LABOUR PRODUCTIVITY: THE LINK BETWEEN USE-VALUE, VALUE, AND INFORMATION

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ABSTRACT: The metabolic link between human labour and nature is undeniable, and may be explained as a process, intrinsic to living beings, of infoautopoiesis or information self-production; a sensory commensurable, self-referential, homeorhetic feedback process immanent to Gregory Bateson's difference which makes a difference. This is what allows the discovery of the immanence of information and productivity of labour. The productivity of labour *is determined amongst other things by the workers' average degree of skill, the level of development of science and its technological application, the social organization of the process of production, the extent and effectiveness of the means of production, and the conditions found in the natural environment.* Thus, the greater the productivity of labour the greater the production of use-values as commodities, and the less the value of the commodities due to the reduced labour time socially necessary for their production. This implied relationship, between the productivity of labour, use-value, and value, may be evaluated by examining the process of generation of relative surplus value. An algebraic approach shows how the productivity of labour is incorporated into the labour theory of value. A parallel approach, using Bateson's definition of information allows the discovery of the immanence of information and productivity of labour, and is shown to correspond to the previously obtained algebraic construction incorporating the productivity of labour into the labour theory of value. In short, relative surplus value is an inevitable consequence of the immanence of information and productivity of labour.

KEYWORDS: Labour theory of value; Information; Infoautopoiesis; Productivity of labour; Relative surplus value

1 INTRODUCTION

The labour theory of value lifts the veil of capitalist production and shows how a surplus is extracted; the difference between the value produced by wage laborers and the wages paid. Wages that reflect the labour necessary for a minimum level of sustenance to continue working on a regular schedule and the generational

reproduction of the working class, but not the full measure of the labour-power expended during a typical working day. Given these circumstances, the incentive for the capitalist is to maximize surplus value. One approach to achieve maximization of surplus value is enhancement of productivity of labour. Productivity of labour *is determined amongst other things by the workers' average degree of skill, the level of development of science and its technological application, the social organization of the process of production, the extent and effectiveness of the means of production, and the conditions found in the natural environment[1]*. In other words, by changing the concrete conditions of production that impact concrete labour. Once changed, these conditions affect the deployment of abstract human labour in the form of the socially necessary labour needed to produce relative surplus value. The implication is that the greater the productivity of labour the greater the production of use-values as commodities, and the less the value of the commodities due to the reduced labour time socially necessary for their production. This implied relationship, between the productivity of labour, use-value, and value, may be evaluated by examining the process of generation of relative surplus value.

The purpose of this paper is to examine relative surplus value by considering enhancement of the productivity of labour as an infoautopoietic process[2], or process of information self-production; a sensory commensurable, self-referential, homeorhetic and interactive feedback process immanent to Bateson's *difference which makes a difference[3]*. This is the key to finding a relationship between labour and information, to close the supposed gap that exists in explaining economic production due to the advent of information science in the middle of the 20th century. For this purpose, the paper is divided into several sections. First, a review of the labour theory of value is undertaken to develop an initial classical graphical description of the generation of absolute surplus value and relative surplus value. Second, an algebraic approach is implemented to explain absolute surplus value and relative surplus value with the intent of generalization. Third, the algebraic incorporation of productivity of labour in the labour theory of value allows a discernment of how the valorisation process works in the generation of relative

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[1] Karl Marx, *et al.*, *Capital. a critique of political economy*, Vol. 1, London, Penguin in association with New Left Review, 1990.

[2] Author, 2020.

[3] Gregory Bateson, *Steps to an ecology of mind; collected essays in anthropology, psychiatry, evolution, and epistemology*, New York, Ballantine Books, 1978, p. 453.

surplus value. The result is an increased production of use-values as commodities, while at the same time reducing the value of the commodities due to the reduced labour time socially necessary for their production. Fourth, the process of infoautopoiesis or information self-production; a sensory commensurable, self-referential, homeorhetic feedback process immanent to Gregory Bateson's *difference which makes a difference* is introduced. The role of infoautopoiesis is shown to be a fundamental element in the metabolic connection of humankind with nature. Fifth, the immanent connection between productivity of labour and information is expressed by a parallel algebraic approach emphasizing infoautopoiesis as part of the labour process. Last, a comparison between the productivity of labour enhancement approach and the infoautopoiesis approach shows them to be equivalent constructs leading to the realization of relative surplus value as an inevitable consequence of the immanence of information and productivity of labour.

2 THE LABOUR THEORY OF VALUE: AN ALGEBRAIC ANALYSIS

$$C' = (v + s) + c$$
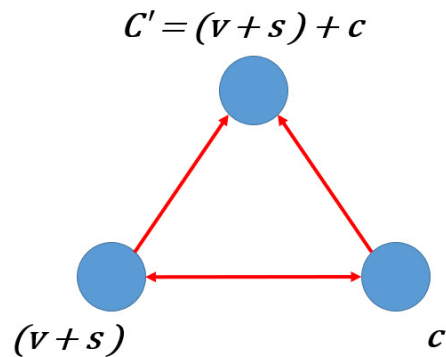

$$(v + s) \qquad\qquad c$$

Figure 1 – The labour theory of value

The quantitative aspect of the labour process may be illustrated as shown in Figure 1, which also portrays the dialectical relationships involved in the labour theory of value. This is reflective of what we qualify as the classical Marxist perspective of the labour theory of value. The labour process consists of dialectical interactions (illustrated by a double-direction arrow) between constant capital, **c**, composed of the means of production, raw material, auxiliary material and the instruments of labour, and requisite labour power composed of necessary labour-time under the guise of variable capital, **v**, and surplus labor-time, **s**, the labor that the worker exerts above necessary labour-time, and that the capitalist

appropriates as surplus labour-time or surplus value. This portrayal shows a starting value of labour power of $(v + s)$ to account for the full value of the labor power, which is then realized as final capital C'. This is done to explicitly show that the surplus value is the result of surplus labor-time, since in fact, the initial capital only covers the initial investment of variable and constant capital, i.e., $(v + c)$.

The condition of selling labour-time or labour-power is that of a labour-time commodity producer, whose labour is sold for money as a commodity, i.e., labour-power for the capitalist has just a price paid as a wage to the worker[4,5]. For Marx the value of labour-power is the sum of the costs of the means of subsistence necessary for the reproduction of labour capacity. Wages, either expressed in commodity-money or in standard prices, are the expression of the price of labour-power as it is modified by the conditions of supply and demand of labour-power.

This interaction, between labour-power and constant capital, c, results (illustrated by two single-direction arrows) in final capital C' that accrues to the capitalist once all the product is sold in the marketplace. This is the process in which the initial capital $C = v + c$ is transformed in the capitalist production process as if by magic into final capital $C' = (v + s) + c$. The difference between these two stages of capital production results in the surplus value, s.

Note that the rate of surplus value is given by s/v; and the rate of profit is given by $s/(c + v)$. Except for the discovery by Marx of the logic of the capitalist system, the capitalist is unaware that she is profiting from this relationship with labor. And, for the most part, laborers are unaware that their labor is appropriated by the capitalist, i.e., that they are participants in a process of exploitation by the capitalist class. In short, workers are the source of the value added in the form of surplus value, s, to the initial capital, $C = v + c$, to arrive at final capital C'.

2.1 Absolute and relative surplus value

Let us now examine the forms in which surplus value can accrue to the capitalist depending on the working conditions of capitalist production.

Figure 2 shows several horizontal lines labelled 1 through 4 that represent different instances of a possible Working Day and are shown distributed vertically in the figure. Let us proceed from the topmost horizontal line labelled 1 downwards.

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[4] Michael A. Lebowitz, *Beyond capital : Marx's political economy of the working class*, 2nd ed., New York, Palgrave Macmillan, 2003, pp. 46-9.
[5] Karl Marx, *Capital: A Critique of Political Economy*, London, Penguin Books, 1976/1867, p. 119.

Line 1 shows the length of a typical working day that could have a duration of 8 hours.
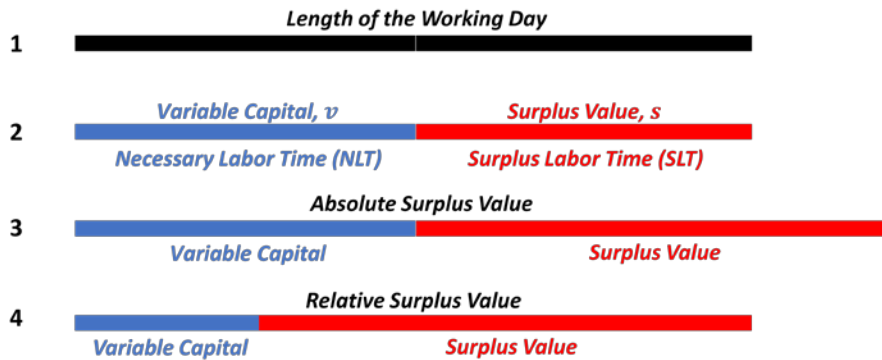

Figure 2 – Graphical representation of absolute and relative surplus value

Line 2 assumes the length of the typical working day to be divided between necessary labour-time (NLT) and surplus labour-time (SLT), each of these labour portions lasting 4 hours. The NLT is the time (per day) which workers must work (in the average conditions of the industry of their day), to produce the equivalent of their own livelihood (at the socially and historically determined standard of living of their day). If the concern in the production process were for the benefit of the worker, this would mean that at the point in which a worker completed his NLT she could leave her workplace, without any detrimental effects to her living wage. But in this case, due to the capitalist treating the worker as just one more element of production that is bought in the marketplace, the worker is not allowed to leave and must complete the working day that she has contracted to complete. What this means is that the rate of surplus value, or rate of exploitation of labour-power, is $(s/v) = (4\,\text{hours}/4\,\text{hours}) = 100\%$. Consider this as our baseline.

Line 3 shows the case where the length of the typical working day is extended by 2 hours, increasing the duration of the working day to 10 hours. The necessary labour-time continues to be the same, i.e., 4 hours. But the surplus labour-time has now increased from 4 to 6 hours. The absolute surplus value of the working day yields a rate of surplus value, or rate of exploitation of labour-power, due to an absolute increase in labour-time to 10 hours of $(s/v) = (6\,\text{hours}/4\,\text{hours}) = 150\%$.

Line 4, the last horizontal line from the top, shows the case where the capitalist, due to increased productivity of labour yields additional quantities of use-values while reducing the necessary labour-time by 2 hours. What this situation permits, without extending the duration of the working day, is the extension of the surplus labour-time from 4 to 6 hours. The relative surplus value due to the relative increase in surplus labour-time with respect to the necessary labour-time in a typical working day yields a rate of surplus value, or rate

of exploitation of labour-power, due to this relative contraction of necessary labour-time, of $(s/v) = (6 \text{ hours}/2 \text{ hours}) = 300\%$.

From the point of view of the potential contradiction between capitalist and workers, relative surplus value is a less coercive form of achieving the cooperation of workers if we compare it with absolute surplus value, which can potentially create resistance among workers and has been shown to not be sustainable over time. In addition, it allows the incorporation of technological advances that workers themselves develop, and the consequent loss of employment of workers who are replaced by the improved efficiency of the new processes introduced. It is a way for workers to manufacture the rope that the capitalist then uses to hang them. This is a recurring process in which the dead labour embodied in machines is revived by a breath of living labour and is diligently made to work for the benefit of the capitalist. This not only achieves greater efficiency in production by using machines that allow greater productivity but helps with worker control. Worker control may be achieved by various methods such as, the implicit threat to employees to conform or face termination; by improving wages due of higher rates of exploitation, whether the labour force is or is not reduced; or, if production requires fewer workers making it easier to achieve work discipline and performance, among others.

2.2 Explanation of absolute and relative surplus value

The illustration of absolute surplus value and relative surplus value shown in Figure 2 is useful to understand how workers and capitalists should view their relationship from a classical Marxist perspective of the labour theory of value. Also, it serves as a starting point to use an algebraic scheme to explain absolute surplus value and relative surplus value.

Considering how absolute surplus value is generated it is possible to note that necessary labour-time does not change, but surplus labour-time increases due to the longer working day. The initial capital $C = v + (c + \Delta c)$, which now includes additional constant capital represented by Δc, due to additional raw materials, auxiliary materials and instruments of labor, is transformed into final capital $C' = (v + s + \Delta s) + (c + \Delta c)$, where Δs is the additional portion of surplus labor-time that the capitalist appropriates as the result of longer working hours. The capitalist has the incentive to increase working hours just so long as he finds that $\Delta s \geq \Delta c$.

Now, if we consider how relative surplus value is generated, we note that the necessary labour-time is relatively reduced to be a smaller portion of the working

day. One way to achieve this is by increased productivity of labour. This could take the form of more efficient organization of production such as the division of labour pin production example described by Adam Smith[6]. Or using new raw materials, tools, and production machinery. The incentive for the capitalist to use increasing levels of productivity of labour and technological innovation is to remain competitive in the constant struggle for market share, while maintaining as high a rate of profit as possible. This constant struggle of the capitalist sometimes yields considerable short-term profits as a reward.

2.3 Accounting for productivity of labour

One approach to account for productivity of labour in the labour theory of value is to consider that necessary labour-time and surplus labour-time are multiplied by a productivity factor, $(1 + i)$. This is shown in Figure 3, which parallels Figure 1.

$$C'' = (v' + s')(1 + i) + c'$$
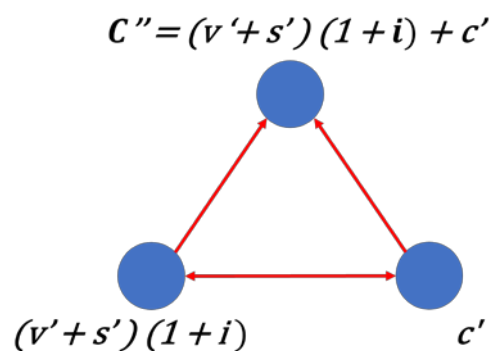

$$(v' + s')(1 + i) \qquad c'$$

Figure 3 – Higher productivity of labour in the labour theory of value

Let us now compare the capitalist production shown in Figure 3 with that in Figure 1, in which the nomenclature has been slightly modified to infer a changed situation from that of Figure 1. This comparison is between a situation with a given base-level of productivity of labour (Figure 1), and a situation with increased productivity of labour (Figure 3).

If we subtract the final capital shown in Figure 1 from that of Figure 3, we obtain,

$$C'' - C' = (v' + s')(1 + i) + c' - (v + s) - c, \tag{1}$$

or,

[6] Adam Smith, R. H. Campbell and Andrew S. Skinner, *An inquiry into the nature and causes of the wealth of nations*, 2 vols., New York, Clarendon Press, 1976, pp. 14-5.

$$C'' - C' = (v' + s') + (v' + s')i + c' - (v + s) - c .$$

(2)

Note that constant capital in these two instances is not considered to be the same to account for the new needed means of production, raw material, auxiliary material, and instruments of labour whose technological innovations result in greater productivity of labour. Thus, the implicit assumption is that $c' > c$ and that $v' = v$, since the variable capital would not be expected to change. The motivation for a capitalist to make the necessary investments requires that $(C'' - C') > 0$, which after simplification implies that,

$$(s' - s) + (v' + s')i + (c' - c) > 0,$$

(3)

or,

$$s' + (v' + s')i + c' > s + c.$$

(4)

Which shows additional gains in surplus value of $(v' + s')i$, besides those present in s', due to greater productivity levels as compared to the base-level. Thus, showing that the generation of additional surplus value plays an important role for making productivity investments on the part of the capitalist.

2.4 Valorisation of relative surplus value

Figure 4 shows a graphical representation of the valorisation of relative surplus value if an increase in productivity of labour takes place. The figure shows a comparison between a baseline productivity of labour (Lines 1 and 2) with the situation of increased productivity of labour using several horizontal lines distributed vertically in the figure and labelled 3 through 5. The length of these lines may be considered as representing use-values per unit of time.
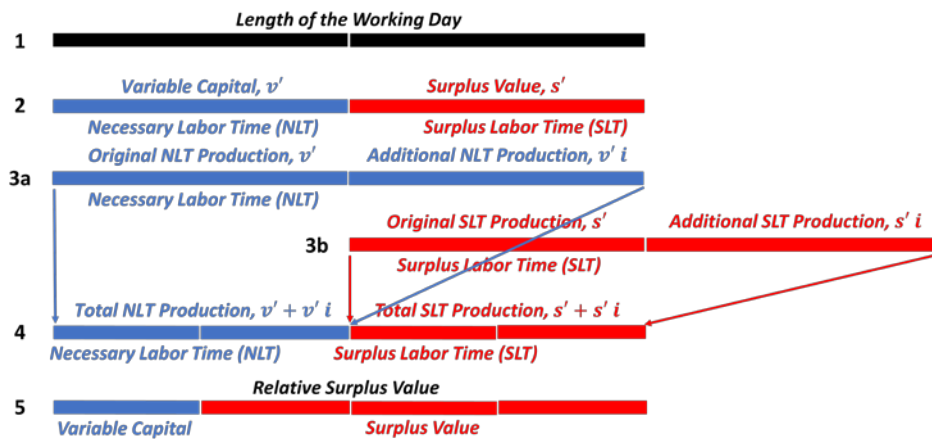

Figure 4 – Illustration of the valorisation of relative surplus value

Lines 1 and 2 are the same first two lines represented in Figure 2: Line 1 is

composed of two halves of an eight-hour-long working day; and Line 2 once again assumes that the first half of the working day is devoted to necessary labour-time (NLT) and the second half to surplus labour-time (SLT). As before, this yields a baseline rate of surplus value of 100%.

Line 3 is sub-divided into Line 3a and Line 3b. Line 3a shows the result of applying a productivity index, i, of 100% to the baseline necessary labor-time, resulting in a doubling of production (doubling of use-values), with a corresponding decrease in value (to one-half of the previous value) of each of the newly generated use-values. Line 3a is composed of the 'Original NLT Production' (v') and the, for now, 'Additional NLT Production' ($v'\,i$).

Line 3b shows the result of applying the same productivity index to the baseline SLT. A similar result is observed: a doubling of production with a corresponding decrease in value of each of the newly generated use-values. Line 3b is composed of the 'Original SLT Production' (s') and 'Additional SLT Production' ($s'\,i$).

Line 4 shows the projection of Line 3a and Line 3b, respectively, onto the two corresponding halves of the Working Day, considering that the value produced has not changed even though the use-values have doubled. All of this without any alteration to the length of the working day. Line 5, the last line, identifies that the purportedly 'Additional NLT Production' of use-values is also reflective of surplus value. NLT, at this new level of higher productivity, appears as reduced by half while maintaining its value. The capitalist has achieved her objective of increasing the rate of surplus value to 300%.

In short, productivity of labour, determined amongst other things by the workers' average degree of skill, the level of development of science and its technological application, the social organization of the process of production, the extent and effectiveness of the means of production, and the conditions found in the natural environment[7], will simultaneously increase the production of use-values as commodities while reducing the unit value of the commodities due to the reduced labour-time socially necessary for their production.

2.5 An interpretation of the realization of relative surplus value

What is shown above is that the capital accruing to the capitalist at the end of a production process that includes technological innovation is given by,

$$C'' = (v' + s')(1 + i) + c',$$ (5)

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[7] Marx, *et al.*, *Capital. a critique of political economy*, p. 130.

which reverts to the classical Marxist perspective of the labour theory of value for $i = 0$.

This equation may be re-written as

$$C'' = v' + [v'\,i + s'(1 + i)] + c',$$
(6)

Where the bracketed term represents the surplus value due to the increase in productivity. Notice that necessary labour-time (or variable capital, v') has an added contribution to surplus value, $v'\,i$. And this is exactly what the concept of relative surplus value predicts should happen. The inclusion of this added multiplier $(1 + i)$ gives an algebraic accounting of the higher productivity of labour. Note that the rate of surplus value is now given by $[v'\,i + s'(1 + i)]/v'$; and the rate of profit by $[v'\,i + s'(1 + i)]/(c' + v')$. In short, an increase in productivity of labor results in additional surplus value whose nature needs further exploration.

3 THE LABOUR PROCESS AS AN INFORMATION EMBODIMENT PROCESS

The middle of the 20th century brought about not only the consolidation of the possibility that machines could be made to think and engage in learning and solving problems[8,9,10], but also the origin of Information Theory[11]. Since that time, thinking machines and Information Theory have certainly shown and realized some of their promise, as we find ourselves with digital gadgets on the palms of our hands that allow us instant connection with our friends and colleagues all over planet earth, as well giving us access to resources that enhance our ability to do useful work. However more computationally and informationally powerful these machines have become; it seems that it is not problematic to discern how they impact the labour theory of value. Marx's original claim about machines, thinking or not, is that *Machinery, like every other component of constant capital, creates no new value, but yields up its own value to the product it serves to beget[12]*. Also, the indistinctiveness between manual and mental labour, as labour is nothing more than the *expenditure of human brain, nerves, muscles and sense organs[13]* points to the inconsequential nature of what some may

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[8] A. M. Turing, 'On Computable Numbers, with an Application to the Entscheidungsproblem', *Proceedings of the London Mathematical Society*, vol. s2-42, no. 1, 1937, pp. 230-65.

[9] A. M. Turing, 'I.—Computing Machinery and Intelligence', *Mind*, vol. LIX, no. 236, 1950, pp. 433-60.

[10] Norbert Wiener, *Cybernetics: or Control and Communication in the Animal and the Machine*, New York, John Wiley, 1948.

[11] Claude E. Shannon, 'A Mathematical Theory of Communication', *The Bell System Technical Journal*, vol. 27, 1948, pp. 379–423, 623–56.

[12] Marx, *et al.*, *Capital. a critique of political economy*, p. 509.

[13] Ibid., p. 164.

consider new forms of labour.

A recent Marxist perspective on thinking machines, information and capitalism is that by Caffentzis which addresses the ongoing debate about the potential that such scientific developments have the capacity to make labour obsolete[14]. Another topic is whether or not the Turing machine[15] (Turing, 1937) makes Marx's ideas about machines obsolete, since these "new" machines potentially learn and solve problems, and could potentially add value in the production process. Careful consideration of the Turing machine argument leads to the conclusion that they are nothing more than a way to resolve the issue of complexity both in machines and in the skill level of individual workers. Apart from determining that the use-value of labour is in a different category than the value-creating capabilities of human labour. In the process, confirming the rightful role of simple average labour, as the correct measure of labour power, as well as proving that machines are incapable of value-creation, except as depreciation. Caffentzis states that *Labor creates value because of the human potential to refuse the transformation of their labor-power into labor. It does not lay in labor's inherent unmechanizablity[16]*. Also, uncharacteristically Caffentzis believes that *Marx's consistent but incomplete theory of machines in capitalism needs to be extended to the realm of Turing machines[17]*. These are topics that need additional examination.

In short, the purpose of this section is to discover whether there is an elusive connection between labour, machines, and information. To perform such an examination, it is necessary to recognize that information, as described below, has always been part and parcel of the design, construction, operation, and improvement of machines, thinking or not, in pursuit of improved productivity of labour. If so, the role of information in the labour process may need reappraisal to fully assess its effect on the labour theory of value. Indeed, is there an underlying labour theory of information that needs unearthing? An attempt is made to answer what is unique about human labour that gives it a value-creating property, as well as determining whether Turing machines need special treatment. It is particularly worthwhile to ask whether information has an impact on relative surplus value because of its close connection to productivity of labour because of the continuous

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[14] Constantine George Caffentzis, *In letters of blood and fire : work, machines, and the crisis of capitalism*, Oakland, Calif., PM Press, 2013.

[15] Turing, 'On Computable Numbers, with an Application to the Entscheidungsproblem'.

[16] Caffentzis, *In letters of blood and fire : work, machines, and the crisis of capitalism*, p. 175.

[17] Ibid., p. 198.

development of the means of production, raw materials, auxiliary materials, and the instruments of labour.

3.1 Labor

Labour, as a fundamental premise, is addressed by Engels thus:

> LABOUR is the source of all wealth, the economists assert. It is this next to nature, which supplies it with the material that it converts into wealth. But it is also infinitely more than this. It is the primary basic condition for all human existence, and this to such an extent that, in a sense, we have to say that labour created man himself. [18]

And is elaborated on by Marx:

> Labour, then, as the creator of use-values, as useful labour, is a condition of human existence which is independent of all forms of society; it is an eternal natural necessity which mediates the metabolism between man and nature, and therefore human life itself.
>
> Use-values like coats, linen, etc., in short, the physical bodies of commodities, are combinations of two elements, the material provided by nature, and labour. [19]

These quotes serve to emphasize the fundamental role of labour in human existence and development; as useful labour and creator of use-values, "an eternal natural necessity" and, as a source of wealth creation.

Further, the role of abstract human labour in industrial capitalism is made clear by Marx by showing its role in the value creation process, i.e.,

> The mystical character of the commodity does not therefore arise from its use-value. Just as little does it proceed from the nature of the determinants of value. For in the first place, however varied the useful kinds of labour, or productive activities, it is a physiological fact that they are functions of the human organism, and that each such function, whatever may be its nature or its form, is essentially **the expenditure of human brain, nerves, muscles and sense organs** (**emphasis added**). Secondly, with regard to the foundation of the quantitative determination of value, namely the duration of that expenditure or the quantity of labour, this is quite palpably different from its quality. In all situations, the labour-time it costs to produce the means of subsistence must necessarily concern mankind, although not to the same degree at different stages of development. And finally, as soon as men start to work for each

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[18] Karl Marx and Friedrich Engels, *Collected works. Anti-Dühring, Dialectics of nature Volume 25, Volume 25*, London, Lawrence and Wishart, 1987, p. 452.

[19] Marx, *et al.*, *Capital. a critique of political economy*, p. 133.

other in any way, their labour also assumes a social form. [20]

The need to explain the workings of commodity production deemphasizes qualitative useful labour and use-values and emphasizes quantitative abstract labour and its role in value creation in the labour theory of value. What we intend is to discern the role of information in the labour process and its impact on the labour theory of value.

3.2 Information in the heterodox economics literature

It is well known that the concept of information is very elusive, and no general agreement has been reached[21,22,23,24]. This is especially evident in the heterodox economics literature. The most thorough treatment of information for the purposes of Marxist economic usage is that in the book *Classical Econophysics*[25]. There is a concerted effort at tying the notion of labour with information by statements such as:

> In the course of interrogating the idea of labour we discover that the modern idea of information provides a key to understanding both human labour in general (chapter 2), and industrial mass production in particular (emphasis added) (chapter 3). From looking at information and machinery, we progress to the notion of the universal intellectual machine foreseen by Babbage and Turing (chapters 4 and 5). The concept of universality developed by Turing provides, we think, a perspective from which the special character of human labour in the production process can be understood. [26]

And,

> We have suggested that doing purposeful productive labour typically reduces entropy. Such entropy-reducing work requires information (emphasis added) in two forms, an action plan or capacity for behaviour, and information coming in from the senses to monitor the implementation of the action plan. [27]

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[20] Ibid., p. 164.

[21] Rafael Capurro and Birger Hjørland, 'The concept of information', *Annual Review of Information Science and Technology*, vol. 37, no. 1, 2003, pp. 343-411.

[22] W. Paul Cockshott, *et al.*, *Classical econophysics*, London and New York, Routledge, 2009.

[23] Wolfgang Hofkirchner, 'Emergent Information. When a Difference Makes a Difference…', *tripleC*, vol. 11, no. 1, 2013, pp. 6-12.

[24] John Durham Peters, 'Information: Notes Toward a Critical History', *Journal of Communication Inquiry*, vol. 12, 1988, pp. 9–23.

[25] Cockshott, *et al.*, *Classical econophysics*.

[26] Ibid., p. 3.

[27] Ibid., p. 30.

The notions of information used relate to the efforts of Shannon[28] and Chaitin[29,30] which only provide an abstract relationship between labour and information in the form of entropy as a measure of order and disorder due to human actions. There is also an extensive review of Hayek[31,32,33] which does not shed much light on the connection between labour and information.

It is worthwhile noting that Flores Morador[34] makes an argument for considering a relationship between labour and information, which does not go beyond preliminary proposals with no relation to the labour theory of value.

Another approach is that by Foley[35] which deals with information services as unproductive labour or to quote Foley, "… the basic principle is that incomes to knowledge- and information-based activities, like resource and land rents, are a part of the pool of surplus value…" "Two factors are central to the dramatic growth of knowledge- and information-based incomes: intellectual property rights and network externalities." The view is that a copyright to a popular song, leading to its low-cost duplication via the Internet, allows its rental to many simultaneous users, not unlike physical assets that accrue rent such as a waterfall. This is nothing more than gaining a share of the pool of surplus value. This is true as well for computer operating systems such as Microsoft Windows that can be rented or sold many times over. Leading to "the illusion that information and knowledge-based commodity production can create value with effectively no inputs at all *beside human creativity and ingenuity (italics added)*." Further, "The potential for confusion on the economics of information- and knowledge-based commodity production is further enhanced by the existence of business models that generate revenue without any direct payments of users at all, such as social networking and web search"[36].

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[28] Shannon, 'A Mathematical Theory of Communication'.

[29] Gregory J. Chaitin, *Information, randomness & incompleteness: papers on algorithmic information theory*, Singapore; New Jersey, World Scientific, 1990.

[30] Gregory J. Chaitin, *The unknowable*, Singapore ; New York, Springer, 1999.

[31] Friedrich A. Hayek, *Prices and production*, London, G. Routledge & Sons, 1935.

[32] Friedrich A. Hayek, 'The use of knowledge in society', *American Economic Review*, vol. 35, no. 4, 1945, pp. 519-30.

[33] Friedrich A. Hayek, *The Counter-Revolution of Science*, New York, The Free Press, 1955.

[34] Fernando Flores Morador, 'Marx and the Moral Depreciation of Technology: Labor Value as Information', https://lup.lub.lu.se/search/publication/7c542df8-c5b6-42e7-b006-e693555e819b, 2013.

[35] Duncan K. Foley, 'Rethinking Financial Capitalism and the "Information" Economy', *Review of Radical Political Economics*, vol. 45, no. 3, 2013, pp. 257-68.

[36] Ibid., p. 265.

While Foley might be correct in assessing the fruits of information services, Foley avoids addressing the issue of what information is and the issue of the role of labour in creating such information services from which someone can reap benefits. In short, the issue that needs clarification is the process of productive labour creation of informational originals, or more generally, how does productive labour incorporate information in the labour process? Or how does information (if we know what information is) impact the labour process? These are the questions that elude an answer in the literature. To quote Foley[37], "A clear understanding of the origin of value in the expenditure of productive labour and of surplus value in the exploitation of productive labour is essential to thinking through the problems of post-industrial capitalist growth, distribution, resource conservation, and environmental protection."

There are countless other efforts that attempt an approximation to including information in a Marxist analysis, but all prove fruitless as they are all unable to establish a relationship between labour and information[38,39,40,41,42,43,44,45,46,47,48].

3.3 What is information?

To develop a more historically meaningful perspective on the word information, we

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[37] Ibid., p. 257.

[38] D.K. Foley, T.R. Michl and D. Tavani, *Growth and Distribution: Second Edition*, Harvard University Press, 2019.

[39] Duncan K. Foley and Adalmir A. Marquetti, 'Productivity, Employment and Growth in European Integration', *Metroeconomica*, vol. 50, no. 3, 1999, pp. 277-300.

[40] Heesang Jeon, 'Cognitive Capitalism or Cognition in Capitalism? A Critique of Cognitive Capitalism Theory', *Spectrum Journal of Global Studies*, vol. 2, no. 1, 2010.

[41] Heinz D. Kurz and Neri Salvadori, *Theory of Production: A Long-Period Analysis*, Cambridge, Cambridge University Press, 1995.

[42] Adalmir A. Marquetti, 'Analyzing historical and regional patterns of technical change from a classical-Marxian perspective', *Journal of Economic Behavior & Organization*, vol. 52, no. 2, 2003, pp. 191-200.

[43] Cheol-Soo Park, 'Testing Okishio's Criterion of Technical Choice', in Paul Zarembka (ed.), *The Capitalist State and Its Economy: Democracy in Socialism*, vol. 22, Emerald Group Publishing Limited, 2005, pp. 199-208.

[44] Ellis Scharfenaker and Duncan K. Foley, 'Quantal Response Statistical Equilibrium in Economic Interactions: Theory and Estimation', *Entropy*, vol. 19, no. 9, 2017, pp. 444.

[45] Ellis Scharfenaker and Gregor Semieniuk, 'A Statistical Equilibrium Approach to the Distribution of Profit Rates', *Metroeconomica*, vol. 68, no. 3, 2017, pp. 465-99, ibid.

[46] Daniele Tavani and Luca Zamparelli, 'Endogenous Technical Change in Alternative Theories of Growth and Distribution', *Journal of Economic Surveys*, vol. 31, no. 5, 2017, pp. 1272-303.

[47] Jangho Yang, 'Informatic Theoretic Approaches in Economics'ibid., vol. 32, no. 3, 2018, pp. 940-60, ibid.

[48] Naoki Yoshihara, 'A Progress Report on Marxian Economic Theory: On the Controversies in Exploitation Theory since Okishio'ibid., vol. 31, no. 2, 2017, pp. 632-59.

find that it derives from the Latin stem *informatio*, which comes from the verb *informare* (to inform) in the sense of the action of giving a form to something material as well as the act of communicating knowledge to another person[49,50,51,52]. The first of these meanings is what allows alluding a tie of information to human labour exertion. In other words, the term information may be said to describe the act of labour between humans and nature. It points to the metabolic connection between humans and nature that allows humans to act to give form to matter, i.e., labour *in-forms* matter. Also, matter *in-forms* humans by reacting to the efforts of humans. It is a never-ending interactive process of action-sensing-action.

This coincides with the qualitative and quantitative characterization of the process of labour by Marx as *expenditure of human brain, nerves, muscles and sense organs[53]*. Or, how humans actively engage with our environment, in not only exerting our labour power but also engaging sensorially with our environment in ways that are relevant to our efforts. It is incumbent upon us, to better understand this process leading to the labour theory of value, that we discover how this physical and cognitive process takes place and how we can tie it into the labour process. To take a step in this direction, a description by Gregory Bateson, of a labourer yielding an axe, is useful:

> Consider a tree and a man and an axe. We observe that the axe flies through the air and makes certain sorts of gashes in a pre-existing cut in the side of the tree. If now we want to explain this set of phenomena, we shall be concerned with differences in the cut face of the tree, differences in the retina of the man, differences in his central nervous system, differences in his efferent neural messages, differences in the behavior of his muscles, differences in how the axe flies, to the differences which the axe then makes on the face of the tree. Our explanation (for certain purposes) will go round and round that circuit. In principle, if you want to explain or understand anything in human behavior, you are always dealing with total circuits, completed circuits. This is the elementary cybernetic thought. [54]

This is a description that evolves from a homeorhetic, rather than a

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[49] Rafael Capurro, 'Past, present, and future of the concept of information', *tripleC*, vol. 7, no. 2, 2009, pp. 125-41.

[50] Capurro and Hjørland, 'The concept of information'.

[51] José María Díaz Nafría, 'What is information? A multidimensional concern', *tripleC*, vol. 8, no. 1, 2010, pp. 77-108.

[52] Peters, 'Information: Notes Toward a Critical History'.

[53] Marx, *et al.*, *Capital. a critique of political economy*, p. 164.

[54] Bateson, *Steps to an ecology of mind; collected essays in anthropology, psychiatry, evolution, and epistemology*, pp. 458-9.

homeostatic, cybernetic perspective of the world that includes a unique conception of information as differences and ideas. Homeorhesis involves following a trajectory of changing goals in space/time, instead of fixed goals which require maintaining equilibrium[55]. Most human activities, like the one described above, are homeorhetic in nature. In contrast, the human organism requires homeostatic constancy in maintaining heart rate, body temperature and respiration rate. Gregory Bateson is well-known for stating that, "In fact what we mean by information – the elementary unit of information – is a *difference* which makes a *difference*... (italics added)" (Bateson, 1978) (p. 453). In short, what the above description does is identify *information/differences/ideas* that are pertinent to the dynamic and evolving labour effort at hand, which is not distinct from many typical labour tasks, and can be ascribed as a series of material informational efforts involving *the expenditure of human brain, nerves, muscles and sense organs. Information/differences/ideas* are material. This is the process of infoautopoiesis or information self-production; a sensory commensurable, self-referential, interactive, homeorhetic feedback process immanent to Gregory Bateson's *difference which makes a difference*. The implication is that labour and *information/differences/ideas* are intimately entwined, and every artefact is the result of a process of infoautopoiesis and embodies information[56]. This aspect relates to the elaboration of all human artifacts, throughout the history of humankind, that goes largely unnoticed. Indeed, all human actions produce syntactic expressions of information as a direct result of the semantic information inherent to human cognition[57]. Human artifacts that embody use-values and utility as necessary prerequisites for their elaboration and existence. One result is that we can easily recognize implements manufactured by humans no matter their anthropological age[58]; as well as signs of butchery in animal bones that are more than 2 million years old[59,60]. Another expression of the ubiquitous presence of

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[55] C. H. Waddington, *Towards a theoretical biology; an International Union of Biological Sciences symposium*, Edinburgh,, Edinburgh U.P., 1968, p. 12.

[56] Jaime F. Cárdenas-García, 'The Process of Info-Autopoiesis – the Source of all Information', *Biosemiotics*, vol. 13, no. 2, 2020, pp. 199-221.

[57] Jaime F. Cárdenas-García, 'The Central Dogma of Information', *Information*, vol. 13, no. 8, 2022, pp. 365.

[58] Maxime Aubert, *et al.*, 'Earliest hunting scene in prehistoric art', *Nature*, 2019.

[59] Ann Gibbons, 'Lucy's Toolkit? Old Bones May Show Earliest Evidence of Tool Use', *Science*, vol. 329, no. 5993, 2010, pp. 738-9.

[60] Mohamed Sahnouni, *et al.*, '1.9-million- and 2.4-million-year-old artifacts and stone tool–cutmarked bones from Ain Boucherit, Algeria'ibid., vol. 362, no. 6420, 2018, pp. 1297-301.

information in our modern-day existence is the joy we take in our familiarity with all the objects that surround us in the artificial environment, of our own making, in which we live.

The intimate entwinement of labour and *information/differences/ideas* results in the capability of humans and other living beings to *in-form* matter by their actions, and to be *in-formed* by matter through sensorial engagement. This is nothing more than the fundamental problem of the science of information, or how a human organism, in a self-referential process, is able to develop from a state in which its knowledge of the human-organism-in-its-environment is almost non-existent to a state in which the human organism not only recognizes the existence of the environment but also sees itself as part of the human organism-in-its-environment, and which allows the human organism to not only self-referentially engage with the environment and navigate through it, but to even transform it in its own image and likeness[61]. This is how we become what we become through an informational process of engagement with our world. The labour process is just another expression of this never-ending process of engagement with our surroundings.

Recognizing that there is an immanent and indissoluble relationship between labour and *information/differences/ideas*, we can unequivocally state that concrete useful labour yields embodied information relevant to use-value and utility. At the same time the impact of information on abstract labour-time is relevant and needs to be ascertained. That is, the link between abstract labour, productivity and its impact on the valorisation process that reduces the unit value of commodities. Information necessarily impacts the labour process qualitatively and quantitatively, and vice versa.

3.4 Labour and information

The consequence that may be discerned from any activity by a human being is that it results in an *information/idea* or *a difference which makes a difference*. This is the result of the metabolic connection existing between humans and their environment. Human actions in-form matter, and the resulting changes in matter recursively in-form humans. This is unavoidable. Thus, any act of labour by humans is immanent

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[61] Jaime F. Cárdenas-García and Timothy Ireland, 'The Fundamental Problem of the Science of Information', *Biosemiotics*, vol. 12, no. 2, 2019, pp. 213-44.

to information. The labour process in capitalist society involves the creation of use-values by concrete labour, i.e., a labour process that in-forms matter or embeds information in matter that endows it with utility. But the labour process also produces exchange value. Considerations of commensurability, as to the exchange value of different commodities, leads to the discovery that commodities exchange according to the congealed quantities of homogenous human labour power expended in their production, without regard to the source of its expenditure. Abstract labour is the source of the value that is passed on in the process of exchange,

> It might seem that if the value of a commodity is determined by the quantity of labour expended to produce it, it would be the more valuable the more unskilful and lazy the worker who produced it, because he would need more time to complete the article. However, the labour that forms the substance of value is equal human labour, the expenditure of identical human labour-power. The total labour-power of society, which is manifested in the values of the world of commodities, counts here as one homogeneous mass of human labour-power, although composed of innumerable individual units of labour-power. Each of these units is the same as any other, to the extent that it has the character of a socially average unit of labour-power and acts as such, i.e. only needs, in order to produce a commodity, the labour time which is necessary on an average, or in other words is socially necessary. Socially necessary labour-time is the labour-time required to produce any use-value under the conditions of production normal for a given society and with the average degree of skill and intensity of labour prevalent in that society. The introduction of power-looms into England, for example, probably reduced by one half the labour required to convert a given quantity of yarn into woven fabric. In order to do this, the English hand-loom weaver in fact needed the same amount of labour-time as before; but the product of his individual hour of labour now only represented half an hour of social labour, and consequently fell to one half its former value.[62]

In other words, when producing commodities, a dyadic labour process may be envisioned. On the one hand, concrete human labour-power in-forms matter with use-values. Thus, concrete human labour-power results in use-values that are identified qualitatively as having a specific use to satisfy human wants and needs. The fact that we can immediately identify the use-value of a specific commodity means that information corresponding to embedded concrete human labour-power is present as a result. While abstract human labour-power results in exchange values

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[62] Marx, *et al.*, *Capital. a critique of political economy*, p. 129.

that are identified quantitatively as the number of hours of socially necessary labour-time expended in their production. When comparing two different commodities, the embedded value is never found, no matter how meticulous the search. In a similar way, there is no information to be found that results from the exertion of abstract homogeneous human labour-power.

Thus, it appears that value and information are equally well-hidden in commodity production. This means that they go generally unaccounted for by the capitalist. A similar analysis as that for value may be merited to account for the information embedded in commodity production.

To engage in a process of discovery of any hidden information in commodities, consider a commodity that results from two different manufacturing processes which differ in productivity. Qualitatively they correspond to the same use-value, but quantitatively the commodity produced under conditions of higher productivity is cheaper than that produced with a lower productivity. In other words, a greater number of use-values are produced under conditions of higher productivity, while conserving value, since it takes the same number of hours to produce both. Recall that the productivity of labour *is determined amongst other things by the workers' average degree of skill, the level of development of science and its technological application, the social organization of the process of production, the extent and effectiveness of the means of production, and the conditions found in the natural environment*[63]. All are concrete conditions that reflect the exertion of concrete human labour-power and the embedding of concrete information in matter.

Since, the process of production involves only variable capital as homogeneous social necessary labour-power and constant capital, any effect to enhance productivity is included in constant capital. Abstract labour as simple average labour adds value to matter in the production process that accrues to the capitalist as surplus value. Marx states,

> In the first place, it must be observed that machinery, while always entering as a whole into the labour process, enters only piece by piece into the process of valorization. It never adds more value than it loses, on an average, by depreciation.[64]

And,

> It is evident that whenever it costs as much labour to produce a machine as is saved

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[63] Ibid., p. 130.
[64] Ibid., p. 509.

by the employment of that machine, all that has taken place is a displacement of labour. Consequently, the total labour required to produce a commodity has not been lessened, in other words, the productivity of labour has not been increased. However, the difference between the labour a machine costs and the labour it saves, in other words the degree of productivity the machine possesses, does not depend on the difference between its own value and the value of the tool it replaces. As long as the labour spent on a machine is such that the portion of its value added to the product remains smaller than the value added by the worker to the product with his tool, there is always a difference of labour saved in favour of the machine. The productivity of the machine is therefore measured by the human labour-power it replaces.[65]

The cost of the machine includes the productivity of labour, which is nothing more than information that is embodied in the machine. That is what labour sees when it exerts its labour-power. So, the capitalist purchases a machine at a cost that needs to be less than the cost of labour that it replaces and sees the result of that replacement of the machine as an increase in productivity of labour, which impacts the production of use-values as commodities, while reducing the value of those commodities.

This leads to the conclusion that information embedded in the production process is equivalent to productivity enhancement and goes unnoticed as information. The resulting enhanced commodity value accrues to the capitalist at sale.

In a similar way, a capitalist purchases a machine, not for the materials and components that make it up, but for the materials, components, and particular arrangement of components produced by human labour that is embodied in its production. The embodied dead labour in the machine allows the functioning of the machine by living labour to produce at least as much as living labour was able to produce with an earlier generation of machine. This is reflected in the productivity of the labour which is the result of using the machine.

The greater the productivity of labour the greater the production of use-values as commodities, and the less the per unit value of the commodities due to the reduced labour time socially necessary for their production. Thus, the implied relationship between the productivity of labour, use-value, information, and value.

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[65] Ibid., p. 513.

3.5 The inclusion of information in the labour theory of value

Let us now explore how to include information more formally in the classical equations for the labour theory of value.

The Turing machine is the basis for the computer revolution[66]. Its notable feature is that it can compute any mathematical function a human or any other machine can compute, by simplifying the process of computation to its simplest elements. Thus, substituting the most complex computations by a step-by-step process of simple steps to get to an answer. Implying that the thought process in humans, however complex, can be simplified and reproduced using a Turing machine. An early example, before the advent of the Turing machine, is the creation of the Jacquard loom, which allowed the mechanization of the computational knowledge of the silk weavers of Lyons[67]. It needs to be emphasized that this mechanization process deals with both the design to be incorporated into the final silk products and to the actual material manipulation of elements during the weaving process. Thus, addressing the differentiation between skilled labour, to achieve a given intricate design, and unskilled labour, just to make the weaving loom perform its operations. Until Turing it was not possible to think in a methodical way to achieve a simplifying homogenization process,

> A Turing machine approach to the labor process is clearly superior, since it allows one to estimate the costs, the complexity and the productivity of a computational procedure that is included in and yet obscured by the notion of "skill." Thus, a Turing machine analysis of the skill of physicians, air-traffic controllers, machinists, paper makers, phone-sex workers could be given a uniform representation and be mechanized via "expert systems," "robots," "digital control devices," "virtual reality machines," etc. Much public attention has been focused on the often spectacular programming and mechanization of these skills, but what is even more important for both technological development and the prosecution of class struggle has been the conceptual precondition of mechanization: a Turing machine analysis of the labor process which is the condition of its mechanization. [68]

This further serves to accentuate the value-creating aspect of human labour in contrast to machines, as well as verifying Marx's claim that the use-value of labour has no role in value creation. Simple average labour is the basis for abstract labour,

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[66] Turing, 'On Computable Numbers, with an Application to the Entscheidungsproblem'.

[67] Caffentzis, *In letters of blood and fire : work, machines, and the crisis of capitalism*.

[68] Ibid., p. 171.

while Turing machine analysis allows us to see the quantitative basis of skill. In other words,

> Marx refused to grant a qualitative hierarchy to different performances of labor. He claimed that simple average labor as the expenditure of human labor-power is the crucial object for study of capitalist production. *Just as thermodynamics gives us the measure to compare all sorts of human energy expenditure so, too, a Turing machine analysis allows us to see the quantitative basis of skill.* It makes precise the "different proportions in which different sorts or labour are reduced to unskilled labour as their standard, are established by a social process that goes on behind the backs of the producers, and, consequently, appear to be fixed by custom." Thus, a computational analysis of tailoring and weaving make clear that "although they are qualitatively different productive activities, are both a productive expenditure of human brains, muscles, nerves, hands etc., and in this sense both human labour." The mystique of skill is penetrated by a Turing machine analysis, and a fundamental continuity between labor—mental and manual—is verified. [69]

In short, the incorporation of information into the production process is reflected by the differentiation between unskilled and skilled labour. Simple average labour is proportional to skilled labour, as evidenced by Turing. So skilled labour may be assumed to be differentiated from simple average labour by some constant of proportionality.

So, let us begin by examining what we will label as total necessary labour-time, v_T', assuming that it is composed of necessary simple average labor-time, v', and skilled necessary labor-time, v_i'. Skilled necessary labor-time, v_i', is that portion of useful labor that at a particular place and time reflects the level of skill of the average worker and is some proportion of simple average labour-time. Or,

$$v_T' = v' + v_i', \tag{7a}$$

Recognizing that skilled necessary labour-time, v_i', may be re-written in terms of variable capital, v', multiplied by an index $\boldsymbol{i}$, that takes values between zero and some upper limit which may be considered greater than 1. Index $\boldsymbol{i}$ is viewed as the capacity of a human being to embody information in the labour process, or even as the index of proportionality needed to equate the skill of the average worker with that of the skilled worker, and expressed as

$$v_i' = v'\,\boldsymbol{i}, \tag{7b}$$

Substitution of this expression in Equation (7a) yields,

$$v_T' = v' + v'\,\boldsymbol{i} = v'(\boldsymbol{1 + i}), \tag{7c}$$

Surplus labour-time can be treated in a similar way to obtain parallel

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[69] Ibid., pp. 171-2.

expressions,

$$s_T' = s' + s'\,i = s'(1 + i),$$ (8)

The full effect of human labour as expressed by necessary labour-time and surplus labour-time results from adding Equations (7c) and (8) together, in addition to adding the contribution of constant capital, c', to obtain the final capital that accrues to the capitalist once all the product is sold in the marketplace, or

$$C'' = v_T' + s_T' + c' = v'(1 + i) + s'(1 + i) + c',$$ (9a)

Recognizing the common factor $(1 + i)$ we rewrite equation (9a) in final form,

$$C'' = v_T' + s_T' + c' = (v' + s')(1 + i) + c',$$ (9b)

This equation reverts to the unmodified labour theory of value if the value of the index for information, i, is equal to zero. Notice that if we subtract the initial capital $(v' + s')$ from the final capital obtained after selling all the commodities that are produced, we obtain a profit or SV of

$$[v'\,i + s'(1 + i)],$$ (10)

This is the same bracketed term of Equation (6), which was obtained by the general assumption of a proportionality term to account for added productivity.

Notice that Equation (5) is the same as the right-side of Equation (9b) and corresponds to the illustration in Figure 3. The route taken to arrive at Equation (5) is different from that taken to arrive at Equation (9b). Equation (5) is obtained by assuming an element of productivity in the production process. While Equation (9b) is obtained by assuming that the process of enhanced productivity is the result of having the ability to simplify any complex production process, *a la Turing*, tantamount to added productivity of labour that *is determined amongst other things by the workers' average degree of skill, the level of development of science and its technological application, the social organization of the process of production, the extent and effectiveness of the means of production, and the conditions found in the natural environment*[70], all elements relevant to in-forming matter. Thus, the implied relationship between the productivity of labour, use-value, information, and value.

4 SUMMARY AND CONCLUSIONS

The concept of information is ever elusive in most fields of inquiry. This is particularly true in Marxist economics where the conception of Econophysics[71]

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[70] Marx, *et al.*, *Capital. a critique of political economy*, p. 130.

[71] Cockshott, *et al.*, *Classical econophysics*.

created the opportunity to explore the establishment of the relationship between labour and information. Extensive engagement with Shannon-Chaitin information theory led to using entropy as a conceptual approach in distinguishing between levels of order that purportedly show the effects of human labour. While this approach is conceptually interesting it does not shed any light into its application to the labour theory of value.

The approach by Foley[72] to explain information services does not suffice, since there is no mention of information per se and therefore no understanding of an information process that might be pertinent to analysing the labour process. Foley classifies information services rightfully as unproductive labour but does not address the issue of productive labour that produces originals that allow the deployment of information services.

This work introduces an etymological approach to information that allows a tie-in between labour and information. The term information may be said to mediate the act of labour between humans and nature, as the act of labour acts to give form to something material, i.e., labour in-forms matter. Also, matter in-forms humans by reacting to the efforts of humans. It is a never-ending interactive process of action-sensing-action. Labour or "the expenditure of human brain, nerves, muscles and sense organs" as "an eternal natural necessity which mediates the metabolism between man and nature" is immanent to a cybernetic Bateson information/differences/ideas perspective. Concrete labour cannot but in-form matter to give it the required qualitative utility of a use-value. But abstract labour, the homogeneous average labour-power inherent to the labour theory of value cannot be judged to contribute an iota of information to the labour process.

One way to gain insight into the contribution of information to the production process is to consider the role of productivity of labour since it provides a connection between use-value and value. Indeed, productivity of labour *is determined amongst other things by the workers' average degree of skill, the level of development of science and its technological application, the social organization of the process of production, the extent and effectiveness of the means of production, and the conditions found in the natural environment*[73]. All these elements of productivity relate to the in-forming of matter, including the level of skill of the worker, and impinge on the use-value or utility of the commodity.

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[72] Foley, 'Rethinking Financial Capitalism and the "Information" Economy'.

[73] Marx, *et al.*, *Capital. a critique of political economy*, p. 130.

When examining the labour theory of value, the inclusion of added productivity results in relative surplus value (RSV). RSV is nothing more than the ability to achieve a greater number of use-values while reducing the per unit value of the commodities produced. Thus, productivity is the missing link and the necessary connection between use-value, value, and information. What is also needed is the recognition that there is no difference between manual and mental labour. The immanence of labour and information in the labour theory of value, in every instance, inevitably produces RSV.

This points to a potentially intrinsic dynamic that is set free in the capitalist process of production by the inclusion of information as an intrinsic property of labour, which is evident from analysing the modified labour theory of value. RSV is the result, not of a preconceived plan by the capitalist, but rather the result of labour taking an active role in the production process by adding information at every step of the production process. This is understandable since the day-in and day-out responsibility of labour is to tend the fruits of its labour and in the process to innovate on the result. This leads to process improvements as well as to tool and machinery improvements that become embodied as new technology leading to higher productivity. This is how labour unavoidably embodies information in the products of its labour in an interactive and iterative process. In short, the capitalist enterprise, intrinsically and sometimes unknowingly, due to the immanence of labour and information, is always generating RSV which serves as an unrecognized incentive for the capitalist as the production process generates use-values and value in the form of information to pursue technological innovation.

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