Integrated Knowledge Management

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Abstract In this paper we present the inception of Integrated Knowledge Management (IKM). Knowledge management is entering its new stage, after the delays of its "definitionless", IT-based period, when knowledge got confused with information, losing thus two decades of fruitful development. Although there now is a significant information overload, killing productivity, creativity and innovation, there can never be any knowledge overload. Knowledge is fundamentally different from information. The integration of data, information, knowledge and wisdom into a coherent and unified management support is necessary for effective transformational IKM support systems.
We draw the necessary distinction between information and knowledge and show that although it is difficult to measure the value of information, the value of knowledge can be measured simply and effectively: by the metric of added value. Several quantitative examples of knowledge measurement are also given.
Once we learn how to measure knowledge, the value of the inputs of data and information can be derived. The space is thus opened for integrated knowledge management. Integrating data mining, information processing, knowledge management and wisdom attainment into a unified support system is a prerequisite for effective management in the post-crisis era of socio-economic transformation.

Keywords knowledge, information overload, exformation, added value, knowledge management, integrated management support, data mining, wisdom, enlightenment, knowledge measurement, integrated knowledge management

1. Introduction

Who is this that darkeneth counsel by words without knowledge?
Job 38:2

In 1987, a paper entitled "Management Support Systems: Towards Integrated Knowledge Management" was published. The notion of Integrated Knowledge Management (IKM) is more than twenty years old. The need for [data-information-knowledge-wisdom-enlightenment] integration is now greater than ever before. In the meantime, numerous strains of knowledge management have been pursued (and abandoned), but fruitful integration of knowledge has not occurred yet. It could be that the prevailing mainstream of KM conceptual development has not sufficiently differentiated between information and knowledge: in fact, knowledge became a label for information, like *explicit knowledge*, while knowledge itself has been relabeled as *tacit knowledge*, taking it into the realm of intangibility, out of the reach of useful measurement.
It is our current purpose to show that knowledge is very tangible and its value is eminently measurable, while the value of information remains difficult to assess, unless it becomes embedded in action (knowledge) as one of its inputs. Only then information attains value, measured indirectly through the value of knowledge (added value of the product of coordinative action). All the rest is *exformation*, i.e. unintegrated, stand-alone, purposeless information, attaining its value only through some TV encyclopedic quiz, like *Jeopardy*, and being best handled by a machine program, such as current IBM

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Watson.
Knowledge has now become the key source of competitive advantage. The failures of knowledge management (KM) of the past two decades can be traced to the following list of several paradigm-intervening factors:

1. Absence of useful, operational and measurable definition of knowledge, resulting from its confounding with information, has led to undifferentiated and unsustainable, IT-based mislabeling of knowledge. Information is *not* knowledge.
2. Knowledge itself continues to be approached as a separate, context-free concept, not properly integrated with data, information and wisdom for the purposes of management/coordination support.
3. No useful measure of knowledge has been developed and so the field of KM was discredited in practice and its advancement slowed down considerably.
4. Meaningless classification of knowledge into tacit and explicit – before defining knowledge itself – has driven a generation of well-meaning young researchers into the intellectual *cul-de-sac*.
5. Modern management and decision making is increasingly plagued by information overload and a massive exformation build-up. Yet, there can be no knowledge overload.

2. Information Overload

As information becomes commodity, the information technology and communications revolution generates significant *information overload* and, as a consequence, attention fragmentation, poor decision making, loss of creativity and innovation as well as declining productivity. While information overload becomes a scourge of modern business, there is *never* any knowledge overload.
The need to shift the focus from information to knowledge has never been stronger: knowledge can hardly become commodity and there can never be "too much" of it. It would be pointless to shift from information to another form of information – even if labeled as knowledge. It does not matter what we call it, the only thing that matters is the real difference between knowledge and information, i.e. between action and its description. Knowledge can exist only as action and information has no existence outside description of action.
Consider the torrent of e-mail and huge volumes of other information (and exformation), from mobile telephones to blogs, tweets, and social networks. Humans cannot (and should not) keep pace with the information flowing incessantly towards them. The whole organization's productivity can be affected by information overload, and no single person or group can address it effectively. *Information addiction* and clogging of communication arteries becomes a new scourge of business efficiency and productivity. The solution is not more and better information processing, powerful devices and dedicated multitasking, but a renewed focus on knowledge production.
Constant exposure to the deluge of new information does not make people more creative. It makes them anxious, harried and stressed. Stress hormones bring in *information addiction*. *Watson-type programs* can help in assisting humans with the information overload. But there is little time left for developing new skills, knowledge or expertise.

Being the most informed is not the same as being the most knowledgeable or wise. *Focus* on knowledge, *filtering* necessary information, and *forgetting* most of it after it has been embodied in the new knowledge, are the right answers, best handled by machines. Becoming *info-disconnected* is so much harder than being info-connected, but for producers of new knowledge there is no other way. It is all about being in control of your digital information inputs, not being controlled by them.

Rethinking *knowledge* work, not just information work, is the key. It is therefore crucial to be able to draw a strong distinction between information and knowledge, so that information workers are no longer called knowledge workers and information is not labeled as knowledge.

3. Knowledge: Tacit and Explicit?

It is of little help to insist that knowledge is tacit, that it is in our heads, or that it is a "justified belief". These were the failed notions of the nineties, leading knowledge management (KM) out of the loop. *Integrated knowledge management* (IKM) cannot repeat the mistakes of the past.

First, knowledge is *not* tacit. Although *tacit* has many meanings, none of them captures the meaning of knowledge. Tacit means implied, i.e. understood without being openly expressed. It also means silent, unvoiced or unspoken. Our knowledge of skiing, cooking or lecturing certainly has to be *expressed*, in order to be noticed, evaluated and measured. But it cannot be expressed through sounds, words, language or any other symbolic *description*. Explicit description is not knowledge, but information. Knowledge has to be expressed *through action*.

Clearly, knowledge is neither tacit nor explicit. Knowledge is *embodied* in an organism (or social organism) and *embedded* in action.

Knowledge is not just in our heads, but embodied in the entire nervous system and even cellular and tissue memory. This capability of the organism is invisible and goes undetected until it is expressed and becomes embedded in action and its products. We then recognize knowledge through its embedding in action. Action and its results affirm the knowledge so expressed. It is only through action that knowledge can be measured. Anything tacit cannot be measured unless it is expressed. Explicating the tacit through symbolic description gives us information. Information is, and always will be, a *symbolic* description of action. Not all information is explicit. Some of it remains silent, unvoiced and outspoken. This is *tacit information*, i.e. descriptions we keep in our heads and do not share. So, it is the *information* which is either tacit or explicit. Also unexpressed knowledge is being stored as description only, i.e. as information.

Knowledge can only be embodied (exists) or embedded (expressed) in action. The embodiment of knowledge is necessary but not sufficient for its action embedding. We know (posses as information) more than we know (express as action).

Either way, knowledge is *not* information; action (embodied or embedded) is and always will be different from its description (tacit or explicit).

Knowledge has value and information has value. Yet, they are fundamentally different. The value of knowledge has little to do with the time, effort and money spent acquiring it. Its value is directly related to the value of its product. In order to know its product, knowledge has to be expressed (embedded in action). The value of any product is related to its supply and demand at a particular place, time and context. Knowledge is better (quantitatively or qualitatively) if it adds more value to its user(s).

Information is a description of action. We do not know the *value of information* until it becomes an input into knowledge formation and embodiment, and then expressed (as an integrated whole) and embedded in action. As an input, information contributes to the product of knowledge (action) and its added value can be measured via measuring the value of the product.
The value of both knowledge and information is measured by the *added value* of their *joint* product. Knowledge produces value directly through action, information contributes to its production as one of the inputs.

4. Forms of Knowledge

There are at least four basic forms of knowledge. They all conform to our definition of knowledge as purposeful coordination of action.
To recognize purposeful coordination of action as a satisfactory or adequate conduct (effective knowledge), an *observer* must be able to assess two things: the *process* and the *outcome*. Any individual coordination can thus be brought into the social domain of assessors (observers), living in language and being thus able to socially coordinate such coordination(s). Purpose, outcome or result is therefore necessary for any coordination to be recognized and validated as knowledge.
None of the above pertains to information; knowledge is *not* a form of information, tacit or explicit. It does not belong into descriptions (data or information) processing domain, or IT.
Any coordination of action involves the choice, sequencing and performance of activities concatenated into processes. We speak of the *rules of conduct* (prescription, recipe, algorithm). The rule-based behavior is natural in humans and animals. As a result of an expressed set of rules of conduct, individuals or groups arrive at intended (and sometimes unintended) result or outcome. Quality of the outcome must be assessed and the process itself validated.
The four basic forms of knowledge are *instinct*, *skill*, *knowledge* and *expertise*.[2]

1. *Instinct*. Not all knowledge is learned. Humans and animals are often born with knowledge which is instinctive and its embodiment is transferred genetically rather then culturally. Knowledge of hunting, copulating, protecting, etc. is crucial to survival of individuals and groups. Without such inborn rules of coordination of action, without instinctive knowledge, survival would not be sustainable. However, the main object of our studying knowledge is the *learned* and culturally transmitted part.
2. *Skill*. The rules of conduct are developed *internally*, within the individual, through self-learning and autodidactics. Such rules and processes are self-validated and only the outcome is subject to external assessment. Robinson Crusoe had only skills – until his observer, Friday, appeared. When chopping wood or typing on a typewriter, an actor can assess *his own* action and judge whether it has been successful or not. A fallen tree or a typed page is the sufficient proof of skill.

[2] The *synecdoche* of knowledge is fully appropriate here. We use a general class name to denote a specific member of that or an associated class.

3. *Knowledge*. The rules of conduct are established externally and learned through cultural transmission (family, school, university). Both the rules and outcomes are assessed and validated in a social context of peer or professional institutions which (not the actors) establish the rules. One cannot claim knowledge without such *social validation*; one can only claim internally self-validated skills. Mastering the rules of conduct, not only delivering the results, is required of a professional.
4. *Expertise.* This refers to socially sanctioned knowledge combined with the accrued and accepted ability to reflect upon a relationship between the actor and the requisite *system of rules*. One can master the rules of the profession, peer group or culture so well that they no longer need to be fully followed. Experts gain control over the rules and criteria of assessment of quality standards. Expertise provides the mechanism for changing the rules.

Clearly, there are significant differences between acting instinctively, skillfully, knowledgeably or expertly. Different tasks require different forms of knowledge; different collective efforts require optimal mixes or portfolios of skills, knowledge and expertise. All forms of knowledge have to add value.
Some people do things instinctively, others have skills. Some are informed, some are knowledgeable. Many can use information and follow the recipes efficiently: they possess dexterity and are specialists. They do not choose their goals, let alone knowing why they should follow them. Only the master chef knows how to coordinate action towards chosen goals. But only a wise man knows *why* such goals should be chosen and others rejected. *Wisdom* refers to explicability: If I know why – and not just what and how – then I could also become wise, not just knowledgeable.

5. Value of Knowledge: An Example

Knowledge has to be measurable in order to judge its usefulness or adequacy. Unexpressed and unmeasured knowledge is being wasted for individuals, community, corporation or nation. Culture based on information, or worse - encyclopedic information, cannot compete on a culture based on knowledge.
It is clear that knowledge has value and the *value of knowledge* can only be measured by its specific contribution to the institution, market, company, department or individual in terms of its *added value*.
Knowledge therefore is not abstract, intangible or esoteric. It is a most concrete, real and tangible process, the action itself, with a defined purpose and criteria for its attainment. Knowledge must be useful and its usefulness is tested by an institution. Knowledge useful to an isolated individual only is just a skill.
All knowledge is action and so it can only be manifested in a specific, individual context of space and time. Knowledge in the U.S.A. is not the same as that same knowledge in Iraq; the knowledge of today is not the same as that knowledge tomorrow.
Knowledge is part of human capital and as such it needs social capital (institutional infrastructure) for its embedding and manifestation. Knowledge, being a coordination of action, is *embodied* in the sensorimotor structures of the organism and *embedded* in the circumstance of its situational context.

Descriptions and representations are just information and so they can be relatively context-free, neither embodied nor embedded, but *externalized*. They can be "measured" only in a *default context*, i.e., outside of action and situation.
The measurement of the value of knowledge must take into account both the individual (embodiment) and his circumstance (embedding).

5.1 Iron Chef

Let us use a simple example demonstrating the natural simplicity of measuring knowledge, regardless of the complexity or scale that could be brought into consideration.
The Iron Chef has invented a rather attractive *foie gras* dish and wants to turn it into innovation. He has mastered its preparation and is now offering it in his two restaurants in Manhattan and Paris. The dish goes for $100 in Manhattan, but is set at $120 in his Paris establishment.
If people are coming, they clearly feel they are realizing added value by consuming this dish. They are obviously willing to pay more than current prices and so the business is sustained. Of course, individual "willing-to-pay" maxima are different and so individuals and groups evaluate chef's knowledge differently, across contexts, time and cultures. If a Manhattanite would be willing to pay up to $200, then he realizes $100 worth of added value, while a Parisian having his maximum at $170 would realize only $50 of added value. The waiting lists are likely to be larger in Manhattan because the added value of knowledge is perceived to be larger. The same knowledge would probably come close to zero of added value in Islamabad.
How much value does this knowledge add to the business itself?
First we have to separate knowledge from purchased ingredients, equipment, services, etc. The calculations in Manhattan showed the following items:

Fresh ingredients …. $50
Use of equipment … $10
Fuel & energy ……. $6
Information ……. $10
Time ……... 20 min

These calculations are similar in Paris, except that $60 was needed for the fresh ingredients; in total, $76 in Manhattan and $86 in Paris. The information database and downloads include analysis of daily clientele, their preferences and customized preparation adjustments. The Iron Chef serves the dish himself.
What is the value of Chef's cooking knowledge, in Paris and in Manhattan? How much should he be paid for his knowledge, per hour? How much can he be paid? Clearly, we subtract the costs of all the inputs from the total price paid (market valuation of his product, based on supply and demand and total costs):

In Manhattan $100 – $76 = $24
In Paris $120 – $86 = $34

This represents the *added value* due to the Chef's *coordination of action*, his knowledge of cooking the *foie gras* dish.
Observe that added value is different from profit. Wage or salary paid does not enter as costs, nor should it. We do not know the value of knowledge until we calculate the added

value. Added value is the only legitimate source of wages and salaries. No business can or should pay more than the added value of the knowledge services. Otherwise the pay carries the risk of expectation, retainer or debt. Because the Iron Chef is directly exposed to the market, his added value can be correctly and fairly measured. He should receive:

In Manhattan $24 × 3 = $72/hour
In Paris $34 × 3 = $102/hour

Observe that the Iron Chef's knowledge is clearly worth more to business in Paris than in Manhattan. The same knowledge would probably not add much value in Harare or Mogadishu. A proper context *embedding* is crucial for any knowledge. Also, a different chef or (God forbid) this author, would most likely not add much value even in *La Coupole* on Montparnass: the proper *embodiment* of knowledge is equally crucial.
The main subject of Knowledge Management (KM) is the proper embodiment and optimal embedding of individually acquired knowledge.
We should also note that in traditional companies people are not being paid according to their added value, but according to their position and performance as evaluated by their superiors. They are not exposed to the market, but shielded from it. So, the evaluation of their knowledge is difficult, if not impossible. It is easier to pay them for position or performance, then for knowledge or added value. The danger is that some would be paid more than their added value and others less than the value they added through their knowledge. This is the price we pay for not letting the market forces penetrate beyond the factory gates: significant inefficiency and unfairness.

6. What is Added Value?

Knowledge is measured by the value coordination of effort, action and process adds to materials, technology, energy, services, information, time and other inputs used or consumed in the process. In any business (and human) transaction, value has to be *added to both* participants (or sides): the provider *and* the customer.
Adding value to both sides is what makes the transaction satisfactory and sustainable. It is the foundation of a free market. If we add value to just one side at the cost of subtracting from the other side, then both sides do not benefit and the market is not free. Governmental *intervention* is an example of such overruling the free market: e.g., intervening on behalf of a specific company or bank, at the cost to the taxpayer. Governmental *regulation* should protect all parties in the transaction against deceit, manipulation, lies and fine print. Regulation should protect functioning of a free market. It should protect the freedom from deception and harm, not the freedom to deceive and harm others. Thus, there is a fundamental difference between intervention and regulation. Confounding the two is not only the misunderstanding of freedom and free markets, but a source of harm in itself. While proper regulation protects and enhances freedom, aggressive intervention deforms market signals and weakens freedom, free markets and value of human knowledge.
There are two kinds of value to be created: *value for the business* and *value for the customer*. Both parties must benefit: the business – in order to produce it; the customer – in order to purchase it. In the global age it is precisely this business-customer *value competition* that is emerging as the hardest and the busiest battleground.

Yet, it is the wrong battle. Business and customer are two sides of a free market transaction. The must both benefit, in a tradeoffs-free sense, not benefit at the expense of the other side, in a tradeoffs-based sense.

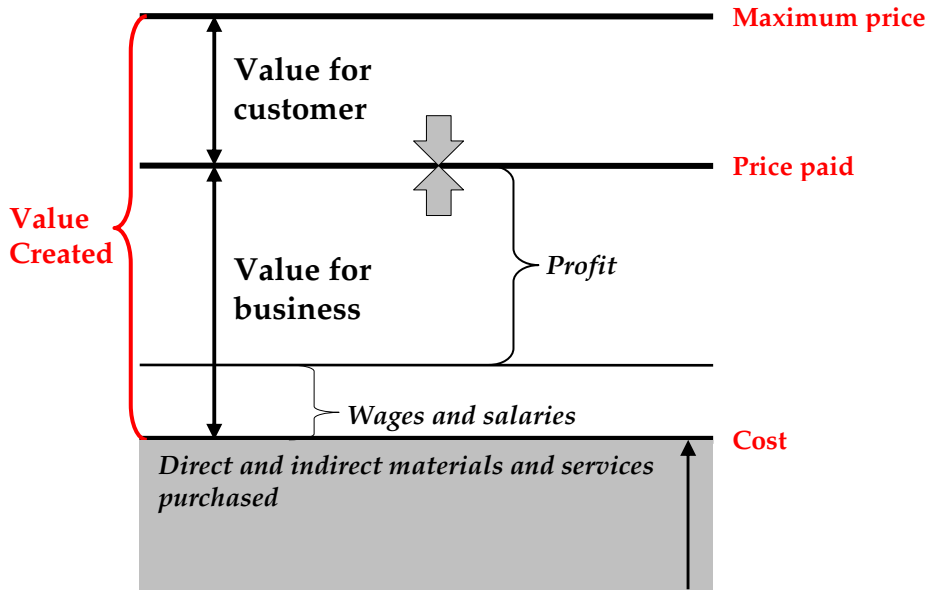

Figure 1 Adding Value for the Customer and Business

In Figure 1 we sketch the process of creating new value. This is also crucial for the identification and assessment of innovation.
First, the customer pays for the service or product: the *price paid*. The producer subtracts the *cost incurred*, including all direct and indirect materials and services purchased. The difference is the *added value* for the business. This added value can also be interpreted as the *value of knowledge* deployed in producing the service or product. In order to pay wages and salaries, the production process and its coordination must generate this added value. Added value is the source of corporate wages and salaries and profits.
If the added value does not *cover* the wages and salaries, then these must be correspondingly lowered. If no value has been added, then the value of knowledge is zero and no payment should be attributed to it. The business must add enough value in order to *cover* at least its workers and managers - their salaries and wages. If even more value has been created, then *profits* can be realized, up to the price received.
The customer, of course, must be willing and ready to pay more for the service/product than he actually paid. The *maximum price* the customer would be willing to pay must exceed the price the producer has asked for. The difference is the added *value for customer*.
If there is no value for customer – i.e. the maximum price is lower than the price to be paid – then the customer would not buy the service or product. In a competitive and free market, the customer pays money only for the value received, i.e. the value for the customer.

7. Examples of Knowledge Measurement

1. *Telephone System Replacement*

The company NewCo (customer) decides to hire an outside internet service provider, ITProvider (provider), to replace its current telephone system and infrastructure, and maintain this new system in the future. Currently, NewCo spends $1,200 a year maintaining its current telephone systems. Table 1 shows NewCo's annual cost breakdown for the current telephone system.

Item		Cost
Infrastructure	$	300.00
Maintenance of equipment	$	200.00
Telephone carrier	$	550.00
T&E	$	50.00
Service (incl. wages and salaries)	$	100.00
Total	**$**	**1,200.00**

Table 1 NewCo's yearly costs with current phone system.

ITProvider responds to a request for proposal from NewCo, indicating that a new telephone system would require an initial investment of $2,795 and an annual maintenance cost of $620, which is cheaper than NewCo's current costs for two reasons: (1) new telephone technology requiring fewer resources to be maintained and (2) By outsourcing the maintenance NewCo can tap into an expanded network of specialists. The price charged by ITProvider must be higher than its costs (excluding wages and salaries) in order to generate value to the provider. Similarly, the price that NewCo is willing to pay must be equal or higher than the price charged by ITProvider, and therefore adding value to the customer. Table 2 shows a breakdown of the price charged by ITProvider to NewCo and its costs incurred by ITProvider.

Item		Price		Cost	Recurring yearly price	Recurring yearly costs
Hardware Equipment	$	750.00	$	712.50	$ -	$ -
Infrastructure (network & facilities)	$	250.00	$	237.50	$ 100.00	$ 100.00
Software	$	400.00	$	380.00	$ -	$ -
Other Equipment	$	750.00	$	712.50	$ -	$ -
Information (training, manuals, data)	$	120.00	$	114.00	$ 20.00	$ -
Telephone carrier	$	-	$	-	$ 100.00	$ 100.00
Maintenance	$	-	$	-	$ 200.00	$ 200.00
T&E	$	25.00	$	25.00	$ -	$ -
Total (excl. Services)	**$**	**2,295.00**	**$**	**2,181.50**	**$ 420.00**	**$ 400.00**
Services (incl. wages & salaries)	$	500.00	$	250.00	$ 200.00	$ 75.00
Total	**$**	**2,795.00**	**$**	**2,431.50**	**$ 620.00**	**$ 475.00**

Table 2 Price charged to NewCo. Costs incurred by ITProvider to the new telephone system

It is important to highlight that the service provided and charged by ITProvider is the *knowledge* component of the example. Because of the new suggested technology, NewCo will be required to pay more for the service component than what it costs today if it decides to move forward with this project. Even though, the annual maintenance price to be paid by NewCo will be lower than today.
Another key component required for this model is the *maximum price* that NewCo is willing to pay for a new telephone system. Probably, the easiest to way to reach a decision is to assume that costs of maintaining the current telephone system is perpetuity to NewCo. Therefore, calculating the present value of this perpetuity should quantitatively result on the maximum price that NewCo is willing to pay for the new system. The discount rate is a key variable for the present value calculation. Let's assume a discount rate of 12%, just to make it simple, as in Table 3.

Discount Rate	12%
Yearly Costs	PV of Yearly Costs (Max price for NewCo)
$ 1,200.00	**$ 10,000.00**

Table 3 Maximum price NewCo is willing to pay for any new telephone system

Similarly, the same concept applies to calculating the cost for ITProvider and the price for NewCo. The main difference is that both price and cost have an initial and a recurring component. The total price (and cost) is the initial component plus the present value of the recurring component. Additionally, the total price must be calculated including the service as this is the amount that NewCo will pay, see Table 4. However, services are not included in the total costs as it must be extracted from the value added component.

	Price	PV of Price
Initial Price	$ 2,795.00	$ 2,795.00
Recurring	$ 620.00	$ 5,166.67
	Total Price	**$ 7,961.67**

	Cost	PV of Cost
Initial Cost	$ 2,181.50	$ 2,181.50
Recurring	$ 400.00	$ 3,333.33
Total Cost (excl. Services)		**$ 5,514.83**
Service Initial	$ 250.00	$ 250.00
Service Recurring	$ 75.00	$ 625.00
Total Cost (incl. Services)		**$ 6,389.83**

Table 4 Calculation of price charged to NewCo and costs to ITProvider.

Upon the calculation of price, cost and cost of service, it is possible to plot the value diagram in Figure 2:

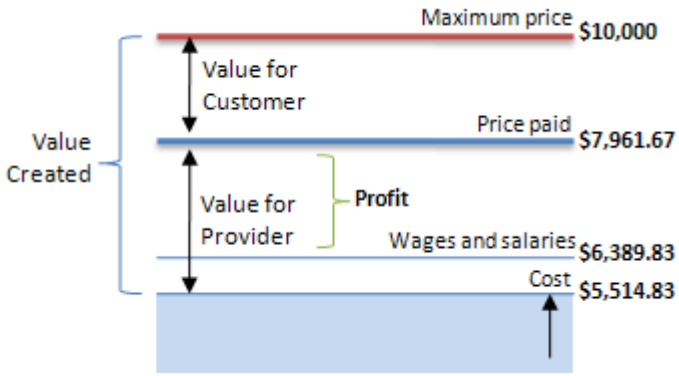

Figure 2 Added-value diagram for NewCo

NewCo will move forward with this project as it clearly recognizes the value created. NewCo was willing to pay up to $10,000 for a new telephone system, and in reality will be paying around $8,000. The quantitative value created for NewCo is $2,000. The same calculation applies to ITProvider: even after applying its human capital to the project (services), it still generates a profit. In this example value is created for both customer and provider.

2. *Electronic guides*

Electronic career guides are sold over the internet to university career centers as well as directly to students. There is a large market in providing career guidance to students before entering and during a program, and especially around the date of graduation. The guides are designed to provide details on specific careers in technology and finance (e.g. banking, accounting, information security, database management). They are written by industry insiders with real world experience in respective careers.
In Table 5 we present an analysis of identifying and measuring the *knowledge embedded* in this business. We are analyzing the added value for the business and for the customer.

Sales of guides	
Quantity sold per month	150
Price per guide	$14.95
Total monthly sales	2242.50
Inputs and operating costs	
Web hosting	$30/month
Credit card fulfillment	$20/month
Advertising – print	$70/month
Advertising – search engines	$80/month
Public relations – Press releases	$50/month
Total monthly operating costs	$250
Added value for business	
Added value for business (salaries / wages not included)	$1992.50
Added value per hour (assuming 200 hours worked per month)	$9.96/hour

Only pay salaries up to added value per hour for business.	
Added value for customer	
Max price estimated from benefits to customer (increased earnings, improved career selection)	$100
Cost per guide less benefit	$14.95
Added value	$85.05

Table 5 Summary of value added for numerical example

In this simple example, we can see that the business knowledge (coordination of sales) generates monthly added value allowing wage rate of $9.96/hour for a 200 hours/month employee(s). An average customer derives $85.05 of added value monthly, but individuals differ in their assessment and realization of benefits (and Max price).
In both of the above examples there are certain policy/strategy implications:

- *Salaries and wages*. The company can pay only up to the level of added value less corporate profit. The added value measures can be provided directly to employees. As their added value increases, wages also increase. This serves as an incentive program to employees to enhance their knowledge and skills of coordination.
- *Marketing*. The company will pay only up to the level of added value. We measure performance and thereby added value. We will measure with the metric of sales. As actionable information increases there will be increases in measured knowledge. This serves as an incentive program to marketing staff and consultants where they benefit with company's increased sales.
- *Customer satisfaction*. We will create metrics through customer surveys, measurement of complaints and phone calls to the company. It is more difficult to measure added value here, due to the subjective perception from inside and outside of company.

Our strategy is to pay for knowledge via added value. We don't want to pay in excess of the actual value added in any area of the organization. This strategy requires the measurement of value in our coordination of effort, action and process.

8. Summary of the Information – Knowledge Interface

Information is always an input (like any other resource) while knowledge refers to the coordination of value-adding and information-transforming process, like decision making, coordination, sequencing and performance.
There is a growing *information overload*, but there can never be a "*knowledge overload"*. The two concepts are very different, as the inputs and outputs are very different from a production *process*.
Knowledge is a purposeful coordination of action. Achieving its purpose is also its sole proof or demonstration. Its quality can be judged from the value of the attainment (its product) or from the quality of the coordination (its process). Coordinated action is the test of possessing knowledge. *All doing is knowing, and all knowing is doing*.

Repeated action leads to accumulated experience and thus to enhanced understanding of the process and better knowledge. So, the already *demonstrated ability* to act effectively towards purpose has value as it represents an active knowledge potential in new contexts. Whenever we act – make decisions, pass judgments, reorder priorities – we create a world of action.
Every act of knowing brings forth a world. *Bringing forth a world of coordinated action is human knowledge*. Bringing forth a world manifests itself in all our action and all our being. Knowing is *effective* (i.e., coordinated and 'successful') *action*.
When we concentrate on the inputs and outputs of the decision process, then we input and output information and information is all that is needed. But decision making is a process leading to real action and therefore is dependent on knowledge and not just information. *Information is a symbolic description of action*. In modern terms: *Information is anything that can be digitized*. Information acquires value only if it leads to action (is transformed into knowledge), which in itself is valuable only in terms of its purposes and outcomes. Let us heed A. Einstein's warning: *Information is not knowledge*.

In fact, a new DIKWE chain of knowledge (Table 6) is appropriate here:

	TECHNOLOGY	***ANALOGY* (*BAKING BREAD*)**	***EFFECT***	***PURPOSE* (*METAPHOR*)**
Data	EDP	Elements: H_2O, yeast, bacteria, starch molecules	Muddling through	Know-Nothing
Information	MIS	Ingredients: flour, water, sugar, spices + recipe	Efficiency	Know-That
Knowledge	DSS, ES, AI	Coordination of the baking process → result, product	Effectiveness	Know-How
Wisdom	WS, MSS	Why bread? Why this way?	Explicability	Know-Why
Enlightenment	Personal BSC	This bread, for sure	Truth, insight	Know-Yourself

Table 6 DIKWE chain and its components

While information allows us to do things right (efficiency), knowledge aspires to do the right things (effectiveness). *Explicability* of purpose is an essential ingredient of its effectiveness in attainment. Wisdom is about *explicability and ethics* of our doing.
Another way of activating the information-knowledge distinction is: *It does not matter what they* (customers, consumers) *say, the only thing that matters is what they do*. It was Ryle (1949) who taught that the capacity to act is more fundamental than propositional knowledge: *Knowing how* (knowledge) *is more fundamental than knowing that* (information).
This distinction between information and knowledge is at the very foundation of human enquiry. Already Aristotle, in his *Nicomachean Ethics*, distinguished between *epistêmê (*knowing-what or that) and *technê* (knowing-how). Only *technê* can get effectively married with *praxis* (doing).

Many informed people know what to do, quite a few knowledgeable experts know how to do it, but only a few *wise persons* know why it should (or should not) be done.
There can be no *knowledge overload*. To paraphrase Thoreau: *To know that we know what we know, and that we do not know what we do not know, that is true knowledge*.
And 'true knowledge' leads to wisdom.

8.1 The ECIS cycle

To pursue action effectively, we have to integrate knowledge and information flows into a *unified system of transformations*. It is insufficient, although necessary, to manage, manipulate, mine and make do only with data and information. *The purpose of knowledge is more (and better) knowledge, not more information.* Information is only a symbolic intermediary between the two phases.
Useful knowledge can be *externalized* and codified into its recordings, descriptions and digitizations. Thus, the obtained information is *combined* and adjusted to yield more useful, actionable information. Actionable information is *internalized* (embodied) as input into effective coordination of action (knowledge). Effective knowledge is then socialized or shared (embedded), i.e., transformed into usefully distributed knowledge. In short, the cycle (knowledge → information →knowledge) can be broken into its constituent transformations, forming the ECIS cycle:

1. ***E****xternalization*: knowledge → information
2. ***C****ombination*: information → information
3. ***I****nternalization*: information → knowledge
4. ***S****ocialization*: knowledge → knowledge.

These useful labels are due to Nonaka (1991) who explores the transitions of 'knowledge' as tacit to explicit => Externalization; explicit to explicit => Combination; explicit to tacit => Internalization; and tacit to tacit => Socialization.
But these are not separate dimensions and should not be separately treated. In fact, *there is no explicit knowledge, only information*.
It is clear that the *internalization* of information into the process of knowledge production is the key. That is, the process I → K → K* → I* adds value to information through knowledge socialization (sharing, observing, imitating, repeating), while
K → I → I* → K* adds value to knowledge through information combination (analysis, research, data mining, integration, synthesis, interpretation).
To summarize: Knowledge is real and tangible. Knowledge, wisdom, and ethics are measurable. The relationship between knowledge and value creation is tangible: knowledge, wisdom and ethics must add value (Data and information are inputs into the value-adding processes). The added value can be interpreted as the *value of knowledge*.

9. Integrated Knowledge Management

The DIKWE chain of [data → information → knowledge → wisdom
→ enlightenment] is not really a chain (from inputs to outputs), and certainly not a hierarchy or pyramid, but a cycle.

A new strategy of systems integration is needed to move *beyond IT*. A *strategy of re-integration* of what should have not been separated and pursued in a specialized way in the first place: namely Data (D), Information (I), Knowledge (K), Wisdom (W) and Enlightenment (E).
These are all inputs or resources into successful business action. All such inputs into a value-adding process must *work in synergy*, in an integrated fashion, to effectively bring to fruition their dependencies and potentials.
Separate, non-interacting or only loosely connected pursuits of vital business functions and components lead to wasteful competition for resources and unbalanced development of component functions.
In the era of information commoditization, when machines and programs like IBM *Watson*, are successfully searching, analyzing and mining data and information (i.e. symbolic descriptions), the emphasis on human abilities of synthesis, interpretation and coordination are only enhanced. It is important to connect and integrate symbolic descriptions of data and information with corporate and institutional action, i. e. knowledge. *Integrated Knowledge Management* is the basis for action-based management, decision making and strategy.
In Figure 3, we sketch the basic outlines of the *Integrated Management Support System* (IMSS). Modern business management needs support from an integrated system, not from separate and increasingly isolated parts pivoting around the commodity of information.

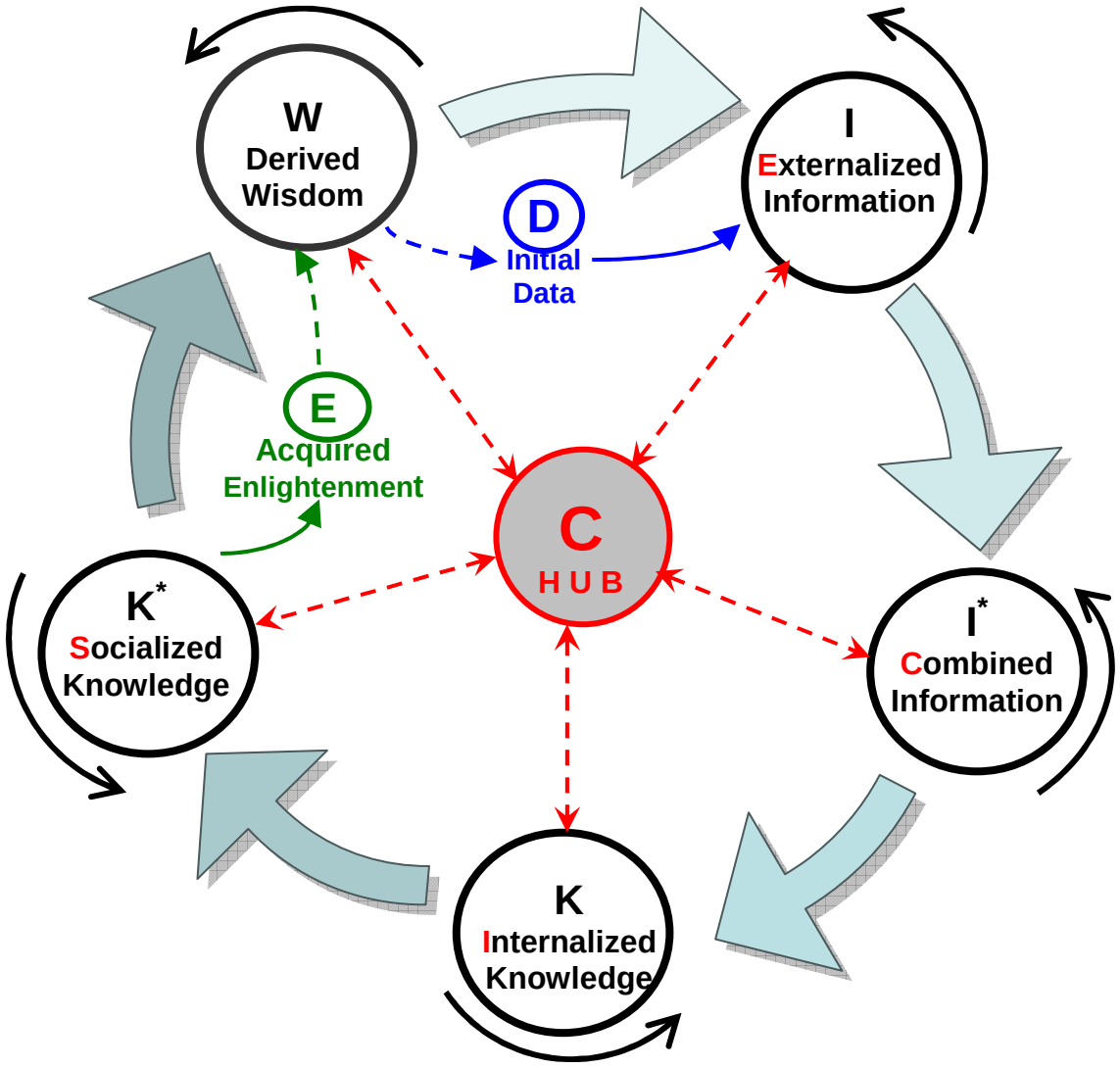

Figure 3 Integrated Management Support System

For example, database management and data mining make hidden information explicit and store it in data warehouses: this is only a small part of the whole. It should not be pursued *per se*, disconnected from the rest of the enterprise. Information has to be combined and internalized (embodied) into knowledge. Knowledge has to be socialized and shared. From the experience of actions taken, new information can be externalized and processed as input into the next cycle.

The newly produced knowledge is circulated and its purposes explicated into wisdom: knowing why to do or not to do something. Wisdom is derived from experiencing repeated action. New initiatives can be justified and initial data collected at a start of a new or parallel cycle. D is a semi-autonomous point of entry, an input from environmental scanning. Finally, after requisite iterations of cycling experiences, enlightenment can be acquired to strengthen self-confidence in the wisdom acquired and in the pursuit of new ventures. E is a semi-autonomous point of exit, an output into individual (and corporate) self-understanding.

Cyclical knowledge and information flows are stimulated, coordinated, maintained and removed by the *catalytic function* of the *Coordination Hub* (C-Hub), at the center of Figure 3. The C-Hub functions are performed under the supervision of IMSS Coordinator who is responsible for maintaining all necessary transformations of the E-C-I-S cycle.

What is the purpose of IMSS? Why does it have to function as an integrated whole? Because it *supports* the most important functions and challenges of business enterprise: *Innovation* cycle, *Process* management, *Decision-making* process, *Customer* satisfaction and *Capital* appreciation. These functions cannot be pursued separately because they are fundamentally interdependent and influencing each another.

Clearly, *data mining* does not stand alone but must be directed towards better *information processing*. Information and knowledge are interconnected through mutual externalization and internalization in a self-reinforcing cycle of *KM*: production, maintenance and degradation of knowledge. *Wisdom systems*, as explication of corporate values and experience, provide justification and ethical anchoring for human action. Finally, *enlightenment* directs our efforts towards human life and its purpose in social action in civilized society; not just towards technology, science and economics.

Conclusion

We have outlined the *hypercycle* of Integrated Management Support System (IMSS) as one from of integrated knowledge management (IKM) system. Although the DIKWE chain is often referred to as hierarchy or pyramid, it is neither. Some of its components are inputs, others are outputs; some components are actions, other descriptions of action. Yet, they are all part of the integrated whole, embodied in human experience and embedded in a network of mutual interactions and interfaces. At some point, humans have dissected their holistic evolutionary endowment into separate, non-interacting parts, and started treating them like components of some huge mechanistic contrivance, a machine which can be taken apart. There have been many efficiency advantages in doing so. But in the end we have to assemble the parts back into a functional whole, to reclaim the lost advantages of effectiveness, explication and ethics. In the end we have to reclaim human evolutionary endowment in its entirety in order not to become just efficient

machines, but effective, self-sustainable and above all enlightened and ethical human and social organisms.

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