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## Automation, Job-Loss and the Law of Entropy

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### Abstract

*Any work that needs to be repeated by humans as a routine process can, in principle, be automated. High level management cadre and the owners of different industries feel naturally inclined to automate routine manual and semi-manual jobs with a view to increase productivity and profit and simultaneously decrease the manpower requirement. With this they hope that they will have to deal with lesser problems that essentially originate from the arm-twisting tendencies of the low-level cadres. Low-level cadres, on the other hand, feel threatened of losing their job and relevance when machines are designed that can potentially replace them. Recently, when widespread use of computers and networking is becoming a reality and promising research in the area of artificial intelligence and robotics is being reported frequently, even high level cadres along with the middle-level management cadres are feeling unsecured about continuation of their jobs. Automation is widely understood to be targeting at displacing humans from their jobs. Are we moving towards a world where there will be no job opportunities as machines would offer to completely replace humans in all their supposed skills? This paper targets to find an answer to such concerns first by finding a similarity between a thermodynamic system and a commercial system and then applying the laws of thermodynamics for such commercial systems.*

### Keywords:

*Automation, Unemployment due to automation, Entropy, Thermodynamic model of Automation*

### Introduction

Workers have traditionally been scared of any process of automation. Any work that needs to be repeated by humans as a routine process can, in principle, be automated. High level management cadre and the owners of different industries feel naturally inclined to automate routine manual and semi-manual jobs with a view to increase productivity and profit and simultaneously decrease the manpower requirement [1][2][3]. With this they hope that they will have to deal with lesser problems that essentially originate from the arm-twisting tendencies of the low-level cadres. Low-level cadres, on the other hand, feel threatened of losing their job and relevance when machines are designed that can potentially replace them [4][5]. Recently, when widespread use of computers and networking is becoming a reality and promising research in the area of artificial intelligence and robotics is being reported frequently, even high level cadres along with the middle-level management cadres are feeling unsecured about continuation of their jobs [6][7]. Automation is widely understood to be targeting at displacing humans from their jobs [8][9]. Are we moving towards a world where there will be no job opportunities as machines would offer to completely replace humans in all their supposed skills? [10][11] This paper targets to find an answer to such concerns.

### Automation and its effect

A 'job' in a commercial/official set up is understood as a responsibility carried out in a series of steps assigned to an employee in order to put things and processes in order. To manage this world that, if left unattended would certainly move towards chaos, we need institutions to keep circumstances under manageable and 'ordered' conditions. Any 'job' constitutes a mixture of some routine as well as some innovative activities that are supposed to be carried out by an employee. Automation attempts at replacing humans with machines to carry out routine assignments. Ever since the era of industrial revolution started, social scientists have

historically continued to worry that industrialization would encourage automation and that would eventually end up reducing job opportunities for human beings. Despite such apprehensions and predictions for the last more than a few centuries, the reality is yet to witness this expected fear. As a matter of fact, 'skills' have changed but not the job requirement for humans. When cars were replacing horses; when automatic weaving machines were being installed to replace manual methods; when ATMs replaced the manual cash-counting skills; when the job of ticket reservations were being eased out from the ticket counters, similar fears were expressed. The point that is often missed out in these apprehensions is that they normally assume that the world and its functioning would continue to remain the same even after automation. Ironically, that is never seen to be true. In fact, these automating instruments have invariably exhibited their capacity to change the way this world used to function before. World and its functioning kept on changing significantly and dramatically as the refrigerators, air-conditioners, washing machines, gas and electric burners, cars, trains, planes, radios, computers, weaving machines, earth-movers and robots were realised from time to time. Today the world is what no one could have even imagined about a hundred years ago.

### Positive side-effects of Automation

Despite fears and apprehensions, history is witness to the fact that job opportunities have swelled despite implementation of automating techniques. Cars, trains and planes have indeed replaced animals in the transport sector to a great extent. But did we lose the requirement of drivers? Recently, industries have started reporting about their progress on realising their dream of producing driverless cars but as of now, it has not been achieved. Till now, the transport industry has asked humans only to update their driving skills but have not been able to completely displace them. Washing machines for utensils and cloths have replaced humans. Account-book keeping has also been computerised. But have we replaced humans completely in these fields? Ticket counters in transport sector and Cash counters in the bank industry besides other routine work involving customers to deal at different counters in all other industries are slowly being replaced by automating machines. But have we been able to throw humans out of all the business?

The answer lies in the very fact that the implementation of automation processes changes the way this world functions. This then, necessarily springs up new avenues of employments that were earlier beyond the collective imagination of the earlier world. Just as calculator helped people to perform arithmetic calculations correctly and swiftly it opened up the job of performing such calculations even for those who were not that efficient in doing these calculations. Computers similarly helped people in the following two ways:

- A. It helped the world in executing repeated steps accurately without mistake. And this feature equipped even lesser proficient persons to handle complex problems in an efficient manner. This helped even school drop outs to find employment in a retail store or in a service sector. The ease achieved in doing a routine complex activity therefore, encouraged expansion of similar activities that were earlier impossible due to the complexity involved in execution.
- B. The above scenario increased the availability of efficient personnel to manifold and allowed industries to think of expansion. Such expansions were impossible even to imagine earlier to the advent of computers and hence the industries had a very conservative outlook earlier on the issue of expansions. A large scale implementation of complex activities eventually changes the environment to such an extent that some entirely new avenues that were earlier unimaginable start springing up as definite possibility.

These points would be better understood once the following examples are analysed to find the validity of the above statements.

1. Networking allowed industries to connect the production and functioning of several of their units in a cohesive and comprehensive way to handle the output much more effectively. But this increased the production capacity and in turn created new users. Refrigerators, Air-conditioners, Washing machines, TVs, Mobiles, Audio equipments and many other equipments that were earlier confined to the elite class is now available almost to the masses.
2. Internet and networking allowed several units to function in such a way that it was never possible in the manual world. A glaring example can be cited wherein railway and airplane reservations can now be done with confirmation from any source to any destination irrespective of the place at which they are being

booked. Such a service is impossible to put in place using even unlimited number of people if working manually. Clearly, with such implementations, the tourism industry opened up many new avenues of employment that could have had hardly imagined before. Similar examples can be cited in the banking sector as now transactions can be done in any branch irrespective of the time and place of the person making the transactions. This again is impossible to implement in a manual banking world. Such unimaginable possibilities, when realised, invariably opens up a host of new avenues of employment. Mobile-industry provides us another such example wherein the unimaginable facility of having possibilities of connecting with anyone has now become a reality and this has given rise to many fresh avenues of employment.

3. Apart from the above, employment avenues in the manufacturing industries of those units engaged in building equipments for automation, such as computers, networking gadgets, mobiles, TVs, Cars, Trains, Planes and robots have also kept on growing to employ humans on a larger scale.
4. Service sectors run by professionals such as Legal advisors, Consultants, Doctors and Teachers have recently begun to fear loss of their jobs due to the possibility of automation in these sectors. However, the automating gadgets will only help the lesser efficient personnel to work like experts in these fields using these gadgets. Many of these sectors may see a boom in employing counsellors in the respective fields who would be able to convince a person asking such a service. People normally require a personal advice to get convinced and decide finally as they often land up in confusion if an automated advice keeps on providing options to the seeker.

### **Entropy analysis of Automation**

A theorem of physics can find its relevance in such a scenario. The most important second law of thermodynamics is also expressed as that no process carried out within an isolated thermodynamic system can reduce the entropy of the entire system. This universe is also an isolated system. Entropy on the other hand is a measure of the disorder in a system. So in simple words, the theorem states that if the entropy is observed as getting reduced in a particular process then it must be happening at the cost of a simultaneous increase in the entropy somewhere else in the system that will surely compensate equally or more than the loss in all other linked processes. This ensures that the entropy of the entire system will either remain same or will increase.

An automation process can be considered to be a process attempting to reduce the entropy as it aims at shifting a complex chaotic process to a systematic step sequence.

Any activity therefore, if it is not properly managed, gets normally carried out on its own in a haphazard manner and that leads to increase in the disorder within the system. Such activities should thus be considered as 'natural' owing to the fact that it requires minimum investment. Any activity that has a potential to provide a financial output can be considered as a commercial process. Such processes increase the extent of disorder in the system and thus increase its entropy unless precautions are taken. Automation attempts to put the system in order and hence it aims at reducing the entropy in the process. Due to this, 'automation' is destined to reduce the possibility of employment in a particular sector wherein it is targeted. According to the second law of thermodynamics therefore, 'Automation' must be associated with effects that may lead to escalate disorder in other related sectors. And therefore those sectors will create fresh provisions for employments and would suggest further avenues for automation in due course of time. Thus Automation can never lead to an overall loss of employment avenues.

It will be interesting to compare a commercial system with those of the thermodynamic system and identify similarity in parameters associated with both the systems. There is a possibility of application of laws of thermodynamics in a commercial system and open up a new field of study.

To carry out such an exercise, drawing parallel with those of a thermodynamic system, let us attempt to identify the substitute of Source, Sink, Work output and Heat engines for a commercial system.

1. The financial profit of a Commercial system can find similarity with work output in a thermodynamic system.
2. Let Commercial business units be considered as heat engines.

3. Let Production and Wastage be considered as Heat-Source and Heat-Sink.

A Commercial unit works between Production and Wastage and works for Financial-profit output.

Drawing a parallel with the second law of thermodynamics we can state in case of a commercial system that no Commercial unit can keep on converting Production into Profit without adding to Wastage. Another alternate way to state the same law says that it is impossible to convert Wastage into useful Production without investing into it. Production would automatically get converted into Wastage if they are left unattended.

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