Appendix A

Prior Definitions of Tacit Knowledge

Allred (2001)
• generally the source of a firm’s competitive advantage
• knowledge that is understood and applied by those possessing it
• not easily communicated to others
• knowledge that is difficult to replicate or imitate
• often even those possessing it cannot fully describe it

Armbrecht et al. (2001)
• contained in an expert’s head
• sources like corporate knowledge, core competencies, customers’ perspectives, and external information, are combinations of tacit and explicit

Arora (1996)
• components of technology that are not codified into blueprints, manual patents and the like
• intangible knowledge
• rules of thumb
• heuristics
• tricks of the trade
Athanassiou and Nigh (2000)
- inherently non-transferable

Baldwin and Baldwin (1978)
- personal, subjective knowledge based on direct experience with social or nonsocial environment (Bridgman 1952, 1959; Polanyi 1959, 1960, 1966 and Skinner 1969 in above)
- understanding of action/attached meanings
- Verstehen (Weber)
- contingency shaped behaviour (learned behaviour from direct experience, without rules of verbal guidance)
- personal discovery/real life experience
- need not rely on verbal elements to be vivid and subjectively real
- subjective quality to contingency shaped knowledge
- explicit verbal accounts are not necessarily involved, although may be invented on an ad hoc basis after learning experience
- maxims
- rule of thumb
- customs
- proverbs
- shop lore
- aphorisms
- information [often] second hand/crude
- culturally accumulated rules

Bassellier, Reich and Benbasat (2001)
- experience and cognition

Bhatt, Gupta and Kitchens (2002)
- difficult to capture, codify and share
- requires a people-centred strategy of knowledge management (Polanyi 1966)
- distribute tacit knowledge in forms of rituals, histories, and organizational stories
- research has shown that the use of rituals, stories, and organizational histories can provide a basis of “collective memories” (Weick 1995)
Breschi and Lissoni (2001)

- highly contextual and difficult to codify, and therefore is more easily transmitted through face-to-face contacts and personal relationships, which require spatial proximity, in other words it is a public good, but a local one
- “tacitness” as an intrinsic property of some scientific or technical fields’ knowledge base (stock)
- synonym for non-codifiability
- this goes against the most recent developments in the economics of knowledge codification, which suggest that tacitness ought to be referred to knowledge flows rather than stocks, and codification to be both a means for diffusion, and a powerful tool for exchanging messages which appear tacit to outsiders (Cowan et al. 2000, Steinmuller 2000)
- fundamentals of tacit knowledge, which requires mutual understanding of working practices
- knowledge exchanges may tacit, even when they are trusted to very formal means of communications (such as mails, scientific articles, or even public conferences). This is because technical knowledge (and even more so scientific knowledge) is highly specific, and the jargon by means of which it can be transmitted is not the same jargon of the broader social community, which hosts the firm and its workers. Rather, it is the jargon of a much closer and restricted community (an “epistemic community”)

Brockmann and Anthony (1998)

- work related practical knowledge (Wagner and Sternberg, 1986 in above)
- that which is neither expressed nor declared openly but rather implied or simply understood and is often associated with intuition
- intuition and tacit knowledge closely related

Bruynseels and Vos (2000)

- is unstructured knowledge that is implicitly present in a community, but is not readily organised or available for its members.

Burton (2001)

- is assumed to be that business-related knowledge that has not been articulated (either in verbal or written form)

Casonato and Harris (1999)

- personal knowledge resident within the mind/behavior/perceptions of individuals
- skills/experiences/insight/intuition/judgment
- typically shared through discussion/stories/analogies/person-to-person interaction; therefore, it is difficult to capture or represent in explicit form

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• because individuals continually add personal knowledge which changes behavior and perceptions, tacit knowledge is by definition uncapped

Chambers (1998)
• resisting capture in symbolic form (Polanyi in above)
• know-how
• can be learned/transmitted however normally slow process, requires direct contact eg. apprenticeship
• difficult to evaluate
• can normally only be seen by looking at results and context to make inferences about the knowledge that must have been involved

Chaseling (1994)
• knowledge that is existing, but it is not articulated

Clarke and Wilcockson (2001)
• the expert knowledge that professionals use but find difficult to articulate is known as tacit knowledge (Meerabeau 1992, Meyer and Batehup 1997 in above)

Coff (1997)
• management is a tacit skill (Castanias & Helfat 1991 in above)
• management requires that we identify tacit constructs, including asset specificity, social complexity, causal ambiguity, and asymmetric information

Collins (2001)
• concealed knowledge
• mismatched salience
• ostensive knowledge
• unrecognised knowledge
• unrecognised/unrecognisable knowledge

Colonia-Willner (1999)
• instantiation of practical knowledge acquired in situations where the information is not openly expressed
• hard to articulate
• usually not explicitly verbalised or taught
Cowan, David and Dominique (2000)

- Unarticulated: knowledge that is not invoked explicitly in the typical course of knowledge activities

Dahl (2000)

- internalised through formal training and practice. Such knowledge can be verbalised and made part of conscious reasoning again.
- inarticulable knowledge’, alluding to the potential for verbalisation.

Dahlbom and Mathiassen (1999)

- no idea how we do a lot of the things that we know how to do
- very fast feats of perception
- recognition
- attention
- information retrieval
- motor control
- know how to see and smell
- how to recognise a friend’s face
- how to concentrate on a mark on the wall

Davenport, De Long and Beers (1998)

- knowledge that resides in the minds of the people in an organization but has not been put in structured, document-based form

David (1992)

- the concept of tacit knowledge refers to the common perception that we all are often generally aware of certain objects without being focused on them (based on Polanyi)

Desrochers (2001)

- “dependent on the particular circumstances of time and place”
- therefore cannot be acquired by traditional market research procedures or transmitted by advertising or long-distance learning
- little truth in the belief information is expensive to produce but can be replicated at little cost for using information from others is always more difficult than using your own information
Devinney (1997)
- *Systemic* … existing knowledge base of the individuals: firm must be able to convert its implicit understanding into codified *conceptual knowledge*; by this stage: information
- *Operational knowledge* how firm able to do something
- *Socialisation*: finally, the individual must be able to meld the know how into their internal schemas

Durrance (1998)
- result of involuntary learning that guides how people behave and act
- deeper than explicit knowledge because it is internalised when individuals are least conscious that learning is taking place
- actions that become second nature to workers
- lines that become spontaneous to speakers
- abilities, such as biking and driving, that are performed without any effort and cannot be explained to another person
- lives in our hunches, intuition, emotions, values, and beliefs
- non-intellectual qualities/mental models—form the basis of how we behave and act
- filter through which we see the world

Eraut (2000)
- that which we know but cannot tell (Polanyi, 1967)
- that which cannot be abstracted from practice (Spender, 1995)

Falkenberg, Russell and Ricker (2000)
- abstract knowledge
- deeply rooted in action
- involvement in a specific context

Fleck (1997)
- wholly embodied in individuals
- rooted in practice/experience
- expressed through skilful execution
- transmitted by apprenticeship/training, through ‘watching and doing’ forms of learning
- differs from informal and contingent knowledge in not being readily articulable and therefore not easily communicable or tradeable in Winter’s terminology
• skill formation is very pertinent here: mentally mediated rather than bodily mediated skills (‘informating’ rather than ‘automating’) across many different sectors (Zuboff 1988 in above)
• carriers almost entirely restricted to individuals in direct contact with one another, owing to the intimate interpersonal form of learning necessary
• component of expertise consequently the most crucial in restricting the social distribution of knowledge, and has been widely identified as a major constraint on the diffusion of both science (Fleck 1935; 1979 in above) and technology (Winter 1987 in above)
• because of wholly personal embodied nature: not tradeable as any form of artefact, but necessarily has to be traded through labour markets
• in extreme cases, individuals possessing highly valued tacit knowledge become very influential if not powerful, and rather than simple status, personal charisma results
• during the growth heyday of `Silicon Valley’, personnel with the latest know-how (or ‘black art’) of chip design and fabrication commanded massive transfer fees and remuneration packages on being head-hunted from one company to another
  a. distributed
  b. apparently trivial
  c. highly specific to the particular application domain
  d. accidental to the general process of technology development
• effective acquisition and exploitation of contingent knowledge can be seen to be a key factor in the success of Japanese manufacturing practices
  • Ishikawa diagrams: accumulating information about causes of problems or defects, statistical process control charts for monitoring quality trends etc.
  • habit of displaying these charts on the walls of the workplace, where they are visible and can therefore be accessed by many, can be seen as an explicit coding or embodiment of contingent knowledge directly into the immediate context
  • use of labels providing immediate maintenance procedures directly on the machines affected (as is now usual with photocopying machines, for instance) can be interpreted as a way of making more explicit and concentrated the contingent knowledge arising from everyday operations and remedial tasks
• contingent knowledge differs from formal knowledge in that it lacks systematic codification and is concrete rather than theoretical
  • it is a form of informal knowledge, perhaps, but tends to remain tied to the context, rather than being informally passed on as more or less generalisable ‘rules of thumb’ or ‘tricks of the trade’
  • it is very specific to the particular arrangements or physical kit and often ‘written’ (sometimes literally) in that context
• informal knowledge exists more in the interactions between people than it is embodied in any one place or individual
• contingent knowledge may appear to be a form of tacit knowledge when mediated through one individual
• differs from other sorts of tacit knowledge in being more related to particularities of the context rather than cognitive or motor skills
  • contingent knowledge: known through an individual or individuals
  • contingent information: ‘written’ directly into the context and available for interpretation by knowledgeable individuals
• contingent knowledge is embodied in specific context in some form, even when mediated through people

**Fodor (1968)**

• *inter aila*, a theoretical term in psychology
• computational operations of some optimal simulation of an organism
• relation the term designates presumably holds between the organism itself and proposition, rule, maxim, or technique
• in attributing tacit knowledge to an organism, we infer from a fact about a simulation of the organism to a fact about the mental life of the organism
  • one might reasonably want to know what sort of inference this could possibly be

**Giunipero, Dawley and Anthony (1999)**

• common sense or intuition
• common sense may elude the outsider or novice
• common sense = type of tacit knowledge
• “we can know more that we can tell” (Polanyi 1966 in above)
• personal quality about it that is rooted in action, commitment, involvement in a specific context
• body of hidden knowledge people have deep within themselves developed over the years
• people use this knowledge to make decisions and often do not realize that they are doing so
• conceptualised as an idiosyncratic, subjective, highly individualized store of knowledge
• practical know-how gathered through years of experience and direct interaction within a domain or profession (Wagner and Sternberg 1985 in above)
• experience becomes integrated, actions become second nature, collected impressions guide actions that are often below the consciousness of individuals and groups (Wagner and Sternberg 1985 in above)
• generally thought of as practical intelligence or know-how about the real world
personal competence or a thinking in practice (Nonaka 1994 in above)

automatic, subconscious process that draws upon experientially established cognitive structures

cognitive structures are schemata (mental maps) or knowledge formed from abstractions of experience that simplify, but may bias, the decision making (Hitt and Tyler 1991 in above)

learned independently of direct instruction

individuals often unable to articulate tacit knowledge

managers do not often enjoy the luxury of making their decisions on the basis of orderly rational analysis, but depend largely on intuitive or judgmental responses to decision-demanding situations (Barnard 1966 in above)

contains two dimensions (Nonaka and Takeuchi 1995 in above)

1. know how: developed from years of doing a particular job eg. experienced trade craftsman: wealth of skills in his or her mind, difficult to easily discuss or transfer this knowledge in terms of underlying principles and theories

2. cognitive: consisting of all the mental models, perceptions, and beliefs that are ingrained in all individuals

• cognitive dimension reflects our perspective of the world around us as it exists and what it ought to be

• most precious knowledge can neither be taught nor passed on, but comes from direct experience (Levitt 1991 in above)

• innovator Craig McCaw: “I try to be an idiot savant. Look at the obvious and ignore everything else. To me, it’s all intuition, it’s all obvious and hits you. Market research is there to confirm what you feel, not tell you what you should think (Hill and Hardy 1997 in above)”

• intuition not magic and is much more than a glorified guess

• intuition is a subspecies of logical thinking, one in which the steps in the process are hidden in the subconscious portion of the brain (Agor 1986 in above)

• bounded rationality: disparity between traditional Western management training on rational decision making and the use of tacit knowledge in decision making (March and Simon 1958 in above)

• difficult to measure and observe, purchasers must realize that it will play a major role in their buying decision

Goldman (1990)

• possessed/utilised on an implicit/subsidiary level without conscious awareness

• “knowing how”

• involved in acquisition/use of physical skills/mental abilities/processes which combine both

• beyond conscious awareness of the user
• contained/expressed in actions rather than conscious thoughts
• recognising one special human face in a crowd
• recognising mood and attitude communicated via that human face
• distinguishing face of toxic infant from irritated/tired child.
• precise amount to tension to exert upon the suture
• felt/shown during the practice of skill
• how to use/feel through a tool
• how to know the spatial position of the tip of the instrument as if it were one’s own
• expert pianist who can perform brilliantly, but freezes in mid-concert if begins to concentrate on the movement of his fingers instead of the music
• implicit
• unspecifiable in proposition
• required to interpret and decide the relevant from explicit information
• used to recognise and apply the appropriate explicit rules to a given problem
• knowledge beyond physical findings/lab data/clinical rules when intensivist fine tunes controls of mechanical ventilator
• knowledge which integrates/permits choice/use of appropriate explicit rules/methods
• knowledge excluded from decision trees/software systems
• expert radiologist (Polanyi 1962 in above), can sort through range of vague shadows/shapes, find concealed panorama of significant details
• which rules to employ when
• which case requires use of which information
• achieving diagnostic closure, deciding upon management course without knowing every routine used in that mental process
• may introspectively reconsider process in more explicit detail
• will not necessarily reflect tacit knowledge inherent in the decision-making process
• may not be aware of that knowledge
• may be fully unaware of ever coming to possess certain knowledge in his skills
• may simply find himself using knowledge by practicing the skill
• knowing-in-action (Schon 1983; Schon 1987)
• clinician does not always reach conclusions one would predict by assuming adherence to rational decision theory
• formal decision theory fails because lacks certain essential knowledge possessed by the clinician in actual practice
Greeno (1987)

- needed for performing a task
- presence unsuspected by the performer
- “such as we have of something we are in the act of doing” (Polanyi 1959 in above).
- not “set out in written words or maps, or mathematical formulae”
- we do not know how to display it directly.
- only communicated implicitly, as unseen and unanalysed component of performance
- exists “between the lines” (Bundy, 1975, in above)

Halter (2001)

- is gained by experience and interaction and also by acquiring and combining skills (Polanyi, 1958, p. 82)
- connects the knower with the world, discerns patterns from experience, and scribes meaning to the patterns

Hannigan (2001)

- by reflecting-in-action, practitioners use a form of tacit knowledge, in which the “science” or “theory” informing activity is embedded in the activity itself

Hedlund (1994)

- cross cultural negotiation skills
- team coordination in complex work
- corporate culture
- customer’s attitudes to products and expectations (adapted from Hedlund and Nonaka, 1993, in above)
- nonverbalised/nonverbalisable
- intuitive
- unarticulated (Polanyi, 1962, in above)

Henderson (1995)

- knowledge which is not verbalised: either because it cannot be or because it may simply be taken for granted or regarded as too trivial to warrant verbalisation
- all types of knowledge, however pure consists in part of tacit rules which may be impossible to formulate in principle (Laser example Collins, 1972, p. 46 in above)
- residual category which encompasses many dimensions of non-verbal knowledge
Hicks (1995)
- tacit/unpublishable knowledge = foundation of scientific/technical credibility
- gestalt shift: personal judgement, embodied (Gelwick, 1977, in above)

Horak (2001)
- has been estimated that between 50 and 90 percent of the knowledge in an organisation is tacit
- information that is in people’s heads in the form of insights, ideas, perceptions, and values.

Howells (1995a)
- is non-codified, disembodied know how that is acquired the informal take-up of learned behaviour and procedures
- does not involve the generation and acquisition of tangible products and processes, or the more formal element of intangible knowledge flows association with specific research, technical or training programmes
- skills
- cannot be directly or easily transmitted (knowledge and task performance, individual specific)
  - “learning by doing” (Arrow, 1962, in above)
  - “learning by using” (Rosenberg, 1982, in above)
  - “learning to learn” (Ellis, 1965; Estes, 1970; Argyris and Schon, 1978; Stigilitz, 1987, in above) = critical elements within tacit knowledge acquisition
- something that cannot be easily codified or learnt
- high speed and simultaneity of information processing: may force a learner of a new skill to work out the details of the coordination for himself/herself. In this case, the actual performance cannot be slowed down and practicing cannot be done slowly
- sometimes difficult to articulate all that is necessary to master a skill since the action is embedded in the context: if one of the many context variables changes too much there will be no performance and all the ‘ifs’ cannot be meaningfully expressed
- involves learning and skill … in a way that cannot be communicated in any direct, codified way
  - “learning by doing”
  - “learning by using”
  - “learning to learn” are therefore crucial elements in tacit knowledge acquisition associated with direct, on the job contact with new equipment/workpractice/operation
- hard to conceive of situations where tacit knowledge can be acquired indirectly as this would involve some kind of codification and lack of direct experience
- direct experience
• person-embodied
• not directly codifiable via artefacts
• firm/organisation can possess tacit knowledge through workforce or via operational milieu that exists and is created and sustained within the organisational structure
• personnel within firm gain tacit knowledge via direct work experience
• not a static stock of knowledge
• continually being built upon/learnt
• involving intuition and trial and error (although equally it can be forgotten; see Douglas, 1987; Johnson, 1992, in above)

Howells (1995b)
• non-verbal knowledge

Johannessen, Olsen and Olaisen (1997)
• emerges and develops through closeness to the work processes
• if work processes change …. may be made superfluous

Joly and Mangematin (1996)
• learning processes are localised/cumulative
• circulates very badly

Johnston (1989)
• can be possessed by itself

Lamberton (1996)
• not written
• cannot be articulated
• acquired/stored/used in course of experience
• inextricably interwoven with human and organisational contexts

Langlois (2001)
• it is always possible in principle to create a codebook, but that codebook will never capture all the knowledge held by the individuals whose code it is
• need not be idiosyncratic
Larkin (1980)

- *Explicating tacit knowledge*: structure and context are often *not* obvious either to the person using it, or to a casual observer

Lawson and Lorenz (1999)

- co-ordinate actions and act capably without needing, or being able, to articulate in words or diagrams exactly how they accomplish this
- must draw upon knowledge that they have come to hold tacitly by acting within, and reproducing, the organizations routines (Cyert and March, 1963, in above)
- not necessarily/typically result of clearly thought out or explicit intentions
- often have no idea of the history leading to/benefits of following, certain routines
- tacit/articulated knowledge are complements
- underlies manual dexterity: knowing how to swim/ride a bike
- underlies scientific capability
- observation/imitation/experience = only method for acquiring skills to formulate scientific problems/develop strategies aimed at their solution (Senker, 1995a, in above)
- process of articulating/codifying knowledge does not simply amount to transforming something which remains unaltered in its meaning or content into a more easily communicated form

Lei (1997)

- unwritten know-how/“know-why”
- understood only by the person, team, unit, or firm that has long worked with it on a deeply personal or embedded level
- becomes part of the personality/guiding process/organisational routines of the person, team of group/firm that possess it, respectively
- much less transparent then explicit knowledge
- often has “sticky” quality to it (Ghemawat, 1991; Polanyi, 1967; Dosi, 1988; Hoskisson and Hitt, 1994; von Hippel, 1994; Wright, 1994, in above)
- very context specific
- deeply embedded within organisation’s routines/practices
- generally unseen by those who have not worked with it on a personal level
- requires “learning by doing” that often first begins with imitation/direct observation/practice
- more “art” than “science”
- embedded in organisation’s dynamic routines
- becomes part of firm’s social fabric of interrelationships/interactions among people (Teece, 1986; Teece, Pisano and Shuen, 1994; Badaracco, 1991; Nonaka, 1991, in above)
Lei, Hitt, and Bettis (1996)
• “learning by doing”, “learning by using” (Badaracco, 1991; Dierickx and Cool, 1989; Dosi, 1988; Polanyi, 1967; Reed and deFillippi, 1990; Sahal, 1981; Teece, Rumelt, Dosi and Winter, 1992, in above)
• neither easily imitated nor clearly understood outside the firm
• firm specific
• often cannot be written or encoded (Dougherty, 1992; Nelson and Winter, 1982; Nonaka, 1991; Polanyi, 1967)
• immutable, hard-to-decipher quality that cannot be easily transmitted to others
• often represents a shared experience among organisation members
• richer than universal knowledge (Dougherty, 1992)
• skills required to implement a new production process successfully are often specific to the organisation or its team members in ways that outsiders cannot easily duplicate
• high barriers erected to imitability through causal ambiguity (Barney, 1991; Reed and deFillippi, 1990).
  1. Scientific: social, abstract, highly mobile
  2. Conscious: individual focused, taken for granted
  3. Communal: interrelated/occurs with organisational culture
  4. Automatic: individual focused, taken for granted (Spender in above)
• appropriability is an important issue (of less concern with automatic or conscious)
• learned by “apprenticeship”
• learned by doing through collaborative arrangements

Leonard and Sensiper (1998)
• tacit knowledge: not yet explicated (Spender, 1996, in above)
• some knowledge unlikely ever to be wholly explicated, whether embedded in cognition or in physical abilities
• semiconscious/unconscious tacit knowledge produces insight/intuition/decisions based on “gut feel”
• largely tacit: coordination/motor/physical (muscle)/negotiation skills, artistic vision
• common element = inability of the knower to totally articulate all they know
• tacit knowing embodied in physical skills in muscles/nerves/reflexes, learned through practice, i.e., through trial and error
• tacit knowing in cognitive skills, learned through experience, resides in unconscious/semiconscious
• individual level (Polanyi in above)
Love (2001)
• unverbalisable and skill-oriented learning that contributes to the education of a professional and classified him or her as an expert
• practice-oriented knowledge that is acquired without explicit instruction

McDaniel, Morgeson, Finnegans, Campion and Braverman (2001)
• “practical know-how that usually is not openly expressed or stated and which must be acquired in the absence of direct instruction” (Wegener, 1987, p. 1236)

MacKenzie (1996)
• motor skills
• intuition
• common sense
• judgment that cannot be transmitted in words or equations alone
• Los Alamos: nuclear weaponry: repeated discovery that explicit knowledge alone is not enough
• expert systems in artificial intelligence: attempts to render tacit knowledge fully explicit have repeatedly disappointed

• tacit knowledge, on the other hand, is knowledge that has not been (and perhaps cannot be) formulated explicitly, and therefore, cannot be effectively stored or transferred entirely by interpersonal means

McAulay, Russell and Sims (1997)
• proximal knowledge (Polanyi, 1962; Athanassiou and Nigh, 1996, in above)
• proximal knowledge: more widely referred to as “tacit” knowledge, is everything which distal knowledge is not
  • cannot be
  • documented
  • formalised
  • easily talked about with newcomers
  • turned into procedures
  • reproduced through statements
  • techniques or models
  • replicated easily by competitors, hence it is a source of competitive advantage.
• precisely the knowledge taken for granted, built up through close working relationships over long period of time
• underlying knowledge taken for granted as managers carry out everyday actions in response to events, or instructions of superiors, or create kinds of organisation they would like to work for
• need not be made explicit as long as it appears to be leading the organisation in the direction it wants to go
• need not be made explicit as long as colleagues share sufficient experience/understanding of underlying meaning of what it is to be a financial director/treasurer/financial controller
• given such sharing of experience and meaning, to spell out and explicitly define these roles is simply a waste of time
• exceptionally difficult
• taken-for-granted knowledge simply used as part of organisational norms and routines, explaining tacit knowledge is unnecessary.

• silent; saying nothing
• not openly expressed, but implied, understood or inferred
• unspoken

Meerabeau (1992)
• helicopter pilots: expert practitioners view situations holistically, draw on past concrete experience, whereas the merely competent or proficient must use conscious problem solving (Benner, 1984, on Dreyfus & Dreyfus in above).
  • *Tacit Knowledge*: Experts do not use same pattern of skills as learners; view situations holistically, much of their knowledge embedded in their practice (Polanyi, 1958, 1967)
  • *Proximal/Distal knowledge*: when we know something only by relying on our awareness of it for attending to a second activity
• psychomotor skills: co-ordination of respiration necessary to swim/action of hammering a nail
• attention to the parts makes us unable to perform the whole
• success depends on personal contact between scientists (Laser construction Collins 1974 in above)
• learning from a careful examination of artistry (Schön, 1987, in above).
• “reflection in action”, reflection upon that reflection (Schön, 1987, in above)
• expressed only in practice, learned through experience (Oakeshott, 1962; Polanyi; Eraut, 1985, in above)
  1. *Replication*: “regurgitation”
2. Application: knowledge in new situations, although still following rules
3. Interpretation: professional education, involving judgement, “ways of seeing” a situation, although these ways may be unquestioned, effort to break free and see situations in new ways may be considerable
4. Association: intuition, metaphors, images (Broudy et al., 1964 in above)
   - medical practice: practitioner cannot suspend action in absence of convincing evidence, or afford to be sceptical, often has to think on his or her feet (Freidson, 1971, in above)
   - medical sociology: tacit knowledge may be a positive asset
   - the hallmark of a profession (Jamous and Peloille, 1970; Atkinson et al., 1977)
   - technicality: procedures that can be mastered and communicated in the form of rules
   - indeterminacy: variety of tacit/private knowledge which cannot be made wholly explicit (Jamous and Peloille, 1970; Atkinson et al., 1977)

Murphy (2001)
- useful stuff you know about that no one bothers to ask

Murray and Teal (2002)
- deeply embedded in individual’s actions and experiences

Nelson and Winter (in Lamberton, 1997)
- “we know more than we can tell”
- “knowledge that cannot be articulated”

Nightingale (1998)
- assuming that “meaning” of information is somehow contained in it
- obviously false, as most technical scientific papers only understood by scientists who are well versed in the subject
- tacit knowledge that enables them to understand science is dependent on the intrinsic biology of the brain
- knowledge dependent on embodied ability to recognise similarity, this implies a brain (and tacit knowledge), information approaches have to invoke “tacit knowledge” in order to explain it
- once we invoke tacit knowledge, “information processing” drops out of the equation as irrelevant, because the tacit recognition of patterns explains our ability to understand information
- information cannot be disembodied, because sense of what it “means” depends somehow on “us”
from tacit knowledge perspective, science cannot be described without scientists
innovation dependent on this conception of similarity
problem is made worse as knowledge is not only embodied, also embedded in social networks
tacit knowledge vital to our understanding of even simple words like “cut” in sentences
“cut the grass” and “cut the cake” (Searle, 1995)
we know the appropriate meaning because we have tacit background knowledge to compare the words to
“see as”, rather than “see” (Gregory, 1980, 1981 in above)
capacity to interpret information and comprehend things that cannot be codified, like
how to ride a bicycle
backgrounds of interwoven experience
automatic capacity we have to relate experience to it.
hard (if not impossible) to codify/transmit because it is the background to which codified transmitted information is compared

Noh et al. (2000)
- is intangible because it represents intuition, subjective insights, beliefs and expertise
  (Dutta, 1997; Wagner and Sternberg, 1985)
- will disappear along with turnover or retirement of employees since it is highly personal, and context dependent
- hard to formalise, communicate, and share with others (Wagner & Sternberg, 1985)
- often elicited by means of figurative languages and symbolism to express the inexpressible (Numata, Hane, Lei & Iwashita, 1997)

Nonaka (1991)
- highly personal
- hard to formalise
- difficult to communicate to others
- deeply rooted in action/individual’s commitment to a specific context
- consists partly of technical skills
- know-how
- mental models
- beliefs

- concerns an individual’s feelings
- often difficult to express in a manner that others can understand
• covers hidden areas
• quite probably partially hidden from knowledge-holding individuals

Nonaka, Takeuchi, and Umemoto (1996)
• personal
• context specific
• hard to formalise and communicate

Olsson and Gullberg (1988)
• formed under long tradition/experience
• mostly mediated by interchange—ritual and maintenance—routine

Osterloh and Frey (2000)
• acquired by and stored within individuals and cannot be transferred or traded as a separate entity
• crucial source of sustainable competitive advantage because it is difficult for competitors to imitate it (e.g., Teece, 1998)

• unspoken; unvoiced, silent, emitting no sound; noiseless, wordless
• not openly expressed or stated, but implied; understood, inferred

Persaud, Kumar, and Kumar (2001)
• cannot be easily coded/transferred
• not easily accessible
• knowledge people carry in their heads
• intuitive and experience based
• represents a disproportionately large part of the knowledge needed to conduct cutting-edge R&D
• cultural or situational specificity is a major component of tacit knowledge
• assigns meaning to data and facts
• often inseparably linked to processes and people

Platts and Yeung (2000)
• can be summarized as knowledge that has not been articulated
• may be a “skill” or “know-how”
• might usefully consider explicit knowledge to mean know-what and tacit knowledge to mean “know-how”

**Polanyi (1968)**
- triad controlled by knower
  1. subsidiary particulars
  2. focal target
  3. knower who links first to the second

**Powell (1995)**
- open culture
- employee empowerment
- executive commitment

**Pylyshyn (1981)**
- cannot be freely accessed/updated by every cognitive processes within the organism
- nor can it enter freely into any logically valid inference
- much of it is not introspectable or verbally articulable, e.g., grammatical/logical rules/social conventions
- no doubt what makes it possible for people to hold contradictory beliefs or to have beliefs that are only effective within certain relatively narrow classes of tasks
- might well be that many people only have access to their tacit knowledge of physics when they are acting upon the world (e.g. playing baseball, or perhaps when they are engaged in something we call visualising some physical process, but not when they have to reason verbally or answer certain kinds of questions in the abstract

**Raghuram (1996)**
- personal quality
- hard to formalise and communicate
- traditions
- values
- organisational cultures

**Richards (1998)**
- is difficult to communicate and share with others
- it is built on our experiences, feelings, values and learning styles
- represents the understanding of the external world

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Roberts (1998)

• embedded in people
• in their heads
• not at all easy to copy or transfer from one individual to another

Roberts (2000)

• collective rather than individual

Ruppel and Harrington (2001)

• tacit knowledge, such as insights, intuitions and hunches is not as easily codified and is more difficult to articulate and transfer
• tacit knowledge most strongly facilitates learning, builds intellectual capital and provides value and competitive advantage to organizations. This is because it is more difficult for competitors to replicate.
• Tacit knowledge includes technical knowledge, such as personal skills and “know-how”, and cognitive models that we take for granted.
• Inkpen and Dimur suggest that an organization’s goal is to convert tacit to explicit knowledge so it can be shared more easily.

Sako (1999)

• “we know more than we can tell” (Polanyi, 1966, in above)
• hands-on teaching
• the way things are done in the firm (Nelson and Winter, 1982, in above)

Sanderson, Nixon and Aron (2000)

• The very nature of tacit knowledge is that an expert may possess the experiences, and skills from which the explicit knowledge is created, but may not even realise that he/she could provide an answer.

Schmidt and Hunter (1993)

• practical intelligence simply more general and broadly applicable form of tacit knowledge
• knowledge does not attain special construct status merely because it is “tacit”
• “often...not openly expressed or stated” or typically acquired informally
• most human knowledge is acquired informally
• just knowledge
• in the job context, it is simply job knowledge
• job knowledge explains wider range of phenomena
has well studied relationships with intelligence, job experience, job performance
relates nicely to known principles of learning theory

**Schulz and Jobe (2001)**
- difficult to express and to communicate to other people by means of symbols (Hill & Ende, 1994; Nelson & Winter, 1982; Spender, 1993)
- more difficult to transmit than codified knowledge
- travels particularly poorly between organisations (Kogut & Zander, 1993)
- efficient transmission of tacit knowledge requires its codification into explicit forms
- depends on sense making of participants
- stimulates creativity, “creative chaos”, innovative forms of response and coordination

**Scott (1990)**
- practice wisdom
- practitioner “has a feeling” about a particular case and its likely causes or outcome

**Senker (1995a)**
- ability to recognise facts
- knowledge that can be possessed by itself
- all knowledge is *either tacit or rooted in tacit knowledge* (Polanyi, 1969, p. 144 in above)
  1. Knowledge implies understanding: acquisition of knowledge is a purely perceptual, cognitive process
  2. Skill: knowing how to make something happen; cognition; manual dexterity; sensory ability, may be based entirely on tacit knowledge
- important to distinguish between tacit knowledge: which is embodied in skills and can therefore be copied, and tacit knowledge which cannot be demonstrated and so is very difficult to transfer (e.g., The recognition of a musical note)
- this differentiation between tacit knowledge/skills marks a fundamental disagreement with Nonaka (forthcoming), who suggest that tacit knowledge involves cognitive dimensions (schemata, paradigms, mental models, etc.), as well as a technical dimensions (concrete knowledge, crafts and skill which apply to specific contexts)
- skills based on appropriate combinations of tacit and formal knowledge in specific contexts might be better defined as “expertise” [It should of course be recognised that the term expertise rightly extends beyond the narrowly cognitive or technical domains to encompass the social context which gives meaning and status to one set of knowledge and skills over another]
- must be acquired by example or experience; in “person-embodied” form
personal interaction or movement only channel (for the most part) by which tacit knowledge can be transferred
hypothesise that tacit knowledge is a very important element of the knowledge transferred through personal networks.
accumulated “on the job”
learning-by-doing
most of the associated knowledge had not yet been published or documented anywhere
firms recruit scientists and engineers who personally embody the required skills and tacit knowledge; by conducting in-house R & D; and by promoting networking
primarily transferred by example/practical experience
channels primarily person-embodied rather than literature based

**Senker (1995b)**
- we know more than we can tell
- ability to recognise faces
- ride a bicycle
- knowledge of techniques, methods, designs that work in certain ways, with certain consequences, even when one cannot explain exactly why (Rosenberg, 1982, in above)
- can be possessed by itself
- explicit knowledge must rely on being tacitly understood and applied (Polanyi, 1969, in above)
- all knowledge either tacit or rooted in tacit knowledge
  - *knowledge*: implies understanding
  - *acquisition of knowledge*: perceptual and cognitive process
  - *skill*: knowing how to make something happen

**Shipman and Marshall (1999)**
- poses a particularly challenging problem for adding formal structure and content to any system
- by its very nature people do not explicitly acknowledge tacit knowledge

**Sidani and Gonzalez (2000)**
- implicit knowledge
- describes a form of “compiled” knowledge that an expert utilizes when dealing with a situation
- knowledge that is hidden, implied, intuitive or judgemental
Skeris (1999)

- no one can capture and codify tacit knowledge in software, hardware, and processes
- hatched of experience
- often nonverbal
- even subconscious in nature
- users can transfer it without direct contact with the owner
- tacit knowledge on the other hand, resides in the acting persons
- the coordination and motor skills to run a large crane are largely tacit
- the negotiation skills required in a corporate meeting or the artistic vision embodied in the design of a new computer program interface
- tacit knowledge entails a body of perspectives
  - our view of customers is framed by ours firm’s experience
- perceptions
  - customers seem disinclined to try our new product
- beliefs
  - investment in new technology will lead to breakthrough new products that will create new customer needs
- values
  - do what is right for the customer
- people usually acquire tacit knowledge in face-to-face interactions
- large part of interaction is nonverbal
- social interaction is especially critical for teams of individuals responsible for delivering new products, services, and organizational processes.

Somech and Bogler (1999)

- informal and implicit knowledge used to achieve one’s goals

Sparrow (2001)

- recognition that subconscious knowledge (in the form of skills and tacit feel) figures in human performance

Stenmark (2000)

- we are not necessarily aware of our tacit knowledge
- on a personal level, we do not need to make it explicit in order to use it,
- we may not want to give up a valuable competitive advantage
- is knowledge that cannot be easily articulated and thus only exists in people’s hands and minds, and manifests itself through their actions
• in contract Polanyi does not make such a distinction. Instead, he envisions tacit knowledge as the backdrop against which all understanding is distinguished.

• is thus a cultural, emotional, and cognitive background, of which we are only marginally aware. This tacitness is a precondition for focal knowledge (Polanyi, 1998; Prosch, 1986)

• Polanyi’s view has sometimes been criticised for being overly concerned with the tacit aspects and this becoming almost monistic

• Polanyi’s opinion that the tacit and the explicit are mutually constituted and should thus not be treated as two separate types of knowledge supported by, for example, Tsoukas (1996), who argues that trying to split these two inseparably related entities is to miss the point.

Stenmark (2000/2001)

• inherently elusive

• not necessarily aware of our tacit knowledge

• on a personal level, we do not need to make it explicit in order to use it

• may not want to give up a valuable competitive advantage

• cannot be easily articulated and thus only exits in people’ hands and minds, and manifests itself through their actions

Sternberg (1995)

• knowledge you need to succeed in an endeavour

• not formally taught

• often is not even verbalised

• typically acquired on the job or in the situation where it actually used

• typically informal

• not actually a part of any discipline formally taught anywhere

• in theory, can be verbalised/taught (in which case we still refer to it as “tacit knowledge” even though strictly speaking it is no longer tacit)

• differs from more formal knowledge in that there is often resistance to its revelation

• e.g., company whose stated promotion policies encourage innovation but whose true promotion policies reward conformity or perhaps membership in certain groups, is not likely to want these facts to be known

• often not readily available for the asking

• must be inferred simply by spending time in an environment

• carefully observing what is happening in that environment

• tacit knowledge is contextually relative

• formal knowledge is not
• tacit knowledge almost always acquired as people interact with real environment in which they have to adapt
• rarely acquired in artificial situations, whether in the classroom or otherwise
• others may have various agendas, lead them purposely to obscure/hide tacit knowledge
• far more important to shaping/adaptation to the environment than is formal knowledge
• organisational cultures = vast repositories of tacit knowledge, when culture changes, so much tacit knowledge
• metacognitive understanding of own tacit knowledge generally weaker than such understanding of formal knowledge
• procedural as opposed to declarative
• practical: knowledge for use in actual organisation/everyday situation
• to be exploited effectively, need to know both procedures (actions) and their link to environment (when and where to use them)
• not enough to know what to do: have to know when/where to do it, when/where not to
• much is scripted (Schank & Abelson, 1977, in above): it is part of script/schema people follow in certain situations
• can be taught

**Sternberg (1998)**
• action oriented
• typically acquired without direct help from others
• allows individuals to achieve goals they personally value (Sternberg, Wagner, Williams & Horvath, 1995, in above)
  a. it is procedural
  b. it is relevant to the attainment of goals people value
  c. it typically is acquired with little help from others
• important part of practical intelligence: particular notion of tacit knowledge used here derived from triarchic theory of intelligence (Sternberg, 1985a, 1997a, in above)
• form of “knowing how” rather than of “knowing that” (Ryle, 1949, in above)
• we view condition - action sequences (production systems) as a useful formalism of understanding the mental representation of tacit knowledge (Sternberg et al., 1995; see also Horvath et al., 1996)
• always wedded to particular uses in particular situations or classes or situations.
• practically useful
• instrumental to attainment of goals that people value
people use this knowledge in order to achieve success in life, however they may define success

- abstract academic knowledge about procedures for solving problems with no relevance to life should not be viewed, in this perspective as constituting tacit knowledge

- typically is acquired without direct help from others

- others can guide one to acquire this knowledge

- environmental support for the acquisition of this knowledge is minimal

- sometimes organisation actually suppress the acquisition of tacit knowledge

- wedded to contexts: tacit knowledge that would apply in one context would not necessarily apply in another context

- to help someone develop tacit knowledge, one would provide mediated learning experiences rather than direct instruction as to what to do, when

- *wisdom*: application of tacit knowledge as mediated by values toward the goal of achieving a common good
  
  a. through a balance among multiple intrapersonal, interpersonal, and extrapersonal interests

  b. in order to achieve balance among responses to environmental contexts

- adaptation to existing environmental contexts

- shaping of existing environmental context

- section new environmental context

**Sternberg and Wagner (1989)**

- rules of thumb that are useful to know to perform well in a given field

**Sternberg (2000)**

- comprises the lessons of life that are not explicitly taught and that often are not even verbalised (Sternberg, Wagner, Williams & Horvath, 1995).

- thus, tacit knowledge has three main features:
  
  a. it is procedural

  b. it is relevant to the attainment of goals people value

  c. it typically is acquired through experience or mentoring, rather than through direct classroom or textbook instruction

- an example of tacit knowledge is knowing how to write and present an article for ensure publication

- forms an essential component of practical intelligence
Sternberg, Wagner and Okagaki (1993)

- practical know how usually not directly taught or even openly expressed or stated
- kind of knowledge that one picks up on a job or in everyday kinds of situations, rather than through formal instruction
- used in adaptation to environments
  - also in deciding when an environment is unsatisfactory and a new one needs to be sought out (environmental selection)
- when present environment can be shaped in a more nearly optimal one (shaping of the environment)
- most relevant to contextual or practical subtheory of the triarchic account of intelligence
- knowledge base that enables us to face the everyday world


- action oriented knowledge
- acquired without direct help from others
- procedural in nature
- relevant to the attainment of goals people value
- acquired with little (direct) help from others
- must be inferred from actions or statements
- always wedded to particular uses in particular situations or in classes of situations
- practically useful
- rules of thumb may permit explicit training of at least some aspect of tacit knowledge
- typically implied rather than stated explicitly
- complex, multiconditional rules for how to pursue particular goals in particular situations
- articulating general rules in roughly declarative form
- abstract/summary representation for family of complex specified procedural rules
- unspoken/underemphasized/poorly conveyed relative to its importance for practical success
- how to seek out, create, and enjoy challenges
- maintaining appropriate levels of
  - self-motivation, self-direction, self-awareness, and personal
- completing tasks and working effectively within the business environment
Subramaniam and Venkatraman (2001)
- largely “indwells” in the minds of people as perspectives on, or images of, reality (Polanyi, 1966)
- define tacit overseas knowledge as “the knowledge of the differences among overseas markets that is difficult to codify and transfer in a systematic way”.
- an unspoken and often subtle understanding of differences in cultures, tastes, habits, or customs (Jain, 1989; Subramaniam et al., 1998).

Sveiby (1997)
- used as a tool to handle what is being focused on
- functions as background knowledge that assists in accomplishing the task in focus
- varies from one situation to another
- often operates as a constraint
- articulated through models or concepts
- externalisation: combining thoughts into actual designs
- most person to person communication
- out of the corner of the eye
- unconscious
- teaches codes of behaviour and skills

Swaak and de Jong (2001)
- intuitive knowledge is hard to verbalise
- in explicit tasks sometimes labelled “inert”

Swap, Leonard, Shields and Abrams (2001)
- intangible assets exist in the tacit dimensions of knowledge
- built up over time in peoples’ heads, hands and relationships

Takeuchi (1998)
- something not easily visible and expressible
- highly personal
- hard to formalise
- difficult to communicate or share with others
- subjective insights
- intuitions
- hunches
inspirations
deeplty rooted in an individual’s action/experience/ideals/values/emotions
two dimensions
technical: informal/hard to pin down skills/crafts often captured in the term “know-how”
cognitive: beliefs/perceptions/ideals/values/emotions/mental (Weltanschauung?)

Takii (2000)
even an instructor can not clearly describe what she wants to say
What she can do is show several examples
trainee must attempt to infer what the instructor wants to say from these examples
the transfer of tacit knowledge requires long term face-to-face contact

Talisayon (2001)
Many people know what works well in particular situations at work, at home and at play.
embodied unconsciously in talented people or embedded in unrecognised excellent work routines
unseen, not because they are hidden from view, but because we do not look for them or we do not know how to look for them

Tibau (2000)
class participants realised that these concepts are inspired by their distinct culture, i.e., by deep tacit assumptions about how the world is, and ought to be, that they share as a group
assumptions determine perceptions, thoughts, feelings, and, to some degree overt behaviour (Schein, 1996).
impied, without being openly expressed
highly personal
deeplty ingrained in action
individual commitment to their specific economic context (Janssens and Tibau, 1995)

Torff and Sternberg (1998)
practical know-how
usually not directly taught or even openly expressed or stated
kind of knowledge one acquires on the job or in everyday kinds of situations, rather than through formal instruction

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• knowing how to convince others of the worth of your idea or product is not kind of knowledge likely to be taught, rather the kind of knowledge one picks up through experience
• procedural in nature, taking the form of “knowing how” (procedural knowledge) rather than “knowing that” (declarative knowledge)
• practically useful; it is directed toward attainment of goals that people value
• acquired under conditions of low environmental support; one often gains tacit knowledge on one’s own, without much direct instruction
• generally unspoken, underemphasized, conveyed in indirect manner (Sternberg et al., 1995, in above)
• knowledge about managing: (a) one’s self, (b) others, and (c) tasks
• crossed with two orientations of tacit knowledge: local (oriented toward the attainment of short term goals, e.g., how to organise daily tasks)
• global (oriented toward the long term, e.g. how to get a promotion) (Wagner and Sternberg, 1985, in above)

Turner (1989)
• tacitness will refer strictly to the reproducible expectations
• assumptions
• presuppositions
• cognitive skills

van Daal, de Haas and Weggeman (1998)
• implicit knowledge: tacit knowledge, experience, skills and attitude, shared through demonstration, attainable through imitation in socialisation processes, can be used as power
• ESA: Experience, Skills and Attitude

Wachter (1999)
• personal and context specific, which is often developed over a long period of time through direct experience.
• due to the extent of embedded learning that supports it, such knowledge is frequently difficult to formalise and communicate.
• such knowledge is internalised and might not be readily transferable to a written report of step-by-step manual
• tacit knowledge also includes cognitive and technical elements
• technical element of includes concrete know-how, craft, and skill
Wagner and Sternberg (1985)
- knowledge usually not openly expressed/taught
- probably disorganised/informal/relatively inaccessible
- ill-suited for direct instruction
- not necessarily inaccessible to conscious awareness/unspeakable/unteachable
- not directly taught to most of us
  - knowledge of managing self: relative importance of tasks one faces, knowledge about more/less efficient ways of approaching tasks, knowledge about how to motivate oneself to maximise accomplishment
  - knowledge of managing others: managing subordinates/social relationships, assign/tailor tasks to take advantage of individual’s strengths, minimise effects weaknesses, reward to maximise job performance/job satisfaction, how to get along with others
  - knowledge about managing career: career reputation established/enhanced, convince superiors of ideas/products, extent one’s priorities reflect what is valued by organisation/field, how to gain respect/confidence of those who judge your work/determine promotions, how to convince others that your work as good as it is
- not automatically acquired with years of experience
- all purpose algorithms (Scriber, 1983, in above)
- abstract, high-level goals, plans developed as result of experience (Soloway, Erlich, Bonar, and Greenspan, 1982, in above)

Wagner and Sternberg (1987)
- knowledge usually not openly expressed/stated (Oxford English Dictionary, 1933, in above)
  a. content: whether knowledge concerns management of oneself, management of others, management of one’s tasks
  b. context: whether knowledge concerned with short/long term accomplishments
  c. orientation: whether knowledge concerns ideal quality or practically of judgements/decisions

Wagner and Sternberg (1990)
- work related practical know how that is learned informally on the job (Wagner and Sternberg, 1986, in above)
  - “learning the ropes”
  - “getting one’s feet wet”
  - “what goes on without saying around here”
West and Meyer (1997)
- organizational capabilities which are embedded in routines
- unobservable
- difficult to change

Woherem (1991)
- difficult to express
- gained through social/cultural interactions in society and area of work.” (Gill, 1988a, in above)
- knowledge gained through apprenticeship

Wong and Radcliffe (2000)
- something that is gained through experience
- can only be observed through action
- inarticulable and uncodifiable
- extremely difficult, if not impossible, to articulate, put in writing or codify

Wyatt (2001)
- tacit knowledge (or intuition) defies recording. This kind of knowledge underlies personal skill, and its transfer requires face-to-face contact or even apprenticeship

Zack (1999)
- subconsciously understood/applied
- difficult to articulate
- developed from direct experience/action
- usually shared through highly interactive conversation/storytelling/shared experience

Zeira and Rosen (2000)
- Often referred to as intuition, common sense, or practice wisdom, is the implicit store of knowledge used in practice
- Is a meaningful and important source of information that influences practitioner’s decisions and actions (Schon, 1983; Scott, 1990)
- Easily accessed on demand
- Remains elusive to critical examination and verification by scientific procedures (Reber, 1993)