - Whole procedure carried out via email

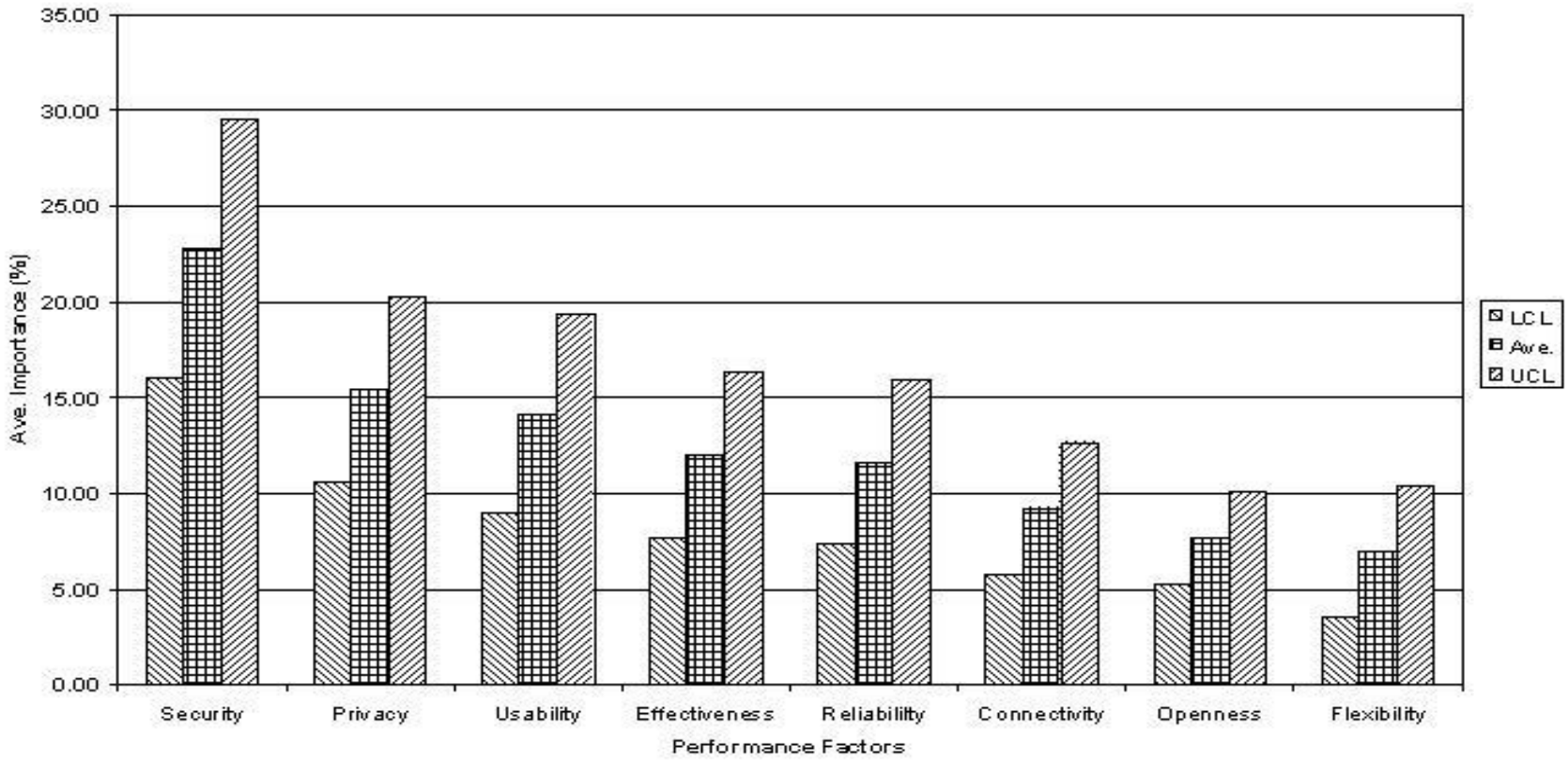
Results I

- Accuracy of results:
  - Internal consistency of subjects for all but 3:
    - Kendall's tau (holdout/actual responses)> 0.4 ($p<0.01$)
  - Extreme outliers of part worths:
    - One outlier (for usability)
  - 4 data sets excluded from further analysis
- Analysis of results:
  - If av. Importance >= 12.5% factor is significant
  - The percentage of subjects giving a factor av.importance>= 12.5%

Results II

Performance Factor	**Avg. Importance**	**Std Dev.**	**99% Confidence**	**above12.5%** (Subjects who gave factor importance>12.5%)
Security	22.78	12.78	16.07-29.50	70.83
Privacy	15.47	9.19	20.30-10.64	58.33
Usability	14.16	9.88	19.36-8.97	50.00
Functionality	12.02	8.21	16.33-7.70	29.17
Reliability	11.64	8.15	15.93-7.36	33.33
Connectivity	9.24	6.54	12.68-5.80	33.33
Extendibility	7.69	4.56	10.09-5.30	16.67
Flexibility	6.99	6.46	10.39-3.59	16.67
Correlation with Avg. Importance				**0.95**

Results III
(Graphical representation)



Conclusion

- All factors are not of equal significance
- Security, usability, functionality, reliability, and connectivity are significant
  - Extendibility, flexibility not as significant, but still important
- A high correlation (0.95) between %age of subjects giving importance>= 12.5% and the av. importance of the factors

Discussion I

- Results support findings in IS literature:
  - E-commerce (leading Web-based application) projected to have a market >$1trillion
    - however, information security a major stumbling block (Joshi, Aref et al. 2001).
  - Privacy is a prerequisite in the information society (Clarke 1999) (Wright and Kakalik 1997)
    - helps prevent commoditization of human beings
    - is a means of enabling e-commerce and electronic service delivery

Discussion II

- Results suggest that the dimensions by which modern software is assessed are many
  - However, the top rated dimensions were outside current major technology acceptance models like TAM
- Most WOSP dimensions but not all, registered with the users of browser software
  - each software type may have its own performance profile.
  - future work may define the criterion weights of the WOSP performance factors for different types of software.