How Much Information: Measure, but What and Why? II.

Abstract: **The author recommends that the computations aiming at government-level decision-making should be standardized and standardization should be based upon the UN's SNA. The paper shortly describes the System of National Information Accounts (SNIA), which is a complex SNA conform system of indicators and accounts to measure information phenomena at the macro level and allocates in the system the indicators adopted in the frames of various „How much information" efforts. In the second part the basic concepts of information flows, transactions, transfers, production , consumption, use and the valuation of stocks and flows are described.**

After defining the ingredients of information activities in the first part of this paper, in the second part information flows and and their indicators in the SNIAwill be discussed.

1. Economic Flows, Transactions and the Information Externalities of Economic Transactions

A process of creation, transformation, exchange, transfer or extinction of economic value, which involve changes in the volume, composition or value of an institutional unit's assets or liabilities is called *economic flow in the SNA*. An economic flow is identified by identifiers of the actor, dates of action and participants.

The *economic actions taken unilaterally by one institutional unit* so that it has consequences on other institutional units, without the latters' consent, are called "other economic flows". The SNA records these actions only to limited extent, even though these phenomena are generating economic flows. The consequences of wars are not treated as transactions but as other economic flows.

Economic transactions should be discerned from other types of economic flows. An *economic transaction* is an economic flow realized by an interaction between institutional units by mutual agreement or an action within an institutional unit that is analytically useful to treat like a transaction, often beacuse the unit is operating in two different capacities. The parties may enter the transaction so that the agreement is forced by law.

In the SNA, *a monetary transaction* is an economic transaction whose one component consists of the payment of money by one party to the other or of the establishment of a new financial claim by one party over the other or the extinction of a financial liability owed by one party to the other. *Payment* itself is an information component to economic transactions, which will be discussed later.

Economic transactions need to be clearly distinguished from the activities, such as physical processes of production or consumption of which they may be composed. The same situation is valid in SNIA: *Physical information flows should be distinguished from the accounted information flows and transactions on the level of institutional units*.

For instance, telephone calls are not taken into account at every physically existing switching centre the call is running through, though at every such centre new signals are produced and the input signals are consumed. Just the signals at the interface between the user and the service supplier (i.e. at both's receiver) are considered and the rest of an arbitrary number of signals of switches, computers etc. are left out of the account.

Economic transactions are interactions between pairs of institutional units which *may have one or more components*. A component to an economic transaction is an action in which:

- the ownership of a good or an asset is transferred from a unit to an other; or
- a new financial claim is created or existing claim extinguished; or
- a unit provides a service to an other; or
- a unit acts (works) for the other.

Accounted economic transactions of SNA sometimes will be partitioned into measurable information transactions or constituents in SNIA and a number of non-accounted of economic information transactions will be added.

Certain information activities carried out by institutional units cause changes in the condition or circumstances of other units without their consent: They may be forced unwittingly and unintentionally consume or use information. These are *information externalities,* which are non-intentional constituents of economic flows.

A local transducer station or foreign and not-interested radio stations can "waste" the air-space over other countries. These can be viewed as unsolicited information services delivered without the agreement of the countries and units affected or even against them. This "unintentional inward flow" influences the opportunities of the domestic production, it can be viewed as "Polluting with impunity".

Contrary to economic externalities, *domestic information externalities of foreign spill-over broadcasting can be well estimated* with survey data. Foreign information externalities of domestic broadcasting are also subject to surveying, but the survey data are mostly not available for the producer country.

Information flow from employer to employee may be treated as an *economic externality*.

1.1. Obligatory and Free Information Constituents of Economic Transactions

Free and obligatory information flows may be free or obligatory information transactions or information components to economic transactions. In the latter situations, information is supplied obligatorily as an essential element and inseparable part of an economic transaction. While the underlying economic transactions can technically be partitioned into an information flow and the rest of the transaction, for the purposes of estimation and measurement, information flow constitutes the organic part of the underlying non-information or information economic transaction, it must not be treated as a self-contained flow.

Examples for this are:

- Information *for soliciting business services:*
all goods and services: orders, specifications
postal and telecomm services:

      mail address

      phone, e-mail dialling

      financial services:

      checking account (consumer transactions)

      savings accounts (consumer transactions)

      ATM transactions of consumers

      credit card transactions of consumers

      application for a loan

      application for a credit card

      medical services

      data supply by patient

- Copies of *contracts and agreements*
- Information on *delivery of goods and services:*

      retail bills and receipts

      invoices

- Information provided *to consumers on goods and services:*

      notice of usage

      contents, ingredients and nutrition information on food

- *Payment* information
- Information at *applying for a job*
- Information provided *for courts*

      by ensuer in civil lawsuits

      by subpoenad witness

- Information provided *for authorities*

      for a driver's license

      for recording birth

      for getting permission to

      conduct a profession

      produce drugs

      distribute films

      sell alcoholic beverages.

Creation of "obligatory information constituents to economic transactions" should possibly be recorded as output which is to be accounted at the producers at various broad titles of information services and goods in the Information Production Account according to the general guidelines of SNA.

Though obligatory information supply is a crucial societal issue, little is known on it. Considering the variegatedness of the items under this title, several statistical surveys will be needed. *Surveying* obligatory information supply is a prerequisite of understanding information stocks and flows of an information society.

The *measurement* of obligatory information components to economic transactions altogether is troublesome. It should be estimated by aggregating all items that can be estimated or measured, including those in the previous paragraph. This is clearly a brutal underestimation and a detailed analysis is needed just to state and contour the problem area.

The operationalization and recording of "obligatory information components to economic transactions" in computer networks is desirable.

Free information components to economic transactions should include all kinds of information that is supplied voluntarily to and received free by a unit, as a real, integrate component to an economic transaction.

Examples of free information components to economic transactions can be

- personal communications by employees of public authorities to their
    clients,
- service and product information other than advertisement in the business
    sphere: traffic information supplied by the transportation corporation,
    salespersons' shopping information to private individuals
- business requests and offers,
- communications by medical personnel to patient during his/her curement.

Operationalization and recording of "free information components to economic transactions" in computer networks is particularly desirable.

1.2 Illegal economic and information transactions and crimes

Illegal economic transactions should be treated in the SNA (1993) and in the SNIA as legal transactions, provided they are genuine transactions into which both parties enter voluntarily.

Thefts are extreme forms of economic *and* information externality in which damage is conflicted on another institutional unit deliberately and not not merely accidentally or casually. These are not treated as information transactions. *Illegal use, like reading classified documents, copying of video- and audiocassettes, software-pirating, illegal receiving of telecommunications satellite or pay TV broadcasting, illegal collection, storage and use of personal data, (DM spammings, collection of GPS coordinates by smartphones etc.),, spearheadphishing etc.* are considered as *"concealed production"* the production which was concealed to avoid punishment, payment of copyright fees, or requesting the consent of the individual concerned. These factors altogether doubtlessly influence the figures of factual information production, consumption and use and so should be measured in some ways in SNIA, but data are hardly available.

The *flows generated by zombie machines under the control of bots*, should be qualified illegal information flows. *The machines under the continuous control of software vendors* like Microsoft, Adobe, Google etc. frequently report data on operation of the user's machine, malfunctions and collect and send personal data without the informed permission of the user, even if they prompted a formal written consent from him/her. These flows are more and more intensive and should be observed and classified as information self-service produced and consumed by the vendor. *Hacking, attacks against websites* are qualified as violent illegal consumption of information products.

2. Information Flows: What is Called an Information Flow in the SNIA?

In accordance with the definition of economic flows, a process can be called an *information flow*, if results in the changing of the volumes of information assets, a change in the state of "informedness" of participant institutional units. Information flows are processes that reflect the creation, transformation, exchange, transfer or extinction of volumes of information.

> *Information flow in a mathematical information theoretical* context is the transfer of information from a *variable x* to a *variable y* in a given process like in Ford & Fulkerson 1962. The present esearch focuses to limitation of disclosure, or propagation of information like van Rooyen's. Those are not flows but products – carrying information - which can be delivered to a person. Bohn and Short (2009) considers "data in motion" as *flows* of data, which may extend to road transportation of carriers.

> In Lyman 2000's interpretation, "original printed information flow" is (compressed) of "unique data which are recorded on printed media" throughout the world. In SNIA terms, this is perhaps the world output of prints.

2.1. Aggregating the Physical Information Stocks and Flows of Elementary Actors

At physical level, in *physical information flows*, those are *human* individuals and *machines* who *can directly communicate* something with each other through a physically existing interface between them. They are *the actors of the physical information flows*.

> Physical information -- signals along neural axons wires and other channels -- flows
> - Among parts of the brain (recognized by individual as faculties of his mind) or

- Parts of brain and communicating (e.g., speech and sensory) organs of the same individual

- Among parts of the same machine and

- Between communicating organs of different (capacities of) people and machines, such that have external interface-- in form of visual, audible and other signals.

Control over physical information flows is the key importance issue at subdevice, OS, device, individual, institutional unit and national level. Owners and proprietors of data, being smart phone holders, Facebook users, authors, data security officers, CIO-s, CEO-s, or ministers, all want to keep information flows under their control.

For instance, today's *smartphone operating systems frequently fail to provide users with adequate control over and visibility into how third-party applications use their private data.* For instance, Enck (2010) addressed these shortcomings using TaintDroid to monitor the behavior of 30 popular third-party Android applications, and found 68 instances of potential misuse of users' private information across 20 applications.

Examples of elementary physical flows are given in Table 1. and Figure 1.

Table 1. Classification of flows by kinds of terminals of flows and channel

Channel	Endpoints of the flows	Intraorganization	Interorganization
Audio	From individual to individual: speech	011	012
Visual	From individual to individual: gestures		
Electronic	From device to device: messaging, signalling	021	022
Visual	From device to individual: displaying	031	032
Audio	From device to individual: playing		
Audio	From individual to device: voice commanding	051	052
Motoric	From individual to device: keyboarding, mousing, screentouching	061	062
Motoric	From individual to media: writing	071	072
Audio	From individual to media: sound recording	081	082
Visual	From product to individual: seeing, reading	091	092
Audiovisual	From product to individual: viewing	101	102
Visual etc.	From product to individual:	111	112
More	From product to device: reading	121	122
More	From device to product: magnetic, optical etc. recording	131	132
More	From outer world (reality) to device: measuring, recording	141	142

Figure 1. Elementary transactors and physical flows in an organization. The notations are taken from Table.1.
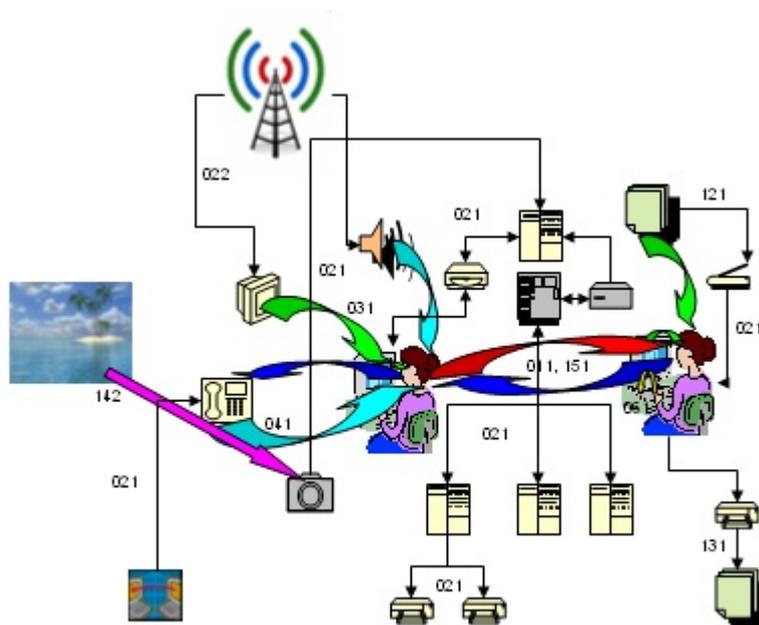
Kinds of physical flows can be intraindividual, interindividual, individual>device, device>individual, intradevice, interdevice, uptake from the real outer world, interinstitutional and intrainstitutional. Interindividual and device>individual and individual>device flows can be classified as acoustic, visual, auditory, audiovisual, motoric, olfactory etc. *Intradevice flows* will not be accounted in the SNIA. Interdevice flows can be wired or not-wired, and electromagnetic, optical etc.

## 2.1. Aggregating the Physical Information stocks and Flows of Elementary Actors

The SNIA distinguishes *elementary actors of the accounted physical information flows* as machines (devices) and (capacities of) individuals, and the *complex units* over them as households of (private) individuals, and corporations or government units which employ individuals as employees and own or possess machines.

Flows between complex actors, like enterprises, government agencies, non-profit institutions owning, renting or possessing these machines, and employing or hiring individuals partly will be deduced from physical flows by defining interfaces. When calculating *the flows of institutional units*, their input and output is accounted only at their own interfaces. These are the interfaces of own devices and employees with the devices and

employees of other institunional units plus the employee/employer interfaces. The *physical interface between an employee and his/her employer* is there, where the interface between the individual – who he/she is - and other elementary actors is. An information flow may be recorded whenever a physical flow transcends the ownership - or alternatively the control - interface between the devices of two owners and employees of the employers. These flows will be classified as machine/human output and machine/human input.

To calculate the volume of information *stocks and assets of complex actors* carry, the volume of information that stocks and assets of elementary physical actors carry will be summed, since they are additive.

Figure 2. Physical intraorganization and interorganization information flows
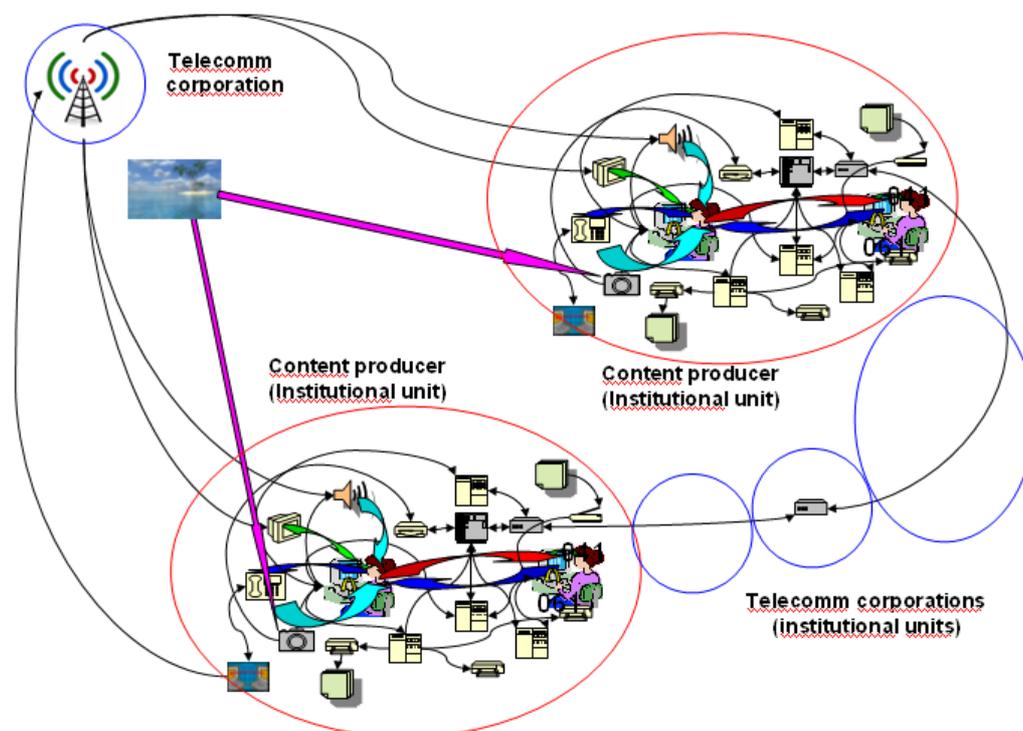
An (accounted in SNA) economic flow may be accounted in SNIA as an information flow, but - as Table 10. shows - the overlapping between economic and information flows is far not perfect.

Table 2. Classification of activities according to SNA and SNIA

The action/activity is	accounted as an economic flow	not accounted as an economic flow	not an economic flow
accounted as an information flow	A studio produces a cinema film to a distributor.	A man displays TV programmes to family members	Viewers view at overspilling transborder TV broadcasting.
not accounted as an information flow	National Post furthers regular mails.	People lend books to friends.	People purchase goods
not an information flow	A factory makes cars to consumers	People clean their home.	People sleep.

Examples of *information flow without accompanying recorded economic flows* are "free-time conversation" or kinds of "religious activity" in time-use studies. Road transportation of books from the printer to the bookshop of the same owner is *physical flow of information goods* that do not represent an economic or recorded information flow.

2.2. What is called an information transaction? Kinds.

Information transactions are information flows by mutual agreement. Information transactions may be either economic or non-economic transactions. The parties may enter the transaction so that the agreement between them is forced by law. Monetary (economic) transactions may have the form of cash, check, magnetic card, electronic transfer, bond, or other forms. While information is money, money nevertheless is information, an information good or service.

Transactions sometimes should be rerouted, when accounted in the SNA. *Rerouting* occurs when a flow is recorded in channels that differ from the actual ones. This can be illustrated by a direct transaction between unit A and C is recorded as taking place indirectly through a third unit B acting as intermediary, as wholesalers and retailers. The route of a mail can be described as Sender-->Post-->Receiver, but a route of Sender-->Receiver will be recorded instead. Storing information goods is not considered as an information activity.

Several, accounted in the SNA, economic transactions may be partitioned into self contained information transactions and self-contained non-information transactions. For example, "output of services of central government" may be partitioned into several information and non-information outputs. The separation of "information constituents" serves the purposes of determination of volume of information flowing in the transaction.

Employees' output -- labor -- will also be partitioned into worktime personal communication production and consumption, and the rest of their worktime activities.

Commercial radio- and television broadcasting corporations may hire broadcasting capacity from other companies, while they maintain themselves by reselling broadcast time for advertisment purposes. The principal parties of transactions to occur here are as follows. In hiring a broacasting station (machinery and personnel) -- an economic transaction -- those are broadcasting company and station owner. In broadcast time-reselling -- an economic transaction -- the principal parties are the broadcasting company and the advertisement agency. No flow of a significant volume of information accompanies to the first and second economic transaction. The principal parties in broadcasting – in this common view - are the broadcasting company and households. This transaction, non-pay commercial broadcasting itself, is an information transaction indeed, which, however, is not an economic transaction and might but will not be treated as an economic externality.

Government financed education, training and other information services impose a similar problem. The payee, beneficiary and the service-supplier are different units.

Telephone services also represent a problem. The caller may or may not be the payer. The payer pays for a service which is nothing else, than delivering non durable electric signals by the telco for himself and the partner. Meanwhile the service company does not pay for the information it consumes in form of acoustic or electric signals (its intermediate consumption) while producing the outgoing electric or acoustic signals. It is not known whether the caller or the payer supplies in average more information.

It is not only payments (wages, salaries) that flow to employees but so does information, either. The *information acquirable and acquired by the employee* and external contributors is valuable. That's why regulations exist, which define the rights and obligations of the employee with the information he/she in this quality accessed. Also intentional "remuneration in information" should be covered -- if feasible – by the SNIA.

In the SNA, an economic transaction should also be assumed to take place when a unit decides to retain a good for purposes of its own final consumption or capital formation i.e. certain intraunit actions are treated as transactions. This is a frequent phenomenon for

economic information transactions. The SNIA should recognize and sometimes account intra-unit transactions. If central government was treated as a single unit, then the transactions between various agencies should be considered as internal transactions..

2.3. Information Transfers: Current and Capital, their Kinds

Information transfer - a special case of transfers in kind - will be defined as providing an information good or service without receiving an economic counterpart in exchange. What a party receives in an information transfer from the actor, it may be a service completed in the interests of a third party and supplied for a fourth party.

A *current information transfer* is an information transaction in which an institutional unit provides an information good or service (excluding information assets) without receiving an economic value as a counterpart. *Information capital transfer* is the transfer of information capital, it consists of the transfer of ownership of an information asset, other than inventories. In the SNIA, information capital transfer in the household sector also includes gifts and inheritance of capital information goods.

2.3.1 Supplying obligatory or free information.

There are several examples of *obligatory information transactions,* when the "agreement" is constituted by law. These flows altogether represent a significant volume of information and their amount and contribution to the flows among various sectors is an important feature of government and the society. Government agencies force individuals and corporations to supply information as examplified by population censuses, statistics, tax returns, customs declaration, testimony at law enforcement authorities, etc. Also government agencies should report certain events to other agencies, and interested parties make testimony before court.

Typical *examples of transfer of free information* are: advertisements, public education, public broadcasting, public information services, free information flow between government agencies and conversations between private individuals will be treated as current transfers.

Advertisements

Advertisement is the far most important example of free services by market vendors. Volume of f*ree advertisement information altogether* should be estimated by adding the volumes carried by various media.

Cross-financing

Institutional units, including individuals, provide free information services in various business models, bundled or unbundled to other goods or services. Free use of the content of Internet site owners and free commercial TV channels are just important examples

Free broadcasting by commercial broadcasters should be treated in a radically simplified situation as consisting of transactions of two main types. In the first type of economic and information transactions, "broadcast time" is bought by advertisers and promotion information (commercials) is transferred to a third party, households. The paid service of the broadcaster is that it completes an economic and information transfer to households. In the transactions of the second kind, the station outputs non-market public information to households. This is information transfer, which though is not the result of law or government mediation, will be grouped here.

Free services by public institutions

Several public institutions provide free advisory or helping information services directly to their clients in accordance with fulfilling their mission in the frames of legislative, regulative, controlling and other government functions in the frames of market conform ro natural distribution systems..

The social purposes of the society on the field of information -- represented by central governments -- may concern:
- diminishing the differences between *information haves and have-nots* or keeping these differences under a limit,

- providing *equal access* to information to members of various *ethnic groups* inside the country,
- providing equal access to information to rural and urban communities, various *regions of the country*,
- providing equal access to members of one or more *ethnic community spread over a number of different countries*, or other purposes.

Free schooling has been implemented and sustained in various systems, which differ in the roles the participants in the flows play. Free schooling may be an information transfer from central or local government or schools themselves to households.

Similarly to schooling systems, *free public broadcasting* can be treated in various ways depending on "Who owns the media?", and how *"owning of media"* will be understood.

Free transfer of household information includes free home education and training, most private oral comunications, private mails, phone calls, family display of TV and radio programs provided by individuals or hosueholds. Both intra-household and inter-household flows may be considered.

3. How Should Information Production of an Institutional Unit Be Defined?

National accounts assume that most benefits to be distributed and consumed have been created in the intentional (willed), planned and conscious production process, so the activity of production -- as defined in SNA -- is fundamental for society.

Information production sensu lato is an activity carried out under the control and responsibility of an institutional unit that uses inputs of labour, capital and goods and services to produce outputs of goods and services carrying information. including those products, whose destination was other than carrying information, like printed T-shirts classified as a piéce of cloth, or the price tagged boxes of chocolates. Instead of information production s.l. the *production of information goods and services* is accounted.

Labour and work play a special, distinguished role in the SNA. In the SNIA the *work performed by devices* that were employed in the task, should be accounted as well as human work.

Short and Bohn (2011) adopts the term "workload" and measures ir in MIPS units, but a clear distinction is needed between various indicators of production.

In the SNIA *production of information is measured* by several indicators the gross or net volume of the resulting product – good or service - and not with expenditures, the volume of digital work spent for making the product, if it was a good.

Those were Inose 1983 and Ithiel de Sola Pool 1984, who were pioneering in the attempts to account information flows and knowledge stocks in a country, particularly in the U.S. and Japan. They introduced "supply" and "consumption" of information and determined the value of these variables. There survey did not cover all institutional units and products. As a unit of their measurements "word" was introduced, neglected pictures. While they accounted various carriers and carriers altogether, their tables can not be viewed as accounts as defined in book-keeping. Neuman 2009 has continued Pool's time series.

Short and Bohn (2010) has defined *enterprise server information* as the flows of data processed by computer servers as inputs plus the flows delivered by servers as outputs, which may be called turnover. This indicator does not fit as output indicator into the phylosophy of national accounting systems.

One of the problems, which one meets when defining the production boundary in the SNA and the SNIA is to get to decision concerning *activities of individuals who produce products, which could have been supplied to others but are actually supplied for consumption in their household or for themselves*. This can be examplified with "bringing up children", "supplying display of TV programs with own TV sets for family members or friends", known as "the production of services for own final consumption in households" in the SNA. These activities obviously result in outputting information. SNA does not account these services as outputs for fearing of generating incomes whose significance is quite different from those that are accompanied with monetary flows. On the contrary, the volume of these activities is significant, but its magnitude is commensurable with that of education in schools, so it has to be recorded in the SNIA.

Having the general, conceptual definition of information production, the production boundary is contoured with an explicit enumeration of those goods and services that are thought to satisfy the general concept of goods and services carrying information. By this, a proper *nomenclature* should be applied so as to cover the bulk of national supply.

The volume of information carried by all copies of all information goods and services (durable and non-durable signals) and human knowledge of all individuals *produced* within a period of time will be called *gross volume of information produced.* Accounting the production on this level is biased by multiple recording and entry of the items consumed in the production process.

For instance, a usual mail may consist of a letter (possibly with a preprinted heading and footing), enclosures (possibly xerocopies, printed matter, photoes etc.), an envelope (possibly printed) with the address, and postage-stamps. Volume of information carried by the mail as a whole may be computed as the volume of all these summed. However, the volume of information of the printed matter and photoes, however, will be recorded twice, once at the printer of the mailshop, once at the sender of the mail. The contribution of the sender is merely his own texts and the scripts on the envelope.

Information goods and services as well as other goods and services are also produced by consuming (Attention; not "using"!) resources, particularly information resources. When the volume of information carried by the information goods/services consumed, will be subtracted, then volume of *information added can be obtained. as a balancing item*. *Information added sometimes can also be directly measured*. To avoid multiplication, this is the indicator SNIA offers.

In accordance with the SNA, to avoid multiplication, the volumes of the resources consumed in the process of production are subtracted from the net volume of the output.

A long production/use/consumption/production *vertical technological chain* is known in mass communication where each element of the chain is a user/consumer of the product issued by the foregoing and the producer of the product used by its successor.

Sometimes the interfaces between succeeding units aren't clearly detectable. However, "originals" that are used in reproduction, distribution, multiplication always carry much less information than the millions of copies, therefore information added by the mass media sector can well be estimated by its gross output.

3.1. Information Output and Information Added

In the SNIA, *information output s.l. of an institutional unit* is defined as the goods and services carrying information and produced by processes of production, and **leaving** the unit. The services produced by ancillary, "overhead" activities are not counted as part of the output of the unit. *Information output s.s.* considers information goods and services rather than goods and services carrying information.

> Short & Bohn 2011 do not include computer, communications or disk overhead in their calculations. By overhead, they refer to the amount of „processing resources" used by system software, such as the operating system, transaction processing (TP) monitor or database manager. In communications, a data is an overhead data iff it is not part of the user data, but is stored or transmitted with it. *Efficiency* is closely related to overhead, so it ought to include in the system, in spite of the definitional, methodical and technical difficulties.

> In 2007 IDC and EMC reported that the *total digital universe* – what they defined as information that is either created, or captured, or replicated in digital form - was 281 exabytes.

> Lyman 2003 estimated 144 exabits of creation of new information worldwide, which seems to be in accordance with my figures with the U.S.

Information added, gross at an economic unit i, can be defined in accordance with the SNA (1993) as its information output, minus intermediate information consumption, due to the production of information goods and services. *Net information added* can be obtained as the difference between information added gross, and fixed information capital consumption.

4. Transborder Flows.

Exports and imports of information goods and services s.s. are *barters, sales, gifts, grants* of information goods and services to and from the rest of the world. Volume of information exported/imported is that which is carried on/in all copies of goods and services whose property was transferred to, or received from a non-resident unit. *Information export and import* is defined as export and import of all goods and services carrying information. *Transborder flow of information* consists of information export and imports, plus transborder information transfer plus the information externalities of economic transactions.

Temporary and permanent movements of resident individuals to abroad and of non-residents from abroad represent the *flow of human knowledge*. Short-term, temporary movements (tourism, business trips, overseas service of employees, domestic students in abroad) may or may not be recorded, while migration (emigration, immigration) should be accounted as movement of assets.

Information consumption of residents, while stay in abroad is mostly considered as information transfer. Foreign experience of individuals -- foreign acquisition of human knowledge -- plays an important role in the development of the countries. Not only technology transfer alone, but the information-for-living ("innovation as seen by man on the street"), is an important factor of social motivation and adaptation. Some elements of the consumption of information by resident individuals in abroad - like students and tourists – should be estimated. Economists as Liu (2004) called the attention to the importance of people's transborder movement in information flows

Paper money, coins, in or out of circulation, securities, mails issued and unissued, government exports and imports, commodities consumed in resident owned off-shore installations, or shipped to or from a country's enclaves should be included into *transborder flow of information goods*.

Education services for foreign pay and non-pay guest students, non-resident immigrants, refugees domestic students learning in abroad at the third level, domestic residents taking part in abroad in adult education or training, and children of domestic - non-tourist - residents receiving education in foreign primary or secondary schools, the attendance of non-residents at spectator sport, entertainment and cultural events, domestic attendants at foreign events should be considered as *transborder information flow of services*.

The provision of domestic pay broadcasting in the country for non-residents will be considered as the information export of these services. Both direct broadcasting and telecommunication satellites supply information to those who have parabolas, i.e. to cable-TV companies, micro AM replay companies and households with equipment capable to receive the program directly. *Cable-TV companies should be considered as domestic producers* when provide amplified satellite programs to the end-users wired to them.

Due to the view accepted in the SNIA regarding the character of telecommunication services, *on-line information sent to abroad to process*, should be recorded as transborder flow, even if later "it" will be returned in "processed form". Computer progranmming services accomplished by foreign programmers hired at domestic firms on an hour or monthly base, should be considered as domestic information output.

In *OSI networks,* the volume of trasnborder information flow should be defined in the deepest, physical layer. In the case of *international phone services* the volume of information carried by the international carrier should be recorded as transborder flow, while the flow of local companies will not recorded as that. The traffic between *resident subsidiaries of a foreign/multinational company and foreign branch offices* should be accounted as transborder flows.

During "international traffic"of *telecommunication services through cable,* a physical interface exists at the first transmitting, amplifier (receiver or sender) station at the frontiers of the countries or inside. Transit services should actually be paid and are to be accounted in SNIA as services imported. The incoming signals that will be later "multiplied" and distributed in the importer country, as signals of cable-TV, should be accounted at the border, and the multiplication will be considered as domestic production.

5. What Should be Recorded as Information Consumption in the SNIA?

The proper treatment of information phenomena requires a *distinction* between *information consumption* and *information use*.

In the SNIA, *information consumption* will be understood as the physical annihilation of those goods and services that convey or carry information. *Accounted information consumption* is generally measured as physical consumption of information goods and services. It is the concept of *information use* that will be introduced to cover the "read"-type flows that are not necessarily related to physical annihilation of information commodities.

An information *carrying good or service is said to be used*, iff it was read by a device or an individual, i.e. the signals it carried was copied and interpreted. *Use always comprises read and write components*, use is a kind of intermediary consumption and production.

The information goods and services supplied altogether by a *supplier* i to an acquirer *(recipient)* j and the supplier j to the recipient i during a period dt will be called the *information turnover* between them. Short & Bohn (2011) calls aggregated information turnover in servers *their flow.*

Sources are available for information consumption of individuals at TV/radio sets *as principal and as background activity*. The transformation of raw data for the latter is not yet resolved.Bohn & Short (2010) measured the volume of information outputted and consumed by those individuals, who at the time did not take part in other activities.

5.1 What is the Difference Between Intermediate (Productive) and Final Information Consumption?

If information services or goods will be consumed in the process of information production, *intermediate information consumption* will be accounted. Embedding of ROM-s and files are two examples.

Short & Bohn (2011) distinguish between information that is created and used in organizations – work information used for *productive purposes* – and consumer information seen or heard by people not at work – information created and used for *consumption*." Ths distinction is in accordance with SNA, but not in SNIA, because thethe significant volumes of information used for producing or growing human capital is considered by Gantz 2010 as „final" consumption to delight, to entertain, to enjoy.

Bohn & Short (2010) analyzes the case of a home video surveillance system with four cameras. In the normal recording mode, at the level of devices, each of the cameras records a frame and three compressed descendents. The volume of information outputted by cameras is the amount of digital signals recorded altogether. These signals flow into the DVR's hard disk, where they are consumed and used (read and write) and a new, more compressed record will be made which is to be accounted as output, consumption and output at the device level. Again, after 24 or 36 hours this record will be automatically cleared (consumed) and the process is repeated. In normal recalling mode two other descendant copies will be produced in the screen-driver and an information self-service to the owner-viewer, abnd the sight of the screen induces one more sensory level representation in him/her. The sum of volumes of all outputs would be recorded as gross output – and intermediate consumption at the device level, and the momentary volume of the stores at the year-end as stocks. However, the SNIA does not account intraunit interdevice, and intradevice flows, so only the flows in recalling mode should be accounted.

Final information consumption of information goods and services is identified in the SNIA with their consumption, when they are annoyed so that this is not associated with their embedding into an information good, transformation into another information good, or use. Differing from final consumption in SNA, final information consumption can not be associated with *positive social values.*

Consumption of fixed information capital is the negative change in the volume of the fixed information assets used for production due to *physical deterioration, and normal rates of obsolescence and accidental damage.*

6. The Valuation of Flows and Stocks

The most outstanding difference between the SNA and natural-unit-tables of the SNIA is in the way they value flows and stocks. While the valuation of flows and stocks in the SNA has practically been based upon *general substitutability for money*, i.e. on opportunity for *selling*, in SNIA it is based upon digital records and the *general substitutability of an analog record for a digital record*, an opportunity of *digital recording*.

Accordingly, it is not "information" in the SNIA, which is considered as resource or product, but those goods and services (including rendering non-durable signals) that carry/convey information by carrying recorded, standard, uniform signals. For digital products, the OS keeps an inventory of the free and reserved for signals places of the memory and stores and provides data on their actual one-time size. *Elementary places to store* one yes/no signal are called *bits* but these *physical* bits allocated on a medium or actually being its small parts, have nothing in common with Shannon's theory of information. It is a non-probabilistic matter of fact, how many bits are reserved or stored at a moment. *The number of bits recorded on/in carriers is called the volume of information that the carrier carries.* It is the long-term stochastic behaviour of two stores, when connected with a channel, and which many times repeat the process of sending/receiving, and which is described by Shannon's and many others' like Dretske (1981)'s theory of information.

Hilbert & López 2011 also calls the attention to the ambiguousness of the concept of "bits".

In the SNIA, the stored digital records or the non-durable digital signals being "in flow", will be valued "as they are", without assuming any additional compression, since statistics – as much as possible - should reflect reality, the facts. Analog records will be accounted *as if* digitized – not optimally but - at the average level of typical technology in the year accounted, so that the display of the digitized copy be equivalent with the display of the analog record for a typical use of a typical user.

> Short and Bohn (2011) holds the opinion that unlike print or film, there is no unambiguous way to measure the size of digital information, because a 600 dot per inch scanned digital image of text can be compressed to about one hundredth of its original size, and DVD versions of movies can be 1000 times smaller than the original digital image. SNIA's method for valuation overcomes Gantz's problems: digital carriers are defined to carry as much information as actually recorded on them, and analog carriers to carry as much information as much recording is necessary for the equivalent typical use of the digital version.

> Bohn & Short (2010) use „bandwidth", defined as the rate at which *compressed* information is transmitted over the link between the originator and the consumer. Related indicators as bit rate, Baud rate, bandwidth, throughput etc. should be carefully studied and the best fit should be adopted in the SNIA. The rate of the actual information flow between a book and the eyes of an individual can be better estimated – at the sensory level - by the uptake parameters of the latter, than with measures of bandwidth "as if" the digital book were transmitted over a digital link.

Let's assume, that we have a floppy on which an ASCII coded „24" has been recorded by the head under the control of the OS of a computer. „As it is", this is neither data, nor information, it is a *record*, or the *content of the floppy at the physical level.* Only if one recorded it in order to record – for instance - the daily average temperature on May 31, 2000, Budapest, or if one reads the record as such, then it should be considered to be a data by those who know that it is a data, and the meaning of the digital magnetic signals displayable as „24" is, that „daily average temperature on May 31, 2000, Budapest is 24 C". A data is always data for or from something, which is mostly not referred to in tables and by naked figures. Digitally recorded characters, actually magnetized spots, become data for a human, if he/she defined a context, in which the character refers to something or assumes that there is such a context. The thought of a statement, that formulates the meaning of the data, and that comes into one's mind when thinking at a data, contains the idea that is manifest by the word (like „twenty four") for the data.. A piéce of written, tabulated data like „black" or „b" for „black" usually is a short form of one's sentence for „The dog Hercule is black." in case if there is – somewhere and somewhen a dog, called by this someone Hercule, and his sentence refers to

this dog. Structured data are handled in relational data bases, just because they refer to the truth of relations, described by sentences.

Braman (1990) in her classical work compared several *definitions of "information"*. The SNIA assumes that in an actual situation, information – for somebody - is data, which modify the beliefs one believes concerning something, whenever this somebody uses it.

> In the SNIA „information" is not a subset of data, and data are not the lowest level of abstraction from which information and knowledge are derived. Short and Bone 2010 is not right, meaning that "data" are artificial signals, because they are created by machines and data are outputs of devices. For instance the data of the population censuses mostly are recorded manually on questionnaires. Their idea concerning nature of „information" and „data" seem to be not elaborated enough.

> SNIA does not adopt „hours spent receiving information" (Bohn & Short (2010)'s $INFO_H$)), and words, because these units can not be used thoroughly for information flows by variegated media. An hour spent receiving information by an individual or a computer connected to a LAN are obviously not equivalent. Hour units are meaningless for measuring the volume of information a book on Picasso's ouvre carries. Pictures can not be transformed to words. SNIA aims at making the information flows between individuals, devices and products comparable, as much as possible.

> Lyman & Varian (2000) define information as flows of data delivered to people

A flow should be valued at the very *same volume of the same (mostly non-bit) natural unit of measurement* through all accounts of all institutional partners. This may present numerous problems. For example, telecommunicated messages - in package switching networks - may change their shape and volume during transfer. Information can be added or lost during the transportation of information goods.

Like stocks and assets in SNA*, information stocks* in SNIA should also be *revaluated*. According to the general definition, the conversion to bits should be done so that it will reflect the actual average technical conditions, which are subject to rapid change. This may lead to *holding gains and losses*, when comparing the figures for the very same stock valuated in two subsequent times.

> In the early eighties printed texts on paper were manually keypunched, when were subject to digitization, which provided eight bit characters. Scanning became the dominant technology in massive digital input in the nineties. Information density of primary scanning (used at pictures and figures) is also growing. At the same time, various compressing algorithms decrease the average storage capacity needed to digitize and/or store documents.

Information goods gradually also lose bits - information - due to their *aging and deterioration*. Hence transactions and other flows of various industries should then be revaluated centrally in national information accounting in common natural units *according to the date of revaluation.* Assets and liabilities should also be valued according to the time the balance sheet relates.

7. Discussion: The Aggregates of the System as Indicators of "Information Household"

The SNIA offers a "whole arsenal" of consistent, coherent accounts, balance sheets tables and indicators. SNIA is in use: Dienes (2010). It is a complete account of information assets and flows as these have been defined in the system. Some indicators, as gross information production, output, information added, transborder information flow, information assets, externalities of foreign information production and a lot of others *may be used independently from the system as a whole*, by analysts, politicians, the press, professional and business communities and the public as summary, global indicators of information activity within society or within its main sectors, corporations, government and households.Governments may use controlling and target indicators of the SNIA.

The indicators of intra and interunit flows of government units describe the character of state. The indicators of employee>device and device>employee flows portray *human productivity.* Such indicators as "per capita information flow from government to households and vice versa" and "share of the government sector in information production", characterize the relationship between households, individuals, corporations and government in the society. A number of similar figures reflect such processes as *centralization* or *decentralization, democracy or autocracy in operation.* The *per capita figures of inward flows* reflect informational *openness* of the country, the *per capita figures of outward flows* may reflect its *vitality*. Per capita volumes of "inward transborder information flows" as related to "domestic production" and "use" determine external *dependencies*. Volume of "information assets" and its distribution qualify the country for being *information-poor* or *-rich.* The magnitude of flows of social redistribution and social transfers of information characterize the efforts of governments to put restraints on internal social or ethnic inequalities.

The SNA and SNIA are now open to further international discussions and standardization under the aegis of national and international official statistical organizations international organizations or professional groups.

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