Green IT, Culture and Ontologies

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Which produces more CO2 pollution?

Questions

- Which industry produces more CO_2 pollution, aviation or IT?

- What proportion of CO_2 emissions is produced by these industries?

Answer

- Both aviation and IT produce around 2% of total CO2 emissions.

Summary

- The Green Agenda
- Green IT
- Organizational Culture; Cameron and Quinn's Competing Values Framework
- Impact of Organizational Culture on Sustainability and the Adoption of Green IT
- Green Ontologies
- Conclusions and Future Research Directions

Definition of Green IT

Three key elements:

- Avoiding waste of energy

- Avoiding pollution (e.g. through disposal of PCs)

- Information Systems which support sustainability (e.g. Intelligent Buildings)

The Green Agenda

- "Development that meets the needs of the present without compromising the ability of future generations to meet their needs"

  Brundtland Commission, 1987

Key Issues

- Greenhouse gases $\longrightarrow$ Climate Change

- Natural resources used at an unsustainable rate

- Pollution

- Careless waste disposal

Legal and Political Framework

- Kyoto Protocol (2003)

  requires signatories to commit to reducing greenhouse gases

- UK Climate Change Act (2008)

  requires companies to continually reduce their carbon footprint

- USA Sarbanes Oxley Act (2002)

  requires environmental reporting by companies

- Paris Accord (2016)

Emissions Trading

- Governments allocate companies a maximum amount of greenhouse gases they are allowed to emit

- These may be traded

- European Union Emission Trading Scheme is the largest

- Emissions trading is highly complex and its validity has been widely challenged.

Role of Companies

- Sustainability must be delivered by companies
- But traditionally companies seek to maximize:
  - Profits
  - Return to shareholders
  - Market share
- They regard their stakeholders as:
  - Shareholders
  - Customers
  - Employees

Triple Bottom Line

- Companies must widen their concept of 'stakeholder'

- Need to consider the TBL of 'People, Profit and Planet'

- Closely linked to concept of 'Corporate Social Responsibility' (CSR)

Resource Based View (RBV)

- Key concept in modern company theory
- A company's competitive advantage resides in its ownership of a set of resources that are not easily duplicated
- These resources can be physical, organizational or social, including:
  - tacit skills developed through long practice
  - social skills developed through complex group interaction

Natural Resource Based View

- NRBV extends the RBV to include resources and capabilities related to sustainability
- Environmental concerns will be key driver of industry in coming decades
- Possession of environmental resources and capabilities will:
  - Confer competitive advantage
  - Lead to more efficient production techniques
  - Enhance reputation of companies

Natural Environmental Orientation

- Higher order construct comprising:
  - Entrepreneurship
  - CSR
  - Commitment to the natural environment

- NEO positively linked to profit and market share, but negatively related to sales growth

- Journeault argues that use of environmental management accounting is positively linked to economic performance

The Need for Greener IT

- Responsible for around 2% of C02 emissions, comparable to aviation industry
- Computers are often:
  - Left switched on all the time
  - Replaced unnecessarily
- Computing equipment contains chemicals which pose major threat to health
- 80% of electronic waste sent to developing world for recycling

Avoiding Waste

- Server Virtualization

- Software as a Service (SAAS)

- Cloud Computing

Green Information Systems

- Environmental information systems monitoring water consumption and pollution
- Intelligent Buildings
- Supply chain information systems optimizing routing and transportation
- Integrated Sustainability Framework (Dao et al. (2011)
    - Combines IT resources with Supply Chain Management and Human Resource Management

Green IT Laws and Concordats

- European Union Waste and Electronic Equipment (WEEE) Directive (2003)
  - producers, importers and resellers of electronic equipment must dispose of, refurbish or recycle equipment in an environmentally sound manner.
- Japanese Home Electronics Recycling Law (1998) imposes similar requirement to WEEE for domestic electronic equipment
- EPEAT – international environmental ratings systems for computers and other electronic equipment

# What is Organizational Culture?

- Culture comprises the collective assumptions and "the way we do things around here"

- People copy, coach and correct each other to fit into this collective Culture and be part of the group

Definition of Organizational Culture?

"A pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration that has worked well enough to be considered valid and hence to be taught to new members as the correct way to perceive, think and feel in relation to those problems."
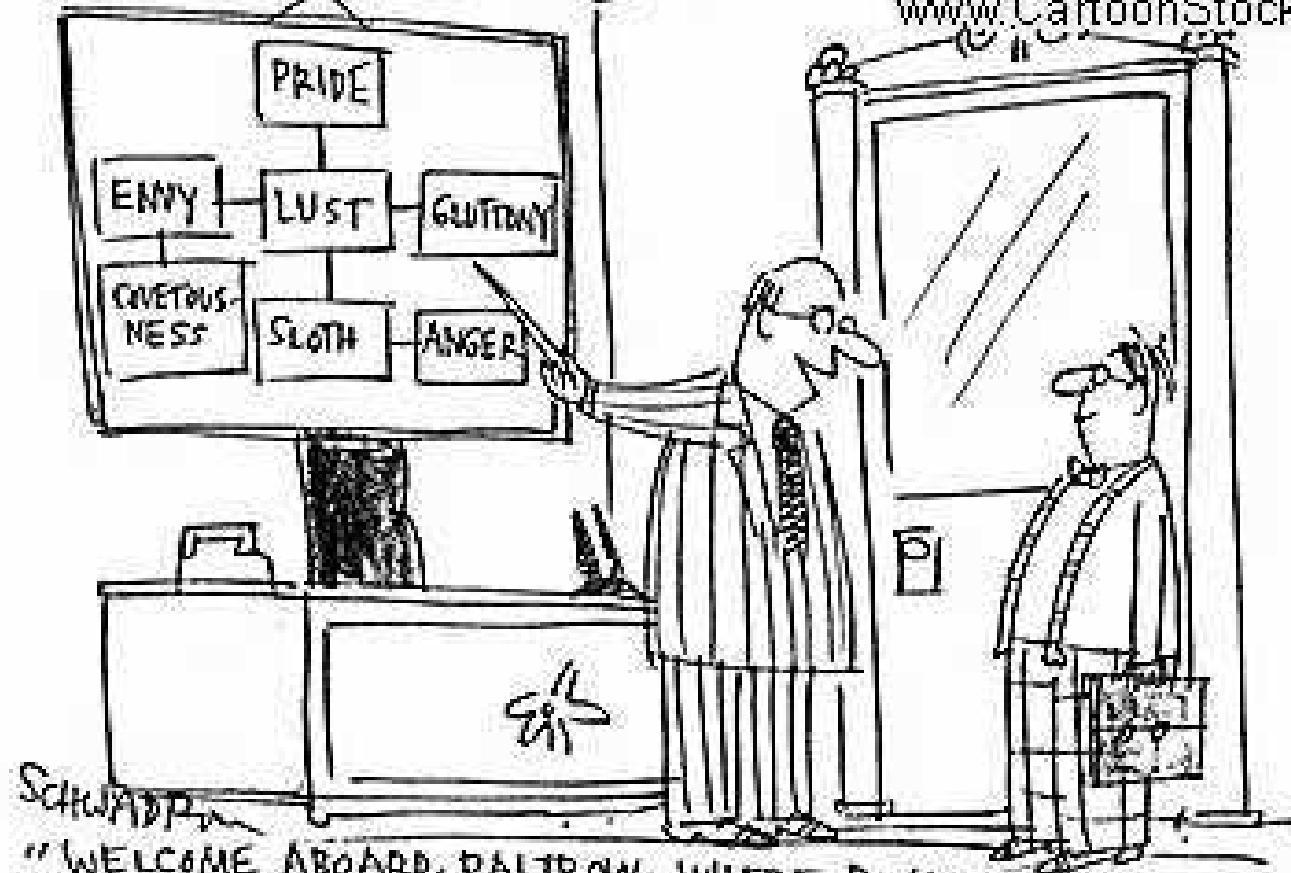
Schein 1992

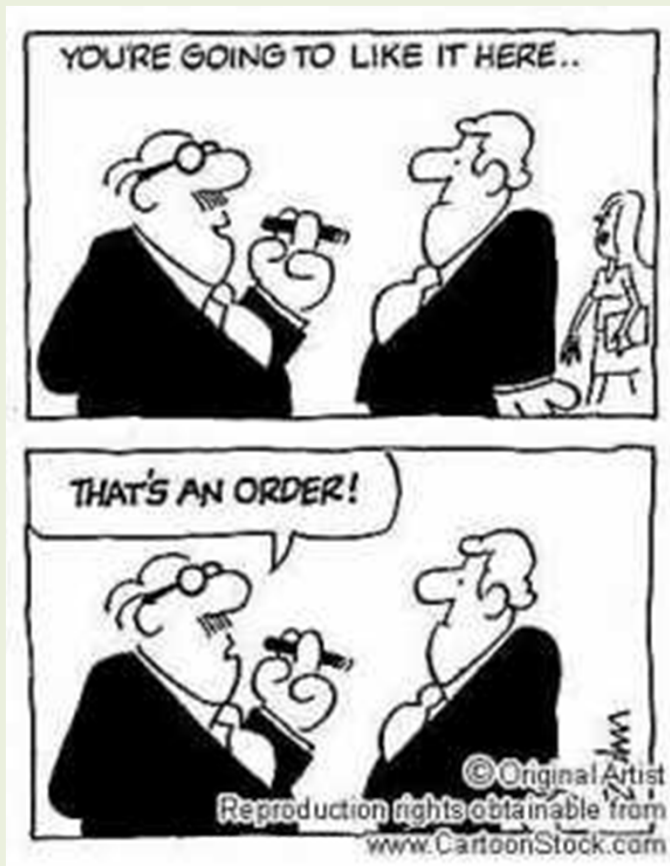# Popular cartoons are often satirical about organizational cultures
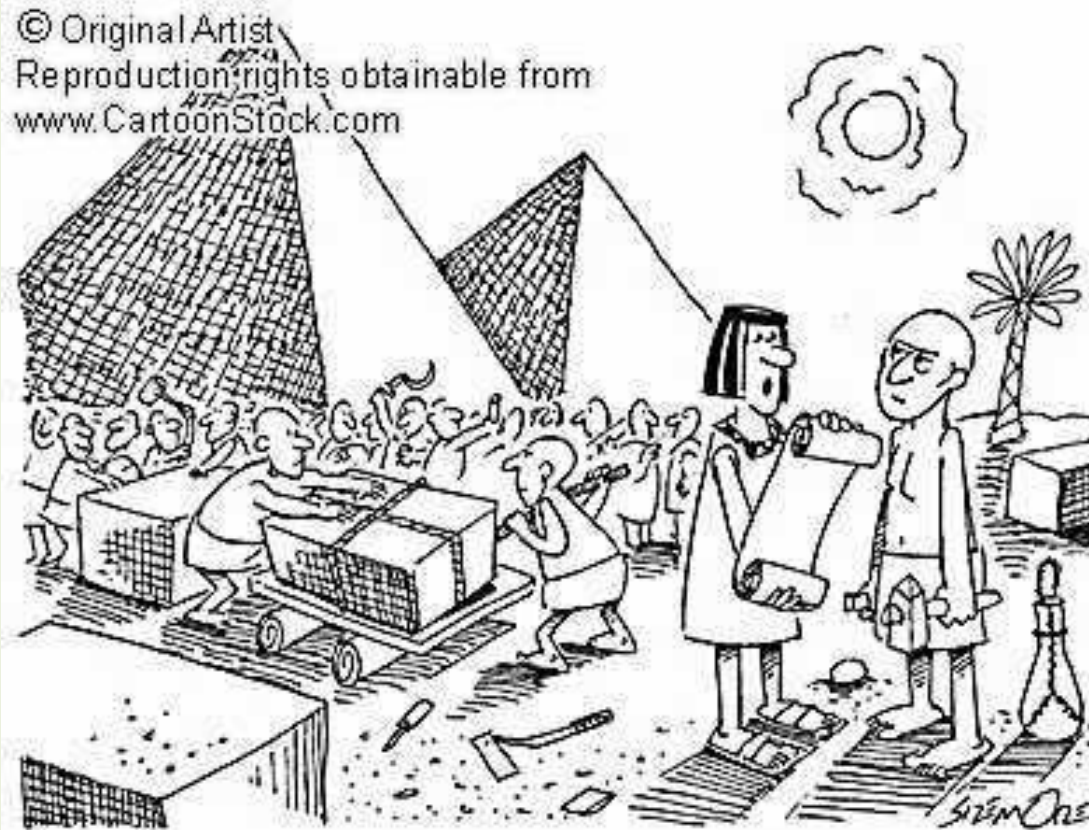
"WELCOME ABOARD, PALTROW. WHERE DO YOU SEE YOURSELF IN THE SCHEME OF THINGS?"

"First of all, let's find out who blew the whistle on us."

Levels of Change

Societal Culture
"Who we are," customs

Organizational Culture
"The way we do things here"

Team Norms
What's (un)acceptable;
"This is what we do"

Individual Personality
Values, beliefs,
temperament, habits;
"Who I am"

The Infrastructure of Every Organization

Physical
(Processes, Tools, & Structures)

Infrastructure
(Management Systems, Measurements & Rewards)

Behavioral
(What Groups & Individuals Do)

Cultural
(Values, Beliefs, & Norms)

Easiest

Most Difficult

Ability to Influence or Change

Short-Term

Long-Term

Durability of the Change
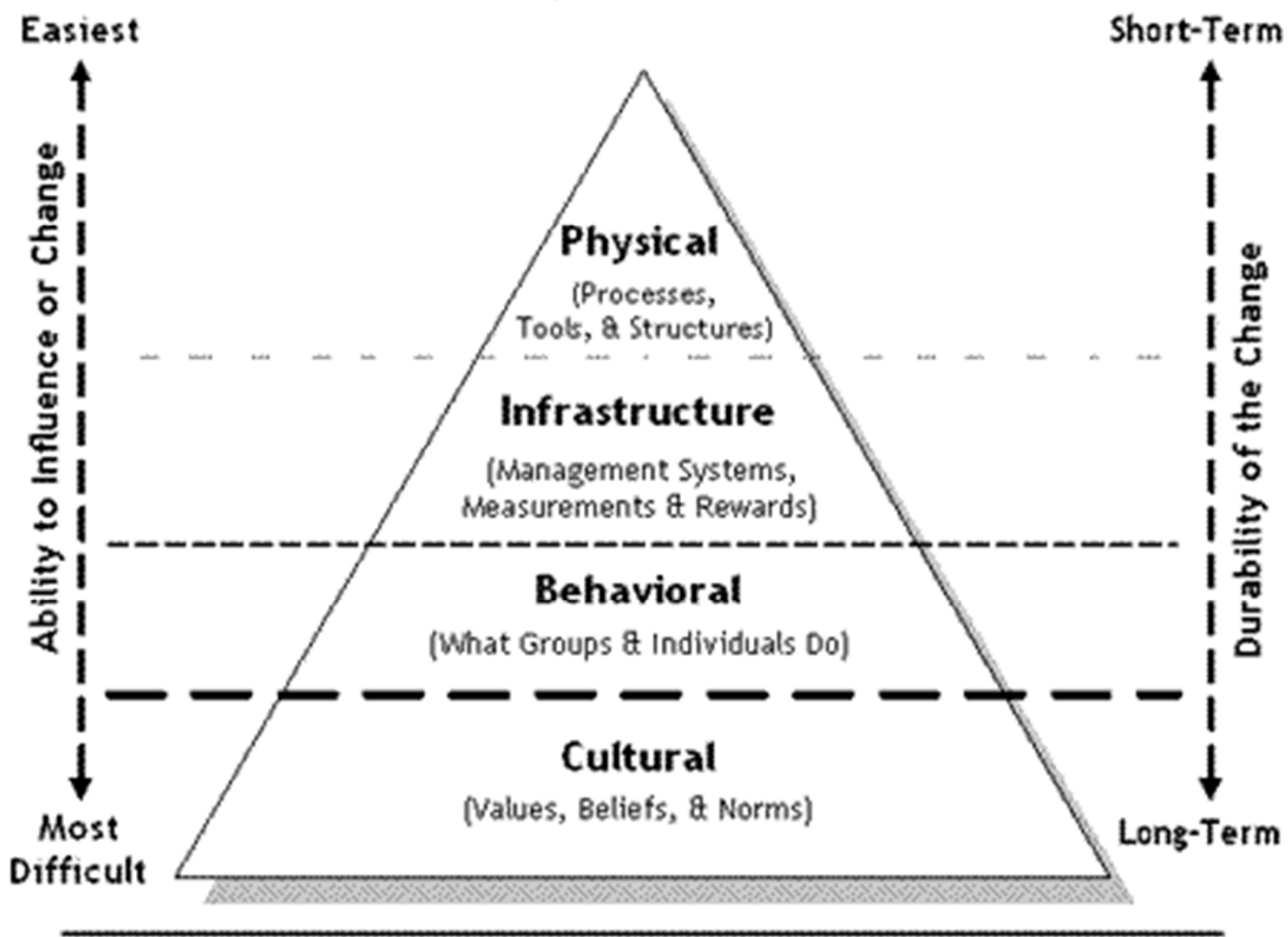
The Culture Iceberg: 90% hidden

Observable symbols, ceremonies, slogans, stories, dress, physical settings, decoration, etc.

dress – age
race/ethnicity
gender – language
eye behavior – facial expressions

body language – sense of self

notions of modesty – concept of cleanliness

emotional response patterns – rules for social interactions

family practices – decision-making processes

approaches to problem solving

concept of justice – values and fairness

perceptions of mental health, health, illness, disability

patterns of superior and subordinate roles in relation to status by age, gender class

Values, beliefs, norms, customs, nonverbal behaviour, etc.

Shorter, easier to change

Level of conscious awareness

Long term, difficult to change

Company Culture matters:

- "The way we do things around here" determines:
- Behaviour, and thus:
- Performance and Turnover,
- Customer Satisfaction and Reputation,
- Market share and Competitiveness
- Employee Retention, etc.

The need for culture change:

- Nearly 75% of organizational change projects fail

- The most common reason cited is a company culture that resists change

- Of the largest US 100 companies in 1900, only 16 now exist

- The top 10 in demand jobs in 2012 did not exist in 2004.

Consultancy

- Consultants are often called in to facilitate major change in companies
- They need to
  - Diagnose the existing culture
  - Work with staff to identify an appropriate new culture
  - Engage people and turn any resistance into momentum and successful change

The Competing Values Framework

- There are many tools for assessing company culture

- The most widely used is the Competing Values Framework

- Developed by Cameron and Quinn from the University of Michigan

Key Dimensions

- 2 major polarities of values were found to determine organization's effectiveness:

  - Internal versus external focus
  - Stability versus flexibility

- This creates 4 major cultural types

4 Culture Types
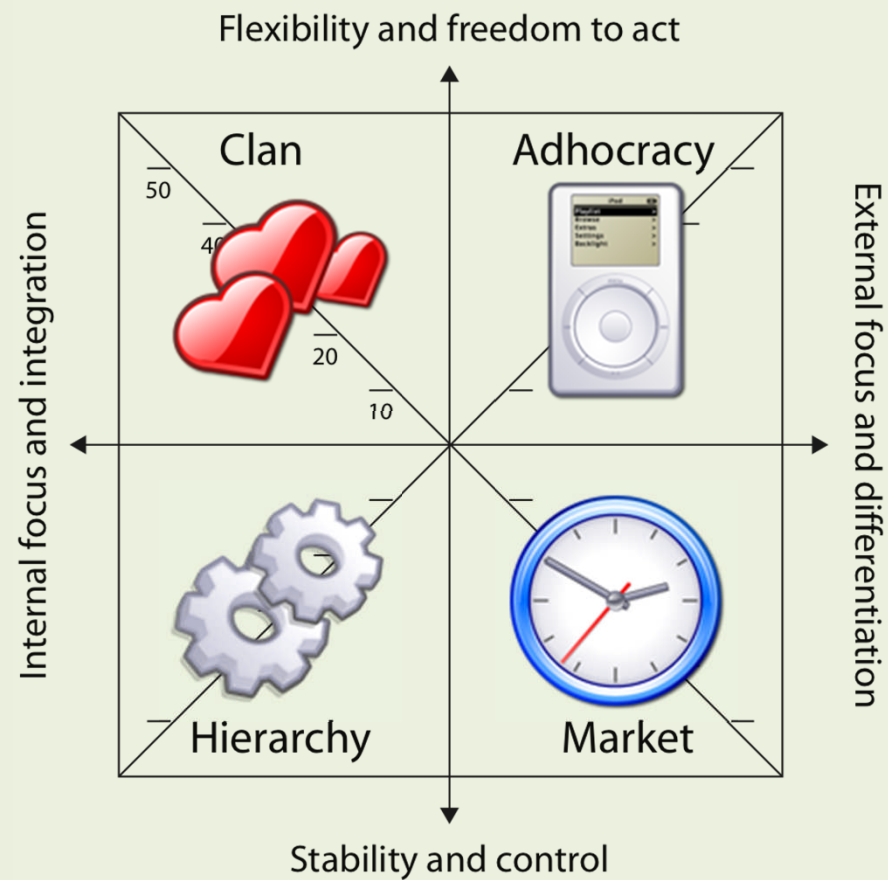
Clan culture

- Internal focus & flexibility
- 'Family': friendly
- Leader type: father, mentor
- Communication, commitment, development
- Theory = High commitment and solidarity produce effectiveness

Adhocracy culture

- External focus & flexibility
- Dynamic, entrepreneurial, creative
- Leader type: innovator, entrepreneur

- Innovation, agility, transformation

- Theory = Innovativeness, growth and creativity produce effectiveness

Market culture

- External focus & stability
- Result orientated, competitive
- Leader type: hard-driver, demanding
- Market share, goal achievement, profitability
- Theory = Goal achievement, market share, numbers produce effectiveness

Hierarchy culture

- Internal focus & stability
- Formal attitude, structure, procedures
- Leader type: coordinator, organizer
- Efficiency, reliability, timeliness, consistency
- Theory = Efficiency, timeliness and consistency produce effectiveness

The Organizational Culture Assessment Instrument

- Focuses on key attributes of an organization's culture

- Looks at the current and desired positions

- Provides a tool for consultants to initiate a change process in a structured, unthreatening way

OCAI assesses 6 key dimensions of culture:

1. Dominant characteristics
2. Organizational leadership
3. Management of employees
4. Organization glue
5. Strategic emphases
6. Criteria of success

The assessment:

- Divide 100 points over 4 descriptions that correspond with the 4 culture types
- Dividing points is just like real life, where you have to divide your time, energy and money
- Assess each of the 6 key dimensions for the current situation

OCAI online

Assess organizational culture quickly, easily and reliably

Introduction Instruction Registration	Current situation Question						Preferred situation Question						Customize results	Get results
● ● ●	1	2	3	4	5	6	1	2	3	4	5	6		
	●	○	○	○	○	○	○	○	○	○	○	○	○	○

Question 1: Dominant Characteristics - now

|	
The organization is a very personal place. It is like an extended family. People seem to share a lot of personal information and features.	40
The organization is a very dynamic entrepreneurial place. People are willing to stick out their necks and take risks.	20
The organization is very result oriented. A major concern is getting the job done. People are very competitive and achievement oriented.	30
The organization is a very controlled and structured place. Formal procedures generally govern what people do.	10

Next

Completing the assessment:

- Assess each of the 6 key dimensions for the current situation

- Then assess each of the 6 key dimensions for the preferred situation (let's say in 5 years)

Example OCAI cultural profile
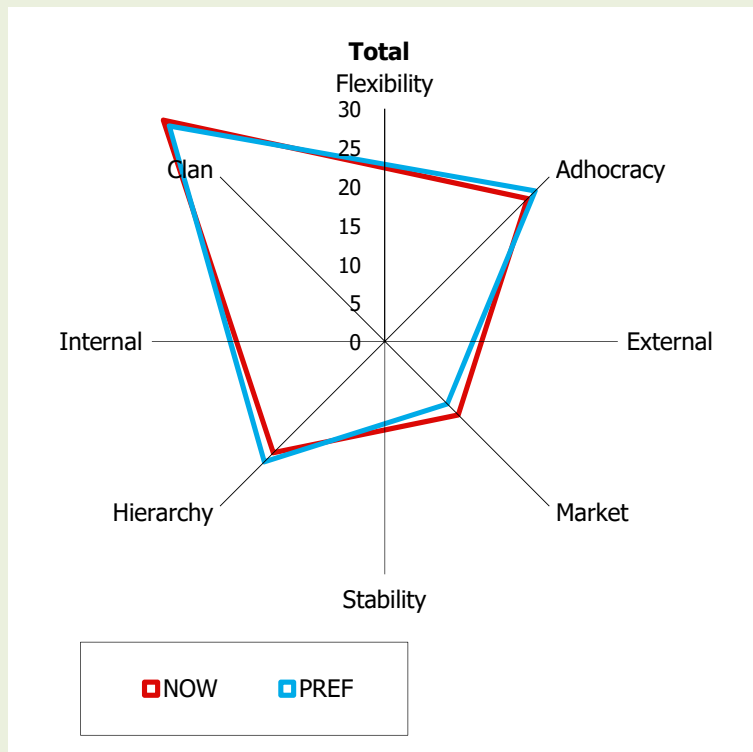
	Now	**Preferred**
Clan	40,32	39,26
Adhocracy	26,02	27,41
Market	13,38	11,39
Hierarchy	20,28	21,94
	100	100

The profile shows:

- Dominant organizational Clan Culture, followed by Adhocracy Culture. Focus on flexibility and professional freedom.
- Hardly any difference between Current and Preferred culture. "I'm content." "I don't want change."
- A fairly strong dominant culture of about 40 points.
- This profile should be discussed with colleagues

Average Company Profile
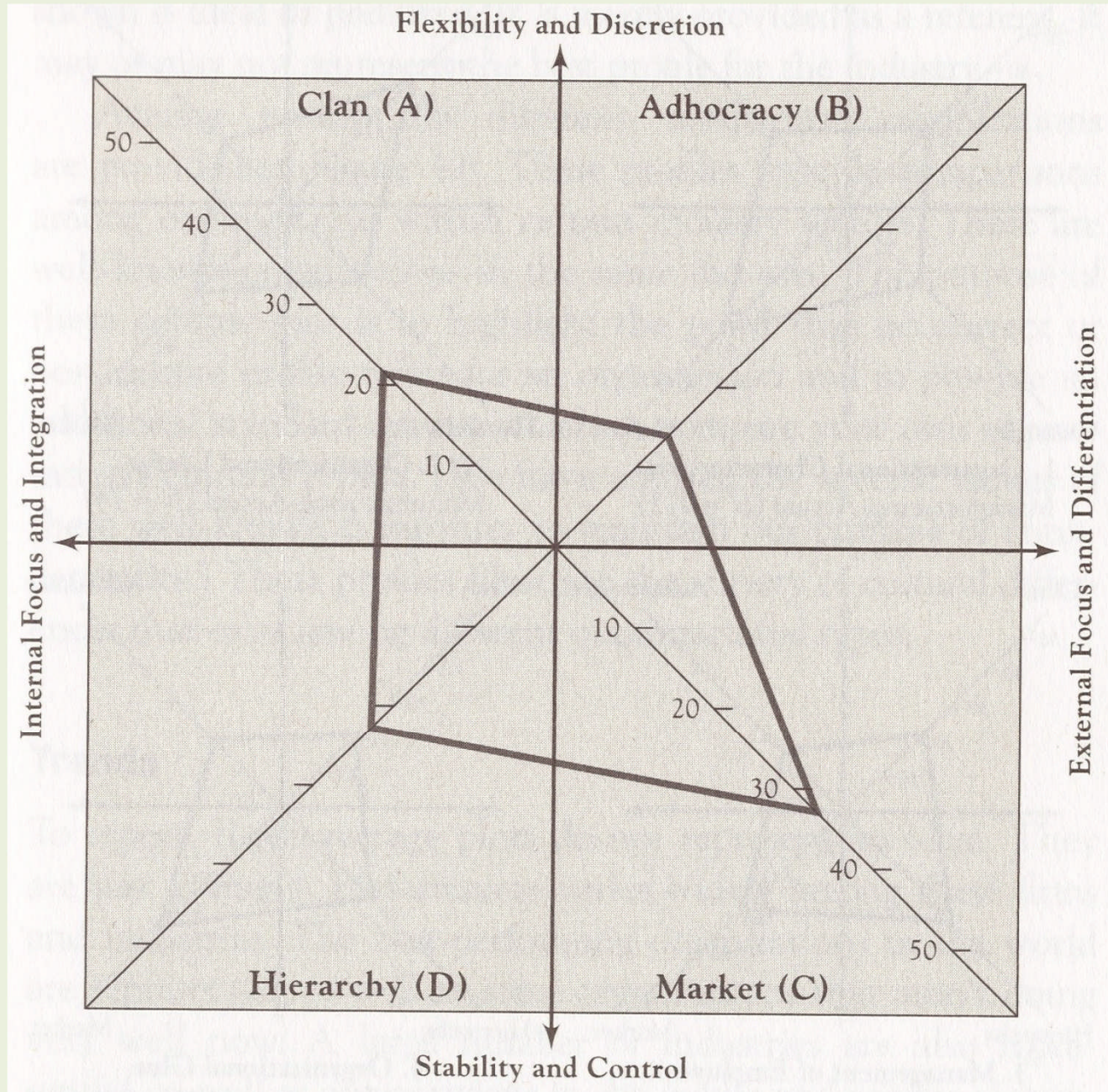
Culture Types and Effectiveness

- In Health Sector, Gregory et al. (2009) found a positive link between clan culture and doctor and patient satisfaction
  - Employee attitudes mediated the relationship
- Richard et al. (2009) in a large study of US industry also found a positive link between a clan culture and earnings and employee satisfaction.
  - The psychological contract was key:
    - Clan culture gave rise to relational psychological contracts
    - Hierarchical culture to transactional psychological contracts

Congruence is a key issue

Between:

- A company and the typical profile for the sector

- Different parts of the company

- Organizational culture and leadership style

- Culture and strategy

IT Culture

- Perspectives:
  - User
  - Manager
  - Developer

- Levels
  - National
  - Organizational
  - Individual

IT Culture: Key Themes

1. Culture and information systems development
2. Culture, IT adoption and diffusion
3. Culture, IT use and outcomes
4. Culture, IT management and strategy
5. IT's influence on culture
6. IT culture

Leidner and Kayworth (2006)

User Cultural Archetypes

- Proactive

- Passive

- Refusal

Walsh et al. (2010) argued that managers can improve user acceptance of systems by tailoring the 'culture migration to their cultural archetype.

Culture and Systems Development Methodologies

- Iivari, Iivari and Huisman (2001, 2011) applied the OCAI to systems development teams.
- An hierarchical culture was most suited to traditional waterfall development methodologies
- An adhocracy culture was most suited to agile methodologies
- It was important for managers to take note of culture when introducing SDMs.

Culture and CMMI

- Muller et al. (2008) applied the OCAI to development teams using the Capability Maturity Model Integration methodology.

- They also applied OCAI to CMMI via a textual analysis of CMMI documentation.

- They found that congruence between the methodology deployed and the culture of development teams was not clearly linked to successful outcomes.

Other Applications of OCAI within IT

- Gupta (20110 found that Indian IT companies were most likely to have a clan culture, followed by an adhocracy culture
- Nickel and Janz (2009) used the OCAI to investigate the impact of organizational culture on the alignment of business strategy and IT strategy.
  - They found a consistent culture across the organization supported alignment of business and IT strategy

Knowledge Sharing

- Lopez-Nicolas and Merono-Cerdan (2009) looked at the impact of organizational culture on knowledge management.

- Yang (2007) applied the OCAI to knowledge sharing in the hotel industry

- Both investigations found that a clan culture was most supportive of knowledge sharing, but an adhocracy culture also provided an element of support.

Culture Change in High Tech IT Companies

- Cameron and Quinn applied the OCAI to High Tech companies

- These tended to start with an emphasis on adhocracy and clan cultures

- But as they matured into large corporations with stock market listings, they tended to evolve towards hierarchy and market cultures.

Organizational Culture and Sustainability

- Organizational culture is key to change management

- Developing a sustainability-oriented corporate culture is often a major change

- Baumgartner (2009) argues that companies need to integrate a 'sustainability dimension' into corporate culture.

Applications of CVF/OCAI to Green Adoption

- Linnenluecke and Griffiths (2010) argue that companies will favour initiatives that are consistent with their dominant culture
- Abbett et al. (2010) surveyed 23 companies using OCAI.
  - They found that initiatives were more likely to be successful if the culture embedded in the initiative was aligned with the company culture

Applications of CVF/OCAI to Green Adoption – continued

- Ubius and Alas (2009) carried out a survey across 8 countries

- They found that:
  - adhocracy culture favours CSR, followed by clan culture, with hierarchy culture last
 - Similar cultures dominated in countries with similar backgrounds

Research Project on Nigeria

- Does organizational culture affect use of green IT?

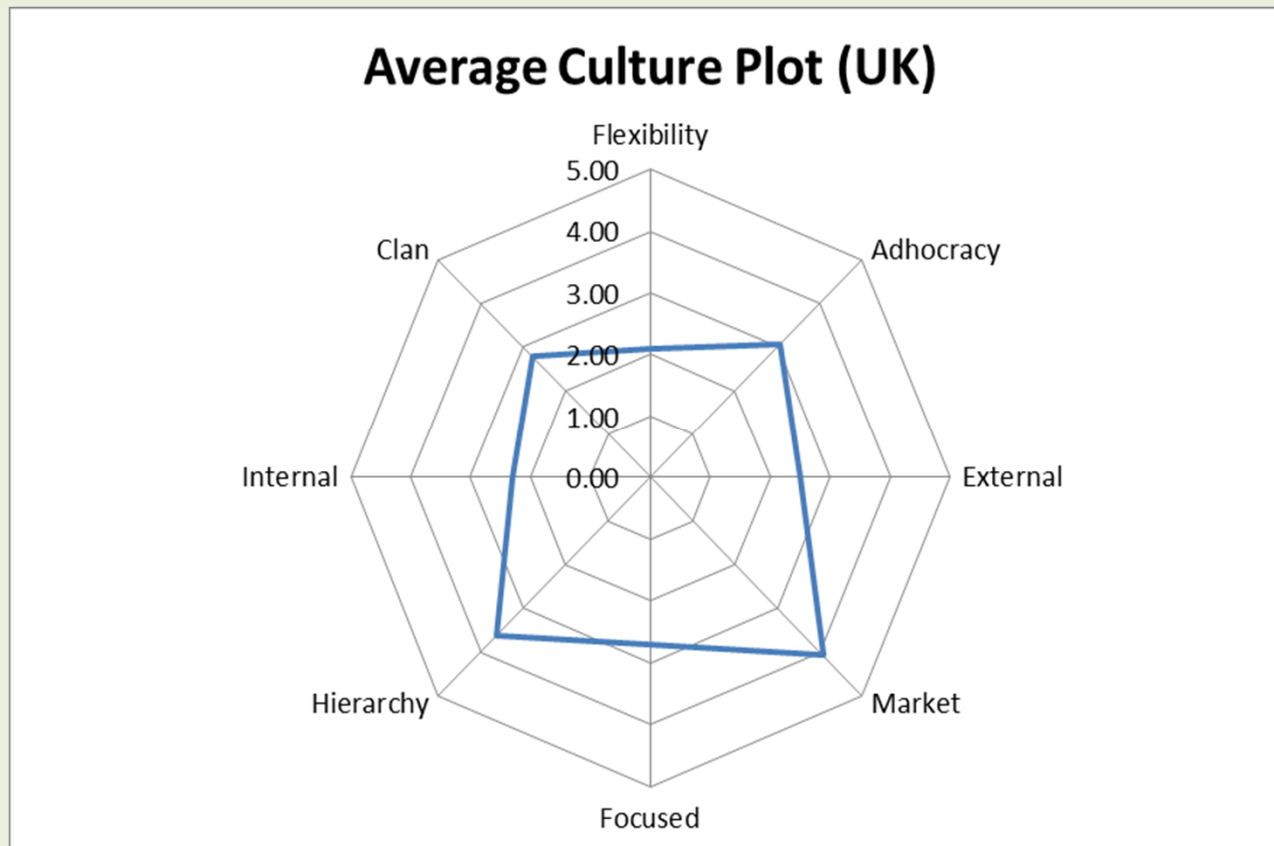- Is there a difference between the UK and Nigeria?

Methodology

- Companies in the UK and Nigeria were asked to complete the Cameron and Quinn Questionnaire and a questionnaire on level of green IT adoption.

- Pearson correlation was used to correlate the results.

Radar Culture Diagrams

Average Culture Plot (Nigeria)
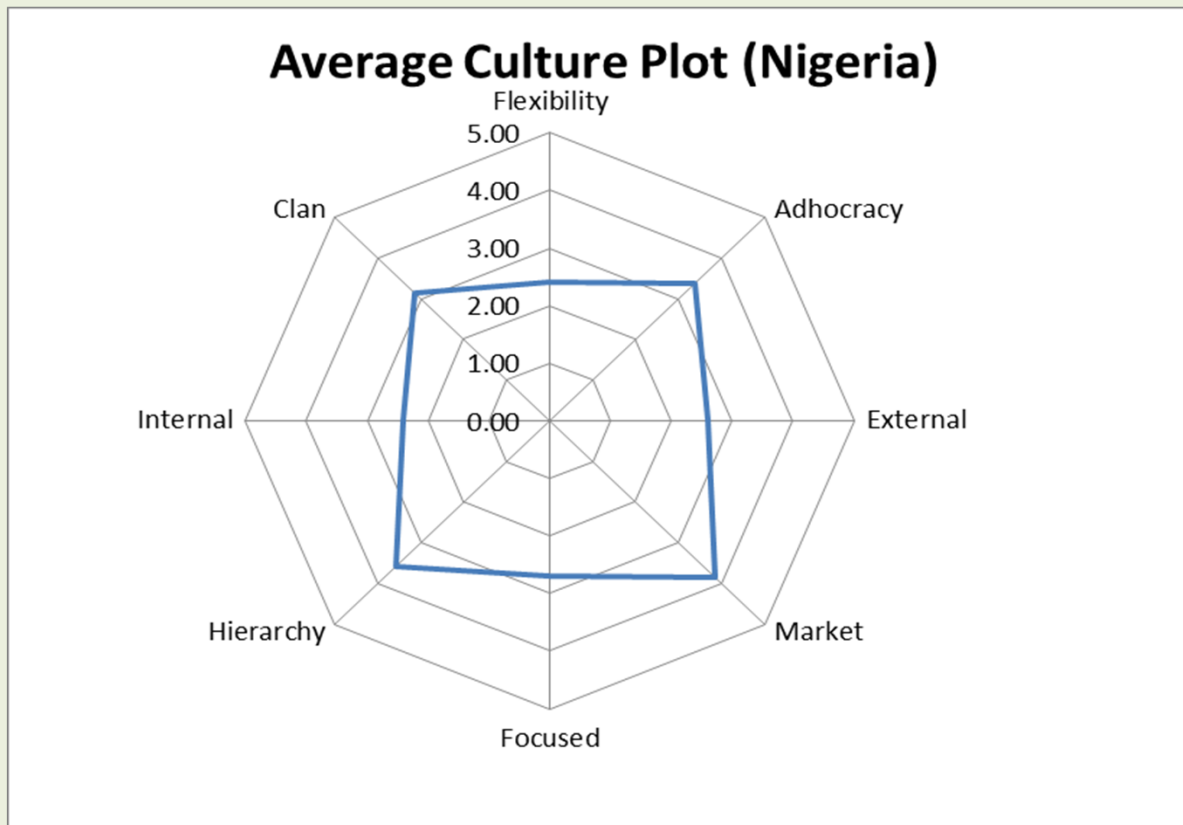
UK Culture

Results

- Clan and Adhocracy cultures favoured the adoption of green IT

- The relationship between organizational culture types and green IT is similar in Nigeria and the UK.

General Trends

- Overall, adhocracy and clan cultures seem to favour sustainability
  - Adhocracy cultures because they support innovation
  - Clan cultures, because the relational psychological contracts between employer and employee support collaborative effort
- But companies tend to drift towards market and hierarchy dominated cultures

Organizational Culture and Green IT Adoption

- IT is uniquely pervasive in modern business
- General agreement that it is important for green IT change agents to understand their cultural context
- Can either change the culture or tailor the initiative to suit the culture
- Can try to 'nudge' the culture

Cultural Congruence

- Companies with strong consistent cultures are more likely to succeed with green initiatives

- Nickel and Janz's looked at alignment of business and IT strategy

  – They found that attempts to extend a 'green corporate culture' into IT were more likely to succeed in the context of a cohesive corporate culture.

Green Systems Development

- Huang (2009) proposed a 'Sustainable Systems Development Lifecycle'
- Clan and adhocracy cultures provide an innovative and collaborative context suitable for developing 'green' software
  - Small, new software houses tend to have this type of culture
- Involvement of users in the design of green software is more likely to lead to successful adoption

IT Development Groups

- IT development groups in large corporations may inherit an overall hierarchy/market culture

- IT managers could seek to nudge their groups towards a more suitable culture:

  – towards a clan culture, by introducing 360 degree evaluation

  – towards an adhocracy culture, by ensuing that HRM practices encourage innovation.

Adoption and Diffusion of Green IT Systems

- Green IT systems are likely to be 'disruptive technologies'
- They are more likely to be adopted by companies with clan/ adhocracy cultures
- But culture change is difficult
  - Could start by changing culture at a superficial 'artifact' level, by e.g. introducing an energy use monitoring system.

Working with Culture

- Choose initiatives that suit the current corporate culture

- Develop a knowledge sharing culture to support an integrated sustainability framework, combining IT, HRM and SCM

- Heads of IT Support seek to understand their users and tailor a 'cultural migration' to sustainability which respects their culture.

Ontologies

爷爷
外公

How would you translate into English?
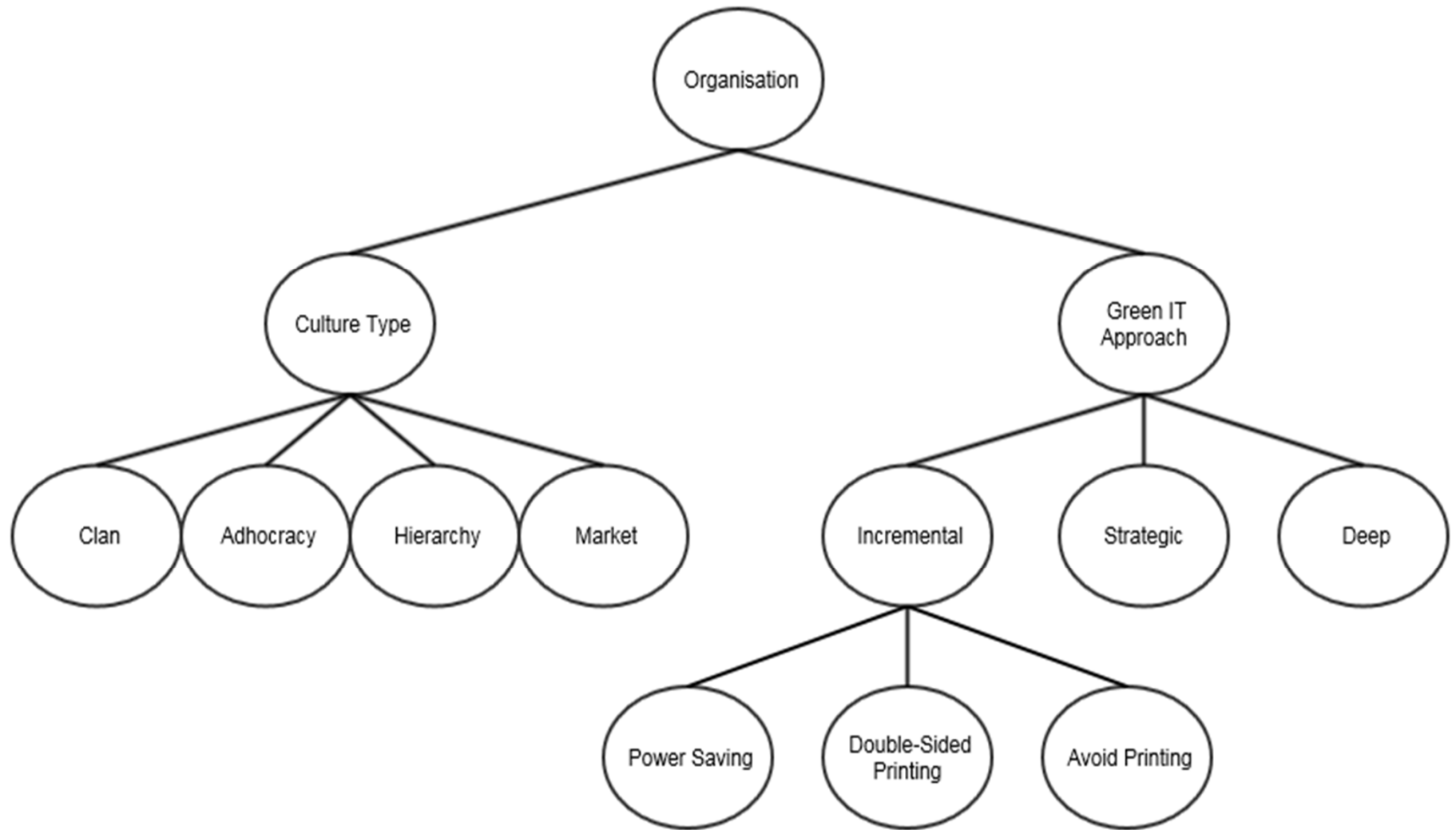
"If you had told me, I would have been happy to help you."

How translate into Chinese?

Ontological Dimensions

- Philosophy
- "Ontology is the study of what things exist" (Effingham 2013)
- Ontologies can be General or Domain Specific
- The model must be accurate, stable, comprehensive and up-to-date
- Tools – descriptive logic, graphical

Extract: Green IT and Culture Ontology

Conclusions and Future Research

- Green change agents must understand their cultural context
- They can seek to nudge the culture, or tailor initiatives to the prevailing culture
- Extensive primary research and detailed statistical analysis is needed
- The international dimension needs to be considered more widely
- Also the impact of social media.

Future research goals

1. Investigate statistically the impact of organizational culture on the adoption of green IT, using meaningful samples

2. Compare different countries

3. Explore interactions between culture and ontologies, in particular green ontologies.

4. Using the results of (1) and (2), develop a green ontology and maybe look at practical applications (e.g. related to the Semantic Web).

- Green IT can be used as a framework for a wide range of research topics, practical and theoretical; and cross-disciplinary
  - Efficiency of data centres and networks
  - Smart cities
  - Internet of Things
  - Comparison of culture across sectors
  - Applying AI Natural Language processing to investigate the impact of languages on green ontologies

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Green IT Survey

https://qtrial2015az1.az1.qualtrics.com/SE/?SID=SV_1FgONekYJNI8FO5&Q_JFE=0

Please complete the survey based on your experience of using IT (widely defined) in a company.