UPCYCLING – CAN IT BE DONE WITH HIGHER EDUCATION?

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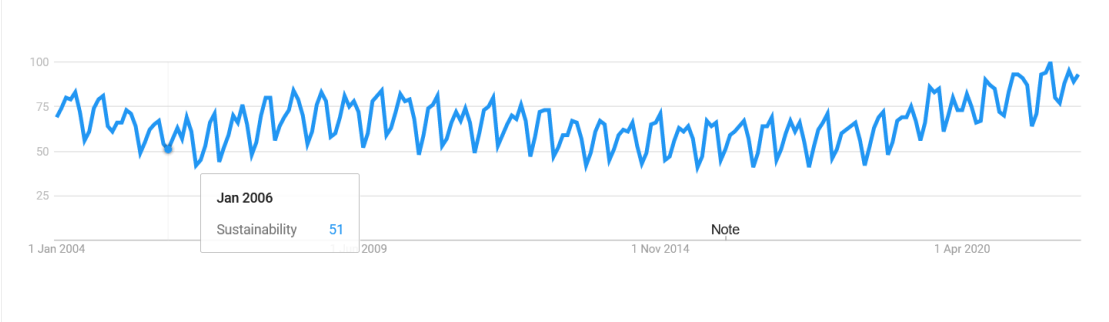
ABSTRACT

Sustainability is an important notion which is gaining in familiarity and becoming an everyday concept. Google trends shows a monotonic increasing interest in the search for this term since 2004, with a constant increase in the trend from the end of 2018 till today.



The climate crisis we are witnessing over the last few years is probably a major reason for this increase in searches. Sustainability, a vastly important concept, promotes various ways to achieve results supporting it. Most famous are "the 5 R's": Refuse, Reduce, Reuse, Recycle, Rot (Judd, 2017). As is customary nowadays, new Rs are added from time to time, the most recent being Recover and Rethink.

When using some of these terms, particularly recover and recycle, the implied meaning is to salvage some remaining value before completely discarding the items. Recently, in terms of language development, a new term has been coined: upcycle. (To be precise, the first known use of this term dates back to 1994.)

Upcycle is a term coined by McDonough and Braungart (2013), that means "to recycle (something) in such a way that the resulting product is of a higher value than

the original item **:** to create an object of greater value from (a discarded object of lesser value)" (Merriam-Webster, 2022). This is quite different than most recycling. In most cases, the product is either recycled back to the same type of product (for example paper recycled to paper) or to a lesser value product (for example concrete to aggregates). Upcycling, on the other hand, means reusing the used material to create higher value items, for example upcycling plastic bottles– and turning them into clothes. (Expats.cz Staff, 2022).

While the idea of McDonough and Braungart encompasses goods and materials only, it is interesting to consider the idea to services, particularly to higher education. That is, can the idea of upcycling be transplanted into higher education design?

The proposal the paper wishes to promote is that the basic design principles that enable upcycling in the physical manufacturing world should be embraced and applied in the higher education sphere, for its own benefit and for society's benefit.

1. Introduction

Sustainability is a concept that is vital for the long-term prosperity of the human race, or even its long-term existence, and it embodies the understanding that we cannot continue the uncontrolled use of the non-renewable natural resources and that we should be using only materials that can be naturally replenished by the planet. Consequently, there are a lot of activities, across all continents and in many countries, to preserve those resources. One of the methods of preserving the resources we have is to recycle products, after their initial use, into other products, there by reducing the need to use new raw materials and, sometimes, also the energy expended during the production processes. However, recycling usually results in the new product being of equal value as that of the original, recycled, products and often time the new items are of lower quality than that of the original items.

A number of years ago, a new term has been coined – upcycle. The meaning of the word, as given by the Merriam-Webster dictionary is " to recycle (something) in such a way that the resulting product is of a higher value than the original item **:** to create an object of greater value from (a discarded object of lesser value) ". (Merriam-Webster (n. d.)).

The idea is naturally very appealing. If possible, why not create an upward spiraling process, creating objects of greater value every time we process old items into newer ones? The idea lends itself quite naturally to products, where there are tangible materials that can be extracted for the disused product and reused in the production of a new one, and then reused again in the third reincarnation after the second product is no longer needed or is not usable anymore, with the addition of some new ingredients along the way, when needed. McDonough and Braungart (2013) contend that the major factor that enables upcycling is their design. When you think about the future uses of the elements that will be of the product being designed, and you consider these future uses, you can upcycle the first product and continue doing it for the subsequent product.

At first look, the concept of upcycling does not lend itself to be applied to services, for what part of a service can you preserve and reuse in the future? However, some (perhaps out-of-the-box) thinking may lead us to believe that it is possible.

In this paper we will explain the ideas behind upcycling and show that they may be applied to services in general and to higher education in particular. As this is (to my knowledge) a novel concept, no literature exists that may be reviewed. Therefore, we begin with introducing upcycling in section 2 in its original product-based form. Then, in section 3, we discuss how services can be upcycled, and in section 4 we propose a way by which we may achieve upcycling in higher education. Section 5 presents a summary and a short discussion.

2. Upcycling Introduced

The main concept of upcycling is that man-made products should not have a finite, usually short-lived use but rather should be part of a cycle, infinite if possible, that actually produces an improved new product that uses the ingredients of the old product. The idea is different from recycling, since recycling usually means using the ingredients of the old product as part of the production process of the new product. Or, if not quite the same product, a similar one of the same 'family' of products. Examples of recycling abound, and the most common ones are paper, glass, metals, and so on. Upcycling is similar in that the old product is not thrown away or disposed of but rather is used in a new product. The major difference between the two (similar) concepts is that upcycling aims to move up in the value chain, not stay at the same level or product. A fairly known example is that of fleece clothing that originated in plastic bottles:

It is perhaps less known that fleece can also be manufactured from clothes made of polyester – if the polyester is not dyed with polluting elements. In this example, polymer cloths can be turned into fleece which can then be turned into a polyester toy, which later becomes clothing again, which can then become (plastic) containers, which become clothing – in an eternal cycle of uses, all from the basic ingredients.

In order to make this type of cycle possible, we need to plan for it in advance. That means that when we design the first product in the cycle – polymer clothes in the example above – we need to plan for its future 'reincarnations'. This planning and design are critical, since they determine our choices of ingredients to use (and equally important, ingredients to avoid)' processes to use (and avoid). These choices take into account not only the direct requirements of the 'starting' product but also of the

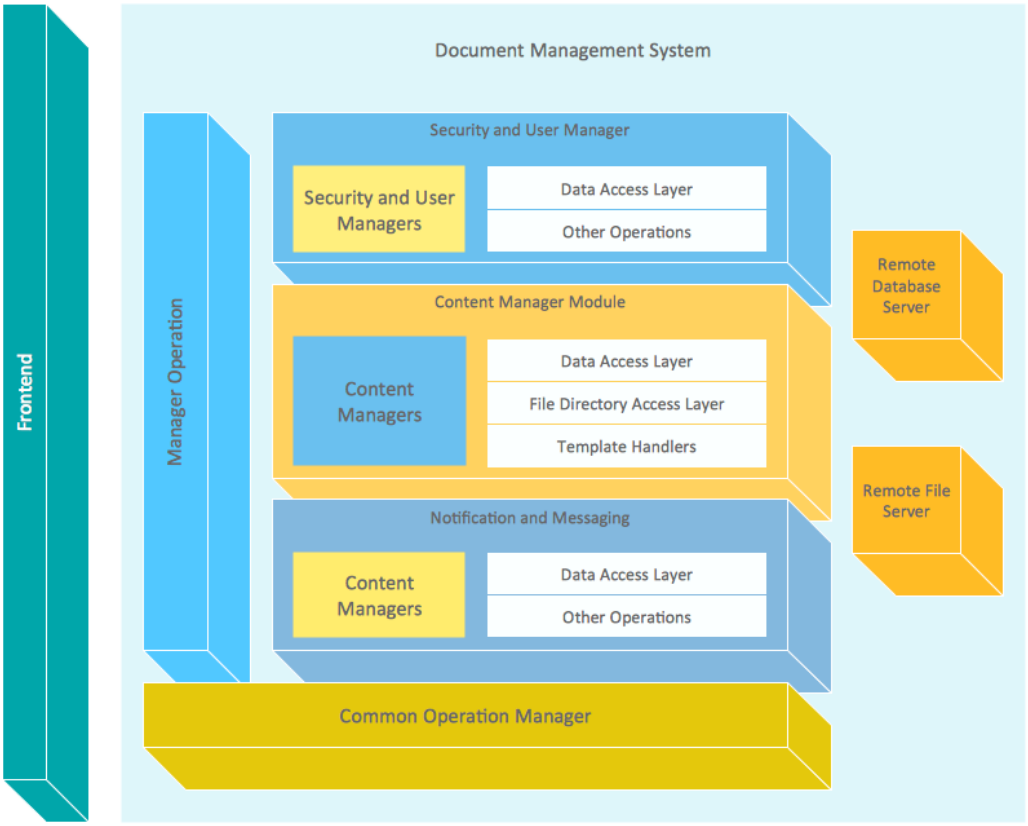
successive products that will be based on the same ingredients. For example, the clothes cannot contain chemical elements that are toxic, or that are known to interfere with the production process further up in the ingredients' life cycle.

In other words, upcycling begins with design. That is, we need to add the constraints of the future products and uses that will come, further down the line, from upcycling the 'initial' product. These constraints and needs, together with those of the initial product being designed form the complete set of constraints and requirements. Following the example mentioned above, of plastic bottles turning into fleece, etc., the initial design of the bottles needs to include considerations regarding clothing – a far cry from those that are involved with designing bottles.

This augmented set of requirements and constraints may lead, in some cases, to increased costs of the initial product. However, if we take into account the total value, of the whole set of products, the cost-benefit analysis frequently gives another answer. If one of the motivations is sustainability, indeed the driving force behind the concept of upcycling, the cost-benefit analysis is usually further improved.

3. Upcycling Services

Upcycling services presents a challenge. Services, by their very nature, are intangible and the instance of every service rendered vanishes with its delivery. So, there seems to be nothing to cycle – either up or down. It seems like there is nothing that can be transferred from one service to another. However, this is not quite true if we view services not in their actualization but instead look at their design. For each service includes, among other components, a set of instructions, or an algorithm specifying how that service should be rendered. Often, these algorithms are not specified explicitly, but just as often they are specifically defined. Let us take software as an example. Software programs, clearly a service, transform a set of inputs into a set of outputs. Each program consists of an algorithm that specifies how that transformation should be accomplished. Indeed, most software programs are composed of many algorithms, not just a single one. There is the 'main' procedure, which serves as an overseer, or manager, and coordinator of the mission the software program is meant to perform, and within it there are other, more specific, algorithms, each designed for a narrow, limited, bounded task. If we look at a program using a schematic view it resembles a rectangle made up of smaller rectangles, where the big, containing rectangle represents the boundary of the software program and the main management and organization module, and the other rectangles are the mission-specific algorithm for the various tasks that are required in order to accomplish the desired result. In some cases, there are arrows indicating flows of control or of data. An example of such a diagram is given here:



This structure lends itself, immediately, to the concept of reuse, a concept that is at the foundation of recycling and of upcycling, since the various building blocks that make up the software program and, indeed, the software program itself as a whole – may be reused as components in another software program. Actually, the concept of reusing software modules developed for one program in another program is basic to the work of software development. Also true is the fact that when software modules are designed in a particular project some components are developed with a view that is not narrowly restricted and limited but is rather broader and takes into account requirements arising from other sections of the software in order to minimize the need to rewrite the code from scratch every time. And this is definitely the spirit of upcycling. It may even seem that the software industry has been engaging in upcycling for quite a long time without realizing it[1].

For the past few years, the software services world, and actually much of the data processing world, has been offering many parts of its tool sets as services. The phrases "SAAS" (Software as a Service), "HaaS" (Hardware as a Service), "IaaS" (Infrastructure as a Service) are quite common in that world. The simplified explanation is that in each of those cases the customer can "choose and pick" components from a fairly extensive list and assemble that configuration that is optimal for his needs. In some cases, this configuration may be performed dynamically, in real time, in order to meet rapidly changing requirements. This may be described as optimized upcycling.

Other services are also upcycling, to an extent, even though they may not be referring to it as such. One notable example is the travel industry, particularly the air travel sector, that nowadays offers an almost infinite selection of combinations of services in varying sizes, prices, availability – that were not so long ago rigidly bundled with no flexibility at all. Now, almost every service is packaged individually, and marketed as such. For example, sending a suitcase in the hold; meals during flights; seat selection. The combinations are almost endless, and each service is nowadays viewed as a profit center.

1. This is reminiscent of the famous line in The Bourgeois Gentleman by Molière, where Mr. Jourdain exclaims "My faith! For more than forty years I have been speaking prose while knowing nothing of it, and I am the most obliged person in the world to you for telling me so." (Wikipedia)

4. Upcycling Higher Education

Higher education fulfills a number of functions: research; teaching; knowledge repository. Research does not seem to lend itself to upcycling, and neither does the knowledge repository. However, teaching may benefit from upcycling. This is particularly trye if we include within the scope of teaching the preparation and training of the next generation for the job market.

The concept of upcycling revolves around the idea of multiple uses of the same item, or the components comprising that item, with an upward inclination. That is, the second time the item or its components are used, the resulting product should have, preferably, a higher value or at least a similar value as that of the original item or its components.

Before analyzing the possible upcycling of the teaching done in higher education, we need to look at the motivation for upcycling within higher education. In the physical world, the motivations are clear: sustainability and profitability. Upcycled product represent a clear environmental advantage and, frequently, also an economic benefit – reduced expenses, increased income as well as a better public image. Without a benefit, immediate or perceived, in most cases upcycling will not be attempted as the design effort, and the implementation, will seem unjustified.

Higher education, being a service and not a manufacturing entity, needs to look at the example of the information processing industry above. It may achieve large benefits from allowing its students to craft a degree program by choosing courses, or modules that are parts of courses but not full courses, and do it according to their needs, desires and goal. Of course, much like in the information processing industry, there will be constraints and limits on what is acceptable and allowed and what is not. In some case, these building blocks will have to be adjusted to the population taking the courses. For example, a module may be designed to fit an undergraduate degree program and later the same module can be enhanced so it will be appropriate for a graduate degree program. This is clearly a case of upcycling as the initial work, that of designing the first course is preserved and then reused in an upscale course. That upscale course can, of course, be designed using less energy and less resources, thus also saving valuable time, energy and other resources. Although this is quite different than the upcycling of physical products, but the spirit is the same: an emphasis of forward-looking uses of the product from its inception onwards and making uses of the value stored in it in the following reincarnation.

When we look at the triangle consisting of, students, administration and lecturers, all of which are involved in the teaching and learning processes, all sides can discern benefits, and therefore motivation, from the proposed reconstruction of the curriculum from smaller, more flexible pieces – the students and the administration.

Students will benefit from an increased number of choices and options; from being able to fashion their studies to better suit their needs and their wishes; from an increased level of flexibility in construction their school schedules; from being able to

accelerate – or decelerate – their studies as they see fit. Depending on the charging scheme used by their institutions, they may even benefit financially.

The administration will benefit from smaller number of classes that will be necessary to support this flexible learning structure (and as a side benefit, a saving in the building construction and maintenance expenses); It is also conceivable that the number of faculty members required to meet the teaching requirements will decrease, affording further savings; students complaints about scheduling are expected to decrease – and their satisfaction with the administrative processes is expected to increase.

The teaching faculty will benefit mainly from their ability to concentrate their teaching in their favorite topics and from not being required to teach topics that are outside their sphere of interest. This may be accomplished by the careful division of coursework into building blocks that are entirely centered around well-defined topics and allowing the faculty to choose to teach those subjects and topics they prefer (all within the institutional constraints, of course).

Naturally, in order to achieve the benefits of upcycling in higher education, the programs offered by the institution will have to be carefully reviewed and redrafted, so that various building blocks may indeed be reused and upcycled. For new programs the task should be easier as their design and construction can think of upcycling from the very beginning and thus avoid the resistance that is likely to come from the faculty during retrofitting existing programs.

5. Summary and discussion

We started by introducing the concept of upcycling in its original ecosystem – that of manufacturing. Upcycling, that sees ingredients of products not only as necessary building blocks for a particular product but as the future components of the product that will be manufactured with them, got its first application in physical products. Although the concept of upcycling initially sounds quite impossible to apply to services in general and to higher education in particular, as those seem to have nothing that may be reused, we have shown that by thinking outside the box and expanding the concept that it may be used within higher education in certain cases.

The equivalent of physical ingredients is a learning module that can be used in more than one course, and that when needed may be enhanced, expanded and enlarged to become a part of another course, and so on – the exact equivalent of the upcycling process in the manufacturing world.

Since the trend of micro-accreditation on the rise (or micro-credentials as they are interchangeably called) (see, for example The Rise and Recognition of Micro-credentials (2022)), the concept of upcycling seems natural, and it is expected that the ideas of reuse and efficiency – both part of the original term – will help higher education better manage its resources to meet these new developments.

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