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By: Aida Cricco Doldan

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Meaningful CE Jobs: Does CE Awareness Enable the Experience of More Meaningful Work? Aida Isabella Cricco Doldán

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of Master of Science In Forest Products Dr 17

. Jennifer Russell Dr. Ralph Hall Dr. Earl Kline Dr. Kevin Carlson November 30th, 2023 Blacksburg, Virginia Keywords: CE, meaningful work, job design, sustainability, well-being

) Meaningful CE Jobs: Does CE Awareness Enable the Experience of More Meaningful Work? Aida Isabella Cricco Doldán ABSTRACT The CE (CE) is increasingly recognized as a pivotal driver for achieving sustainability. Nonetheless, it has been criticized for neglecting the social dimension of sustainability. While job creation is often touted as a significant social benefit of the CE, there is a conspicuous gap in discussions about the quality of the jobs it generates. By drawing on organizational behavior theory, this study investigates the quality of jobs in the CE with a specific focus on meaningfulness. The research questions explore the key factors contributing to job meaningfulness in CE roles, the impact of heightened awareness of the CE on workers' perceived meaningfulness, and the mechanisms through which such awareness affects meaningfulness. To address these questions,

a pre-test post-test quasi-experimental study was conducted, involving 111

employees from two CE companies in the United States. The study assessed factors such as autonomy, skill variety, co-worker relations, knowledge of the CE, perceived social impact, perceived social worth, and experienced job meaningfulness. An intervention was then implemented on a treatment group, consisting of a five-minute training video explaining

the CE concept , its benefits, **and the role of** workers **in the**

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CE. The findings reveal that the video intervention effectively increased employees' perception of task significance, perceived social impact, experienced meaningfulness, and awareness of the CE's impact on society and environment, as well as their perception of their contribution to the CE, the organization's contribution to the CE, and the societal value of the CE. This study highlights the importance for CE companies to provide employees with general training on the CE. Additionally, it provides initial evidence of the potential of a CE to increase human well-being, especially when considered from the eudemonic perspective of what gives life meaning rather than purely economic measures of well-being. Meaningful CE Jobs: Does CE Awareness Enable the Experience of More Meaningful Work? Aida Isabella Cricco Doldán GENERAL AUDIENCE ABSTRACT This study looks at the kind of jobs created by the CE (CE) and how they affect sustainability and well-being. The CE is about making the best use of resources and, as a consequence, to reducing waste, but it has been criticized for not paying enough attention to how it affects people's lives and jobs. This research focuses on understanding what makes a job in the CE meaningful and how CE knowledge may affect how workers feel about their jobs. To do this, employees at two CE companies in the U.S. were studied. The research looked at how much control employees have over their work tasks, the variety of skills that are demanded by their work, and how they get along with their co-workers, as well as their familiarity with the concept of the CE. The sampled workers

were separated into two groups (treatment and control). The treatment **group** 72

watched a video that explained what the CE is and how their work contributes to it and to a better world. The study found this video made these workers feel that their work had a bigger impact and that their jobs were more meaningful. It also made them see the CE as something that helps society and the environment. The main research contribution is that companies in the CE should give their employees training and lessons about what the CE is. By doing so, workers may increase their experienced meaningfulness on the job, which could enhance an individual's overall happiness and productivity at work. This research also shows the need for discussions on sustainability and the CE to include what gives meaning to our lives when we are thinking of human well-being. Acknowledgements Firstly,

I would like to thank Dr. Jennifer Russell **for her** unconditional **support throughout my** 124

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. Kline, for patiently giving me their time to discuss and improve my research. To Dr. Huang for always supporting me in my master's program. To my family in Paraguay for always supporting my desire to obtain a higher education level. For my husband Pedro and our son Emmanuel, thank you for being the best family I could ever dream of. To all my friends, especially Emily, Viverjita, Ipek, Mona, Gabriel, Caetano, and Lisley. Thank you very much for the great times and the support during my master's program. You made my stay in Blacksburg a great one. To Virginia Tech and the United States. Thank you for giving me this opportunity. iv Glossary Terms Definition Source CE (CE) "A CE describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso-level (eco-industrial parks) and macro level (city, region, nation and be- yond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations" (pg. 224). (Kirchher et. al 2017, p. 224) Measure A measure is developed to measure a construct, and it is usually composed of three or more items, or statements, that together form the measurement model for the construct. (Kline, 2019) Construct Abstract variable that cannot be directly observed or measured, and therefore requires the development of a measure composed of observable variables. (Kline, 2019) Item Single question or statement that when combined with other items form a measurement model for a hypothetical construct. (Kline, 2019) Variable A variable can be observed or abstract, in which case it requires a measurement model. Independent variables are used to predict the dependent variable in a regression equation. Sustainability "Enhancing human well-being to more equitably meet the needs of both current and future generations." (Clark & Harley, 2020, p. 333) Sustainable development Development path "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Bruntland, G.H., 1987) CE jobs All jobs in a company that has a circular business model embedded, regardless of the industry in which the company operates, regardless of the occupation within the company. v CE business model "How a company creates, captures, and delivers value with the value creation logic designed to improve resource efficiency through contributing to extending useful life of products and parts (e.g., through long-life design, repair and remanufacturing) and closing material loops" (Nubholz, p. 13) Mediator Variable "A variable that transmits the effect of an independent variable to a dependent variable" (Mackinnon et. al 2012, p. 2) Variance Inflation Factor (VIF) An index that tells you how highly correlated each predictor variable is with the other predictors. 1 $VIC = 1 - Ri2$ (Carlson, PowerPoint, September, 2022) Score reliability The degree to which the measures developed for a given construct are free from random error, are precise, consistent, and repeatable. (Kline, 2019) Score validity "Soundness of inferences based on the scores; that is, whether they measure what they are supposed to measures" (Kline, 2009, p. 205) Internal consistency reliability "If responses across the items are consistent-that is, the items are positively correlated with one another- then the internal consistency reliability may be high" (Kline, 2009, p. 208) Coefficient alpha (Cronbach's alpha) "The most widely reported estimate of internal consistency" (Kline, 2009, p. 208) Convergent validity "A set of variables presumed to measure the same construct shows convergent validity if their intercorrelations are at least moderate in magnitude." (Kline, 2009, p. 215) vi

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Sample Size for **Participants who completed** both **the Pre-test and Post-test** 49

 1. Introduction Human activity—exemplified by population, real GDP, resource consumption, and other indicators—has been rising sharply since the 1950s altering the functioning of the Earth system at a global scale as indicated by key environmental parameters such the increasing atmospheric concentration of CO2, N2O and CH4, ozone depletion, increases in the northern hemisphere average surface temperature, loss of tropical rain forest and woodlands, and species extinction (W. L. (William L.) Steffen, 2004). Nevertheless, human activity is restricted by the physical limits of the planet—arable land, water, and other resources that cannot grow with exponential rates of human activity. If the current growth trends continue, planetary overshoot will be reached resulting in a drastic collapse of population and resources (Meadows et al., 1971; Randers, 2012). Recognizing the fragility of the Holocene epoch, the only geological epoch capable of sustaining human life on earth, the planetary boundary (PB) framework uses scientific evidence to identify the safe operating space for nine different planetary boundaries that are essential for the stability

of the Earth system (Corlett, 2015; W. **Steffen et al., 2015**). Steffen **et. al** 122

(2015) found that four earth systems processes—

climate change, biosphere integrity, land systems **change** and biochemical **flows (phosphorus and nitrogen** 116

)—have exceeded planetary boundaries and are now in a zone of increasing risk for disrupting earth systems. These findings support the need for new development paths that are able to reduce anthropogenic impacts on earth systems.

The circular economy (CE) **is a** framework **that** proposes **a** transition from our **current** 131

linear system

of production of “take-make-dispose”, to a circular system that is regenerative and distributive by design and it is viewed positively by governments, businesses, NGO’s, and academics as a potential solution to the problems of unsustainable use of resources and resource scarcity (

Ellen MacArthur Foundation , 2013). **One of the** main strengths **of** the **CE is** 166

that it is

seen as a win-win **solution to environmental and economic** problems: **the** 70

decoupling of economic growth from the environment may lead to a decrease in global warming, as well as an increase in job creation and gross domestic product (GDP) (Aguilar-Hernandez et al., 2021). Nonetheless, some scholars question the possibility of decoupling economic growth from the environment since economic growth is linked to material and energy use (

Ward et al., 2016; Wiedenhofer et al., 2020). Giampietro (2019) argues **that the** pace **of** 102

current economic growth outpaces the nature’s capacity to supply raw materials and sinks to continue economic growth. Ward et. al (2016) question using GDP growth as an equivalent of societal well-being. Lastly, the focus on the economy and the environment is also criticized for overlooking

the social dimension **of sustainability (Kirchherr et al., 2017** ; Lowe & Genovese, 2022; **Mies & Gold, 2021** ; Murray **et al., 2017** 83

, Laurenti et al., 2018). The social benefit most often cited in the CE literature is job creation (Mies & Gold, 2021). Despite the positive outlook regarding employment in a CE, the literature regarding the quality of jobs in a CE is scant. This study

will contribute to expanding the **literature on the** social dimension **of the CE by** exploring **the** 54

potential of the CE to make work more meaningful. Meaningfulness refers to how valuable and worthwhile workers see their work (Hackman & Oldham, 1975). Sustainability, as defined by the United Nations Brundtland Commission (1987) refers to "meeting the needs of the present without compromising the ability of future generations to meet their own needs." The concept of needs is broadly defined, and although in most cases it is assumed to mean physical needs, this study focuses on psychological needs. According to self-determination theory, human have three basic 1

psychological needs : autonomy, **competence, and relatedness, which when satisfied** leads to **self- motivation and mental health, and when** unsatisfied, leads **to diminished well-being** 64

(Ryan & Deci, 2000a). Autonomy, competence, and relatedness are all constructs that are strongly linked to meaningfulness (Kahn, 1990; May et al., 2004). By studying how the CE can contribute to more meaningful jobs, this study intends to reveal how the CE can contribute to improving psychological well-being and basic psychological human needs satisfaction. The research motivation is to explore the relationship between the CE and meaningfulness. The core research premise comes from the belief that the CE proposes changes in how we related to environment, and by creating a more positive relationship with nature it increases meaningfulness. The CE eliminates the logic of take-make-waste that disconnects humans from the environment and reinstates a relation between humans and nature.

1.1 Research Objectives The main objective of this study is to examine 88

worker well-being in the CE focusing what factors are most important in explaining workers' experience of meaningfulness by working on a job in the CE. Apart from looking at the traditional job enhancing characteristics, this study will explore whether increased knowledge of the CE increases an individual's experience of meaningfulness by enhancing task significance. Specifically, this study will look at the following research questions: RQ 1: What factors are most important in explaining meaningfulness in CE jobs? RQ 2: Through what mechanisms does an awareness of the CE affect experienced meaningfulness? RQ 3: Does increasing a worker's awareness of the CE have a significant effect on their experienced meaningfulness? 1.2 Thesis Overview Figure 1: Thesis Overview This thesis first presents a literature review of the circular economy, employment in the CE and what constitutes meaningful work. The methods section explains the survey design and measures used. The results section presents

the results to each of the three research questions 149

explored. The conclusion summaries the findings and recommendations.

2. Literature Review 2.1 CE and Sustainability 2

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.1.1 What is Sustainability? Origins of the Concept, Aims, and Definition

The concept of sustainable development was first presented **in 1980 in World Conservation Strategy** 91

, which was a jointly effort

by the International Union for Conservation of Nature and Natural Resources ((IUCN), the United Nations Environment Program (UNEP), and the Worldwide Fund for Nature (WWF 44

). Although not explicitly using the sustainable development term, it underscored the interconnection of conservation and development (IUCN, 1980). Emphasizing an integrated approach, it called for considering ecological, social, and economic factors, promoting sustainable resource use to meet human needs while preserving ecosystems. This definition shaped the discourse on sustainable development presented in the Brundtland Report in 1987, where it was proposed as new development path “that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland, 1987, p. 41). In the section titled, “Meeting Essential Human Needs”, the Brundtland report states that “the most basic of all needs is for a livelihood” (Brundtland Report, p. 49). Other needs mentioned are the need for staple foods and protein, energy, housing, water supply, sanitation, and health care (Brundtland, 1987). Within the concept of basic needs, the report highlights the necessity to prioritize “the essential needs of the world’s poor”, and for the affluent to adopt more sustainable lifestyles (Brundtland Report, p. 41). Therefore, sustainable development involves inter and intra-generational social equity: “Sustainable development requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life” (Brundtland, 1987, p. 42). By including aspirations for a better life, sustainable development references something less tangible than basic needs, such as human aspirations. Amartya Sen called for the concept of sustainable development to go beyond satisfying basic human needs, to sustain human freedom and capabilities, cautioning against the authoritarianism of who gets to decide what constitutes a need to be satisfied (Sen, 2013). According to Clark & Harley (2020), sustainability today goes “beyond just meeting basic human needs to embrace a broader vision of sustainability as fairness: enhancing human well- being to more equitably meet the needs of both current and future generations” (Clark & Harley, 2020, p.). Sustainable development also involves recognizing the interdependencies and trade-offs between economy, society, and the environment. Economic development and environmental issues cannot be addresses separately since they are linked through a complex system of feedback loops (Brundtland, 1987). Economic development that destroys the environment on which it depends is not sustainable. Clark & Harley (2020) also emphasizes the importance of the interdependence between development and the environment when studying sustainable development (Clark & Harley, 2020). Achieving a balance between the environment, society, and economy, known as the three pillars of sustainability, is viewed as one of the core aims of sustainable development (Mensah, 2019). Sustainability and Well-being

Sustainability involves enhancing human well-being (Clark & Harley, 2020). According to Ryan and Deci (2000) well-being has two main conceptualizations: the hedonic approach and the eudemonic approach. In the hedonic approach, well-being is equated with pleasure, happiness, and the lack of pain (Ryan & Deci, 2000a). In the eudemonic approach, well-being is related to the realization of human potentials, and to humans living according to their purpose and values (Ryan & Deci, 2000a). Diener (1984) grouped definitions of well-being in three groups: the eudemonia definition where well-being is related to virtue, well-being based on subjective life satisfaction, and well-being based on the prevalence of a positive affect over a negative affect. The second and third definitions are studied within the realm of subjective well-being. These two different conceptualizations of what constitutes well-being, eudemonic and hedonic or subjective well-being, affect what we aim for as a society, and how we measure well-being. Subjective well-being assessments are the most common indexes of well-being (Ryan & Deci, 2000a). Subjective well-being has three main components: pleasant affect, unpleasant affect, and life satisfaction (Diener et al., 1999). These can be assessed within different domains of life:

work, family, leisure, health , finance, health, and **one's** own **group (Diener et al., 1999** 100

). The main critique of this conceptualization is that it does not derive measures of well-being from the psychology literature (Ryff, 1989). The concept of eudaimonia was first discussed by Aristotle in his book Nicomachean Ethics and Eudemian Ethics. Ryff (1989) developed measures of psychological well-being consistent with the eudemonia definition, based on the psychology literature of what constitutes well-being (Ryff, 1989). Ryff identified

six dimensions of well-being: self-acceptance, positive relation to **others, autonomy, environmental** 56
mastery, purpose in life, and personal growth (Ryff, 1989). Ryff

found self-acceptance and environmental mastery were associated with previous well-being measures, but the other measures where not closely associated. This indicates other measures of well-being are not considering important theoretical aspects of well-being such as purposeful life and self-realization (Ryff, 1989). Baumeister et al. (2013) describe the relationship between a happy life and a meaningful life. They found happiness, usually defined by subjective well-being, is related to need's satisfaction, while meaningfulness involves an "assessment of whether one's life has purpose and value" (Baumeister et al., 2013, p. 506). Happiness is conceived of in the present moment, while meaningfulness involves "understanding one's life beyond the here and now, integrating future and past" (Baumeister et al., 2013, p. 506). Thinking about the future, as well as concerns with expressing one's personal identity, were found to be associated with meaningfulness, but not with happiness (Baumeister et al., 2013). Therefore, what makes a person happy, defining happiness from the subjective well-being perspective, does not always correlate to leading a meaningful life and vice-versa. Income is positively related to subjective well-being, but the relationship does not always hold constant. Wealthier people are happier than poorer people within the same country, nevertheless increased real income within the US overtime did not lead to overall increased happiness overtime (Diener, 1984). Campbell (1976) explained that although income and social

indicators increased from 1957 to 1972 in the USA, self-reported measures of happiness fell most prominently among the most affluent. Some potential explanations for this phenomenon are: income has an effect only at the most basic level when basic needs are not yet met, status and power, which correlate with income, may be impacting subjective well-being, and income may affect subjective well-being through social comparison. Therefore, even though the overall economic indicators may increase overtime, the increasing inequality may lead people to experience less subjective well-being though social comparison (Diener, 1984). While the relationship between income and well-being is not consistent, many sustainability measures still focus on economic measures to gauge well-being. According to Clark & Harley (2020), under the inclusive wealth theory, per-capita well-being can be measured through per- capita wealth. Inclusive wealth has three main components: natural capital such as forests, land, and oil, human capital such as education and health, and produced capital, such as equipment and machinery (Managi & Kumar, 2018). These three types of capital goods are considered the stock upon which social well-being can be derived and are therefore considered as the means to an end (Managi & Kumar, 2018). Though these measures of capital maybe practical to account for the potential of future generations to generate well-being, it does not challenge the notion of what is human well-being, and it is again relies on economic theory to measure well-being. 2.1.2 What is the CE and why is it important?

The concept of the **CE has** recently **gained attention** from governments, **business, and** 66

academics because it is seen

as a path to operationalize **sustainable development** (Kirchherr **et al., 2017** ; Murray **et al., 2017** 94

).

The European Union launched its first **CE action plan in 2015 and** a new **CE** 107

action plan in 2021, where scaling the CE was described as a “decisive contribution to achieving climate neutrality by 2050 and decoupling economic growth from resource use” (European Commission, 2020, p. 2). China presented a development plan for the CE within its 14th Five Year Plan Period and the plan is a key part of their climate strategy (Chipman Koty, 2021). Since the concept is still relatively new, there is no consensus on its definition, though many studies have addressees the need to define the CE and proposed improved definitions

of the concept (Desing **et al** ., 2020; **Kirchherr et al., 2017**). The **most** common 93

definition according to **the**

conceptual review conducted by Kirchher et al. (2017)

is the one proposed **by the Ellen MacArthur Foundation** Report: Towards **a** 168

CE (2012): “A CE is an industrial system that is restorative or regenerative by intention and design. It replaces the ‘end-of-life’ concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models” (p. 7). This definition highlights the aims of the CE as restorative and regenerative; it includes clear strategies that embody the CE, and it mentions the redesign of business models. Regardless of being the most common definition, Kirchner

et al . (2017) **found that the Ellen MacArthur Foundation (EMF** 163

) definition was used in only 11 of the 114 articles they analyzed that included CE definitions. This shows the wide variety and lack of consensus regarding the definition of the CE. Lastly, this definition does not explicitly mention sustainability, sustainable development, the pillars of sustainability or future generations. The following definition proposed by Kirchher et al. (2017) does encompass sustainability: “A CE describes an economic system that is based on business models which replace the ‘end-of-life’ concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso-level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations” (p. 224). Another main difference between the EMF and Kirchher et al.’s definition is that the EMF definition describes the CE as an industrial system. In contrast, Kirchher et al. describes the CE as an economic system. Nevertheless, in the “Toward a CE” report, the EMF relates the CE to the rethinking of economic models and contrasts the CE to the “take-make-dispose economy” (Ellen MacArthur Foundation, 2013, p. 6). The report also describes our current “industrial economy” based on the logic of take-make-dispose that began with the industrial revolution. Industrial and economic systems tend to be used interchangeably, since they are interlinked, and both will require a paradigm shift under a CE. The take-make-dispose economy is also referred to as our current linear economy, in contrast to the CE in which products are cycled rather than disposed of. A review conducted by Merli et al. (2018) also emphasizes

the macro, meso, and micro level applications **of** the **CE** , and views the **CE as a** way 10

to

operationalize environmental and economic sustainability specifically. This review also calls for the need to address the social implications of a CE (Merli

et al., 2018). Desing **et al** . (2020) **has pointed out that** 169

though the bottom-up approaches prevalent in CE definitions and discourse such as reduce resource use, minimize waste, reuse, etc., are useful at the business level, they are not enough to ensure the CE leads to sustainability. Hence, they argue that the CE needs to consider the larger earth systems and societal systems in which it operates. In a separate conceptual review that narrates the origins of the CE, Murray et al. (2015) claim that the CE is closely linked to industrial ecology and closed-loop economy. 2.1.3 Does CE Lead to Sustainability?

The relationship between the CE **and sustainability is** an important **topic of** 153

discussion in the CE literature (Geissdoerfer et al., 2017). Many scholars see the CE as a way to operationalize sustainable development, but there is substantial uncertainty with regards to the link between circular and sustainability. This ambiguity is reflected in Kirchher et al.'s (2017) conceptual review. They find through a systematic review of 114 CE definitions that very few definitions (12%) explicitly mention sustainable development, and that few definitions (13%) mention all three dimensions of sustainability. Nevertheless, in their proposed definition they state that the aim of the CE is "to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations" (Kirchher et al., 2017, p. 225). With this, Kirchher et al. (2017) communicate that though sustainable development is not part of most CE definitions, it should be. Their work also highlights that the social dimension of sustainability receives the least attention, with only 18- 20% of definitions mentioning social equity. Murray et al. (2017) also emphasized the lack of attention given to

social equality in terms of inter -generational, **intra-generational** , racial, and **gender equality** 54

in the CE framework and they stress the need to include social dimensions in the concept. Many scholars question the proposition that the CE will decoupling economic growth from the environment (Giampietro, 2019). They argue that the CE ignores basic principles of thermodynamics, such an entropy where a certain amount of energy and materials are lost as by-products of a certain process, and therefore products cannot be cycled in the economy endlessly because they lose quality (Corvellec et al., 2022; Giampietro, 2019). Some also highlight that the circular economy may increase waste by seeing waste as a resource and monetizing otherwise useless material (Corvellec et al., 2022). 2.2 Jobs in a CE 2.2.1 Defining

Circular Jobs The Circular Jobs Methodology (Circle Economy & UNEP, 2022, p. 3) defines a circular job as “any occupation that directly involves or indirectly supports one of the strategies of the CE”. The CE strategies referenced here are those of the Key Elements Framework which are: “stretch the lifetime, use waste as a resource, prioritize regenerative resources, design for the future, incorporate digital technology, rethink the business model, team up to create joint value, and strengthen and advance knowledge” (Circle Economy & UNEP, 2022). Three types of circular jobs are identified by the Circular Jobs Methodology (2022): 1)

core circular jobs ; 2) **enabling circular jobs** ; and 3) **indirect circular jobs** 152

. “Core circular jobs are all jobs that ensure the closure of raw material cycles, including jobs in repair, renewable energy, and waste and resource management” (Circle Economy & UNEP, 2022, p. 3). Enabling circular

jobs are those in sectors **that enable the acceleration of core** CE **activities** 134

such as: designing for

the future, rethinking the business model, incorporating digital technology 154

in economic activities, teaming up to create joint value, and strengthening and advancing knowledge (Circle Economy & UNEP, 2022). Indirect circular jobs are defined as those in sectors that can adopt circular strategies and provide services to core circular strategies (Circle Economy & UNEP, 2022). Under this definition, the sector, classified by International Standards Industrial Classification (ISIC-4) codes, define whether a job is circular. Under this definition, many companies that are incorporating CE strategies within traditional industries, e.g., thrift shops in the fashion industry, are not going to be considered circular because the industry as whole is not circular.

The U.S. Bureau of Labor Statistics (BLS) Green Jobs Initiative defines **green jobs** 90

as “jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources” and “jobs in which workers’ duties involve making their establishment’s production processes more environmentally friendly or use fewer natural resources.” With this definition, if a business is found to produce green goods or services, all jobs within that business are considered green, regardless of the industry. Analogously, this research defines circular jobs as all jobs in companies that have a circular business model, regardless of the industry in which the company operates. Nubholz (2017) defines a circular business model as: “how a company creates, captures, and delivers value with the value creation logic

designed to improve resource efficiency through contributing to extending useful life of products and parts (e.g., through long-life design, repair and remanufacturing) and closing material loops" (p. 13). 2.2.2 Job Creation in a CE Most of the literature that addresses employment in a CE uses macroeconomic modelling to predict the quantity of jobs created in a transition to a CE and the projections tend to be optimistic (Commission, 2018;

Ellen MacArthur Foundation et al ., 2015; Laubinger **et al., 2020**). Laubinger **et al**	128

. (2020) reviewed 15 different modelling studies with 47 policy scenarios and found most studies conclude that CE policies have a net positive or neutral impact on employment. The "Growth from Within: A CE Vision for a Competitive Europe" report (2015) reviewed 65 academic articles and reached the same conclusion—i.e., growth is expected from increased spending due to lower prices and labor-intensive repurposing activities. At a theoretical level, Stahel and MacArthur (2019) make this same proposition: jobs will be created in a CE by substituting the energy intensive production of new products with labor intensive service life extension strategies such as reuse, repair, and remanufacture. Production of new goods is considered energy-intensive because they require more new raw material and raw material is considered energy-intensive and low-labor (Stahel & Ellen MacArthur, 2019). Wiebe et al. (2019) use a multiregional input-output (MRIO) model to compare the environmental and employment impacts in a business as usual (BAU) scenario and a CE scenario, and they also find a positive, but small, impact on employment in a CE scenario. One of the only studies to use a case study methodology discovered that not all repurposing activities in a CE have the same impacts on employment (Nasr et al., 2018). Repurposing activities, or value-retention processes (VRPs), are CE activities that seek to preserve value such as reuse, repair, refurbish, and remanufacture (Nasr et al., 2018). Remanufacturing is the only VRP that brings a product to as new or better than new condition and is therefore most comparable to the production of a new product (Nasr et al., 2018). Comprehensive refurbishment provides an almost full life (Nasr et al., 2018). Remanufacturing and comprehensive refurbishment provided more employment opportunities relative to the manufacturing of a new product, because they require new production stages such as disassembly and product testing that are labor intensive (Nasr et al., 2018). In contrast, arranging direct reuse and repair provide less employment than producing

a new product since **the** labor needed **to** arrange **the** reuse **of** new **product is**	164

minimal compared to producing a new product (Nasr et al., 2018). Since different repurposing activities have different impacts on employment, the overall impact of a transition to a CE on employment also depends on which CE activities are prevailing. In addition, impacts will vary by sector and geographic region. Wiebe et al. (2019) projects that employment will increase in most countries under a CE scenario, and that employment will fall in capital intensive industries such as mining and manufacturing and increase in more labor-intensive industries such a renewables and service sectors which require slightly higher skilled jobs. This signals a need to train the workforce for these sectoral employment changes. Negative employment outcomes are expected from reduced demand for fossil fuels, metals, other minerals, and forest products

(Wiebe et al., 2019). These are compensated by increased demand for repair, reuse, and share (Wiebe et al., 2019). 2.3 Meaningful Work 2.3.1 Defining Meaningful Work The “experienced meaningfulness” of work refers to how workers value their work (Hackman & Oldham, 1975). Allan et al. (2019) distinguish meaningful work from meaningful experiences— one may have both meaningful and not meaningful experiences in the same job, but meaningful work involves recalling these experiences and making a “global judgement that one’s work accomplishes significant, valuable, or worthwhile goals that are congruent work with one’s existential values” (

Allan et al., 2019). This research uses this definition **of meaningfulness, in** 141

which the employee or subject is the one that defines if the work they are performing is meaningful to them, based on their own values and their recollection of their experiences at work. 2.3.2 Theories and Frameworks that Incorporate Meaningful Work One of the first theoretical models to incorporate the concept of experienced meaningfulness on the job is

Hackman and Oldman’s (**1975) Job Characteristics Model** (see **Figure 2**). In **this model** 125

, experienced meaningfulness is one of the three main psychological states that relates certain job characteristics to positive

work outcomes such as higher **internal work motivation, work performance** , job **satisfaction, low absenteeism, and turnover** 76

. This model identifies three main core job dimensions that affect meaningfulness:

skill variety, task identity, and task significance. Skill variety refers to the degree to which a job requires 71

multiple skills or talents,

task identity to **completing a** recognizable **piece of work from** beginning **to** end, and **task significance** to **the** impact the **work has on** the lives of **others** 9

in and outside of the organization (Hackman & Oldham, 1975).

Core Job Critical **Dimensions Psychological States Skill Variety Experienced Task Identity** 14
Meaningfulness of the work Task Significance Autonomy Experienced Responsibility for the Outcome
of the Work Feedback **Knowledge of the Actual Results of the Work Activities**

Figure 2:

Job Characteristics Model (Hackman & Oldman, 1975) **Personal** and **Work Outcomes High** 50
Internal Work Motivation High Quality Work Performance High Satisfaction with the Work Low
Absenteeism

Another theoretical framework that incorporates experienced meaningfulness on the job is Kahn's (1990) theoretical framework on work engagement, in which meaningfulness is one of the three main psychological characteristics important for engagement at work (see Figure 3). In this framework, meaningfulness is also a component of the task characteristics identified previously by Hackman and Oldman, but Kahn's framework includes new dimensions of meaningfulness. Kahn (1990) classified the components of meaningfulness into three main groups: tasks, roles, and work interactions. Task, which have much overlap with the

core job characteristics identified **by Hackman and** Oldman (**1975**), include challenge, 145
skill variety

, creativity, autonomy, and clear purpose and goals (Kahn, 1990). Though there is some overlap, several task characteristics in Kahn's model are new: challenge, creativity, and having a clear purpose and goals (Kahn, 1990). Role characteristics refers to measures of status, influence, how a person identifies with a given

role, and if **the role** provides **a** sense **of** shaping **the** external world (**Kahn, 1990** 148

). From this conceptualization, task significance would be part of role characteristics rather than task characteristics, since task significance measures the workers perception of the impact they have in the world through their work. Work interactions refers to rewarding interpersonal interactions with clients or coworkers, and a sense of being valued and appreciated at work (Kahn, 1990). Degree of challenge Variety Creativity Tasks Autonomy Clear procedures and goals Fit with self-image Meaningfulness Roles Status and Influence Interpersonal connections Work Interactions Feelings of appreciation and respect Figure 3: Graphical representation of Kahn's theoretical framework May et al. (2004) tested Kahn's

theoretical framework in a field experiment conducted in an insurance company. The model tested included three components for meaningfulness: task characteristics, worker role fit, and coworker relations. Task characteristics were measured using the following measures from Hackman and Oldman's

Job Diagnostic Survey: skill variety, task identity, task significance, autonomy, and feedback from the 77

job. Their results found a significant positive relationship between the three

psychological conditions—meaningfulness, safety, and availability—and employee engagement , but 137 meaningfulness showed **the**

strongest relationship (May et al., 2004). Chaudhary (2019) found that corporate social responsibility has a positive relation

to employee engagement and that **this relationship is** fully **mediated by** 140

the three psychological conditions identified by Kahn.

In a recent **meta-analysis** of **meaningful work, Allan et al. (2019** 63

) found meaningfulness to have high correlations with job

outcomes such as job satisfaction, work engagement, **and commitment** . In addition, **they** 52

found meaningful work to have large to moderate correlations with well-being variables that are unrelated to work, such

as life satisfaction, life meaning, and general health (Allan et al., 2019 96

). These results support the argument that understanding meaningful work is important to understanding general human well-being. 2.4 Meaningfulness at Work in a CE Experienced meaningfulness at work, as identified in the literature, is dependent on many varied aspects of work that include properties of task characteristics as well as social interactions at work. It is likely that some jobs that will be prominent in the CE, such as repair and remanufacturing jobs, will be higher in

core job characteristics such as autonomy and task variety than a traditional manufacturing jobs that are more repetitive and require less skill. On the other hand, there may be an increase in jobs in the waste management industry (Commission et al., 2018), which may be low in task characteristics as well as role characteristics. Therefore, we can expect to have both an increase in jobs that are higher in task characteristics as well as jobs that have lower task characteristics as defined by Hackman and Oldman (1975). This research will look specifically at CE jobs in remanufacturing and reuse at all levels of an organization. Though it is expected that higher levels of job characteristics will exist in remanufacturing as compared to manufacturing, it is not possible to test this hypothesis due to the lack of benchmark data for manufacturing jobs. Nevertheless, this research will explore if there are overall high levels of job characteristics in remanufacturing jobs. Rather than focusing on job characteristics, that could be high for some jobs in the CE and low for others, the focus

of this research is to explore if **the** CE **concept can** 37

make all circular jobs more meaningful. The CE has the potential to change production systems for the better. Therefore, a central question of this research is whether the CE concept enables workers, who contribute to the CE, to see their jobs as more meaningful by increasing their task significance or perception of the impact they have in the world. The way this research approaches this question is by testing if employees who have more awareness of the CE have more experienced meaningfulness on the job. 3. Research Methods

The main objective of this research **is to understand how** 20

a more CE can impact worker well- being by focusing specifically on what makes work meaningful. Table 3.1 provides an overview of research methods used to address each of the three

research questions. The data used to answer each of **the research questions** comes from **the** 19
same questionnaire. RQ1 **and**

RQ2 only use the pre-test data, and RQ 3 involves comparing both pre-test and post-test results. The following sections explain

the research design, the development of **the data collection** instrument, **and** the **data** 46
analysis technics **used**

to address the research questions. Table 3. 1: Overview of Research Methods Theoretical framework Hackman and Oldman's (1975) Job Characteristics Model, Kahn's (1990) theoretical framework for work engagement

Research Design Quasi-experimental pretest-posttest control group design Target population 99

Two CE companies in the US Sampling method Convenience sampling Data collection instrument Online questionnaire delivered through QuestionPro* Research Questions Data Source/Method Data Type Data Analysis Method RQ 1: What factors are most important in explaining meaningfulness in CE jobs? Does CE awareness contribute to more meaningful work? Questionnaire Quantitative/ Cross-sectional Regression Analysis RQ 2: Through what mechanisms does an awareness of the CE affect experienced meaningfulness? Questionnaire Quantitative/ Cross-sectional Path Analysis – Mediation Analysis RQ 3: Does increasing a worker's awareness of the CE have a significant effect on their experienced meaningfulness? Questionnaire - Pretest Post- test Control Group Design Quantitative/ Panel data One-way ANOVA *QuestionPro is an online software used to create and deliver surveys.

3.1 Research Design The research design is key **to the** 35

internal and external validity of a research study (Kline, 2019). Internal

validity refers to the extent **to which** a causal relationship **can be** inferred **from** the **study** 123

, while external validity

refers to the extent to which the results of the experiment can be expected **to** 38

hold on a larger population or to other settings (Kline, 2019). Three criteria are important to establish causal inference between two variables: temporal precedence of the cause, covariation between cause and effect, and elimination of other possible explanations for the effect (Kline, 2019). Experimental and quasi-experimental designs are the strongest designs to study causal relationships (Grant, 2008; Kline, 2019). Experiments, also known as randomized control experiments, require the randomized

assignment of treatment **to** the **treatment and control groups** (Kline, 2019). When **the** assignment **of** 38

treatment is not randomized, the design can be considered a quasi-experiment (Kline, 2019, Grant & Wall, 2009). Quasi-experimental designs were described and encouraged by Campbell and Stanley (1966) for studies taking place outside of a laboratory, where researchers may not have the ability to fully control the experimental environment. Some of the benefits of quasi-experiments are greater external validity than lab experiments because they take place in real life settings while also enabling stronger casual inferences through experiment like design (Grant & Wall, 2009). This research is designed to answer two different types of questions: RQ1 and RQ2 involve using cross-sectional data from the pre-test and RQ3 uses panel data since it compares the same subjects at two different points in time, pretest, and post-test. RQ1 and RQ2 are able to provide an insight into the relationship between CE variables and experienced meaningfulness on the job regardless of the effectiveness of the video intervention. RQ3 is dependent on the effectiveness of a CE video intervention having an impact on employees experienced meaningfulness on the job and CE awareness and perception. RQ3 has the strongest causal inference design since it uses a quasi-experimental

pre-test post-test control group design. In a **pretest-posttest control group design** 87

, a survey is conducted with both

treatment and control groups before and after the treatment or **intervention** 42

takes place (see Table 3.2). In this research, a survey was administered to employees of two different CE companies in the US. In

this study, a quasi-experimental pretest-posttest control group design was 106

conducted with employees of two different CE companies in the US. A survey was assigned to all employees in the sample. A five-minute training video about the CE and its benefits was then assigned to a treatment group at each company as the intervention; the control groups at each company did not watch the video. Following the completion of the intervention video (for the treatment group), all employees were assigned the post-test survey (see Table 3.2). Employees

were randomly assigned to one of the **two groups** via **the** 12

use of email lists, and either received an email

containing a link to the survey with **the** video embedded or **an email** with **a link to the survey** 79

that did not contain the video. Employees were given a choice of whether

to participate in the study, and so although employees **were** randomly **assigned to** either **the** 42

treatment or control groups, each employee had the final choice to take the survey or not. As a result, the assignment of participants to the treatment was not perfectly randomized, and the study design was quasi- experimental. The objective of the intervention video was to provide the treatment group with foundational information about the CE and then measure the before and after-effect of the video on employees' experienced meaningfulness on the job. This design satisfies two of the three conditions for causal inference: temporal precedence—since the intervention video occurs before the post-test survey measures employees' levels of meaningfulness; and elimination of other possible explanations by using a treatment and a control group. Table 3. 2: Pretest – Posttest Research Design Pretest Intervention Post-test Treatment group Survey 1 Video Survey 2 Control group Survey 1 No-video Survey 2 3.1.1 Sampling

The target population for this research **consisted of** all **the** employees **of** 42

two CE companies in the US. Any company that has a CE strategy embedded in its business model was potentially eligible for inclusion in this research (see Section 2.1.2). The companies were selected by convenience sampling and because they both had established circular economy strategies embedded. In the case of the two selected companies, Company A engages in the remanufacturing of office furniture and sells remanufactured furniture across the United States and Canada, and Company B engages in the distribution and sale of reused goods and operates within the territories of Virginia, Maryland, Pennsylvania, and West Virginia. Consistent with the definition of a CE job used for this study (see Section 2.2.1), all employees working within a CE company are considered as holding a CE job. Therefore, all employees in these two CE companies were part of the target population, regardless of the job title employees held. The sampling technic used was to send the online surveys to all employees of the two target companies. Participation in the study was voluntary, so not all

employees completed the survey. More participants completed survey 1 (pre-test) than survey 2 (post-test) (see Section 4.2 for the details of the actual sample size). Since the pretest-post-test experimental design requires comparing the same subjects before and after the test, a self-generated code was used to connect the pre-test sample with the post-test sample. As an incentive for participation in the survey, employees were offered the possibility of entering a draw for a $50 gift card when they successfully completed both survey 1 and 2. This study focuses on the effect of CE awareness on experienced meaningfulness, and not on the particular task performed by employees, or the particular services provided by the companies. Accordingly, the sample serves as a case study to explore the effect of CE awareness on employee's experienced meaningfulness.

It is important to note that , as **the sample** reflects only two **specific** 4

CE companies, neither the sample nor the findings can be considered representative of all CE companies. Self-Generated Code The purpose of having participants create a code was to be able to identify the group of people who

completed both the pre-test and the post-test 27

without collecting identifiable information from participants such as email, social security number, name, or phone number, which would require a different level of IRB approval and might have also influenced a participant's perception of the confidentiality of their responses. The solution was to ask employees to generate their own code which would be imputed in both pre-test and post-test. To avoid employees forgetting their self-generated code one week after the pre-test, participants were asked two questions that combined made up their code. The first question asked participants to input

the last four digits of their phone number , and **the** 162

second question asked them their day of birth, e.g., if their birthday was the September 23, 1990, the day of birth imputed is the 23. These questions combined to form a self-generated code that did not contain identifiable information. Gift Card Selection Process To select the winners to the $50 gift card, a list of all participants who completed both survey 1 and survey 2 for each company was created. Then, the participant's self-generated codes were used to link the participant of survey 1 and survey 2. For Company B, a total of 30 codes were found on both the pre-test and post-test. For Company A, 27 participant codes were found matching on the pre-test and post-test. These participants were then arranged in an Excel sheet and numbered from 1 to 30 for company B, and 1 to 27 for Company A. The google random number generator was used to select a number from 1 to 30 and 1 to 27 to choose the two winners of the draw. The gift cards where then emailed to each company and distributed to the winners by the companies themselves, many weeks after the survey completion. 3.1.2 Data Collection Procedures The general data collection procedures are synthesized in Figure 4. First, a pre-test was

conducted on all employees, then employees were randomized to two groups, treatment and control. Finally, a post-test was conducted one week after the pre-test. The procedures to deliver the pre-test and post-test surveys varied slightly between Company A and B, as different methods were expected to result in greater participation in the two different settings. The delivery methods were recommended by the organizations themselves, as outlined below. Company A, pre-test: Administrative employees (office) received links to the surveys via their company email accounts, whereas assembly (manufacturing plant) employees were invited to complete the survey using three computers that had been set up for this purpose in a designated room. Assembly employees were called in groups of three people per round to complete the survey in the designated room. Company A, post-test: The post-test survey was completed by the original participants between three to seven days after completing the pre-test survey. Employees

were divided into two groups, the treatment **group** who received **the** video **and the control group** 55

who did not receive the video. For administrative employees, IT personnel from Company A randomly divided email addresses into two groups and sent the two different surveys to the treatment and control groups. For the assembly employees, as was done with the pre-test, computers were once again set up in the designated room with the difference that, for the post-test survey, one computer contained the treatment group survey (embedded) CE video, and the other computer contained the control group survey (no video). Upon arrival at the designated room, employees were randomly assigned to one of the two computers. Company B,

pre-test and post-test : Both **pre- and post-test** 26

surveys were distributed to employees at Company B via email and text message. Employee participants were given the choice to complete the pre- and post-test surveys on their mobile devices or computers. Company B's Human Resources personnel divided phone numbers and emails into two randomized groups to send the post-test survey out using the same format and methods. Pre-test ? Information Sheet and Consent ? Drawing Participation ? Block 1: Demographic Questions ? Block 2 to 10: Job Characteristics and Meaningfulness Questions ? Block 11 to 13: CE Awareness and Perceptions ? Code-generation ? Thank you 1 week apart Randomization of employees into two groups

Post-test: Control Group Post-test: Treatment Group ? Information Sheet **and** 27

Consent ? Information Sheet and Consent ? Code Completion ? Code Completion ? Block 1 to 3: Meaningfulness ? Video and Manipulation Check Questions ? Block 1 to 3: Meaningfulness ? Block 4 to 6: CE Questions Questions ? Block 4 to 6: CE

Questions Figure 4: Data Collection Procedures 3.2 Data Collection Instrument In this section, the process of developing the questionnaire is described. An overview

of the questionnaire **development process is** presented **in Figure** 5, **and the** 144

full questionnaire with sources for each question are included in Table 3.3, 3.4, 3.5, and 3.6. The development of the questionnaire is based on classical (measurement) theory; therefore, the section starts with a description of the measurement process based on measurement theory. A measurement model is needed when the study involves variables that cannot be directly observed, or directly measured, such as intelligence, happiness, or meaningfulness (DeVellis & Thorpe, 2016). These types of variables are called latent variables, and they are also referred to as hypothetical constructs. Overview of Questionnaire Development Process Lit. review of theoretical frameworks including the concept of meaningful work Pilot questionnaire Adapt questionnaire Lit. review of exiting questionnaires used to measure meaningfulness and related concepts Draft CE measures of each of the hypothesized relationships Selection of measures based on relevance to the study, previous validation, and recency Develop understanding of potential relations of CE to existing theoretical frameworks Figure 5: Overview of the Questionnaire Development Process 3.2.1 Measurement Theory and Process The measurement process involves three main steps: (1) the identification and definition of the attributes to be measured; (2) determination of how the definitions will be effectively measured; and (3) determination of the scale that will be used to translate the operational definitions into quantitative terms (Kline, 2019). Classical (measurement) test theory uses multi-item scales by convention, and because of the benefits it provides compared to single item scales. Multi-item scales refer to when more than a single question or statement is used to measure a single construct, e.g., in this research, meaningfulness, which is the main variable of interest, has a total of six items that make up the measurement model that are all

measured on a 7-point Likert scale (see Figure 6). **The** scores **of all** six items **are** 57

averaged to give a total score for meaningfulness for each participant. Multi-item scales help correct for when a given participant misreads or misunderstands a particular item, despite understanding the other items in the multi-item scale. Also, multi-item scales usually have a greater range than single item scales. Following this convention, this study uses multi-item scales of at least three items per construct. Meaningfulness requires the development of a measurement model because it is a hypothetical construct, also called a latent variable. In Figure 6, meaningfulness is encircled because it is a latent variable. The arrows pointing from meaningfulness toward each of the items indicate meaningfulness is predicting the items, which are in rectangles because they are observed variables used to measure meaningfulness. In path diagrams, the

latent variables are represented with **a circle and the observed variables** 6

with a box. A one-sided arrow represents a path in which one variable causes the other and two-sided arrows represent covariance or variance. 3.2.2 Identification of Constructs to be Measured The first step in the development of the questionnaire was to understand the theoretical frameworks that incorporate the concept of meaningful work. As mentioned in the literature review section, two main frameworks that help explain the factors leading to meaningful work include

the Job Characteristics Model (JCM) developed by Hackman and Oldman (**1975) , and** 103

Kahn's (1990) framework for work engagement. The JCM is accompanied by the job diagnostics survey that includes all the items that go into the measurement model for each of the constructs in the model. Kahn's framework identifies and defines the constructs that are relevant for meaningful work, but it does not provide a measurement model for each construct. According to the Job Characteristics Model, only three job characteristics are important to explain meaningfulness: skill variety, task identity, and task significance. Kahn's framework on the other hand is much more extensive and classified job characteristics important for workers experiencing meaningfulness into three groups: tasks characteristics, role characteristic, and work interactions. Task characteristics involved: level of challenge, skill variety, creativity, autonomy, clear purpose, and goals. These characteristics have some overlap with the JCM but involve new elements. Role characteristics relate to the identity the job gives the employee and how this identity fits how the workers see themselves. It relates to the status provided by the role, and the level of influence and sense of shaping the world the role provides. Lastly, worker interactions relate how rewarding employees found their relationships with co-workers and clients. In addition, Grant (2008) identifies two new concepts that relate to task significance and meaningful work:

perceived social impact and perceived social worth. Perceived social impact is 101

defined as "the degree to which employees feel that their actions benefit other people" and perceived social worth as "the degree to which employees feel that their contributions are valued by other people" (Grant, 2008, p. 110). In summary, these three main theories were used to identify the constructs that were relevant to understanding meaningful work. Section 3.2.3 specifies the constructs measured in this study and where the measures for each construct were obtained. Table 3.3 includes all the constructs measured, the sources, and the research questions they relate to. The theories above were used as a starting point to understand how CE can impact meaningful work. The main research hypothesis is that the CE can affect meaningful work by impacting

task significance, perceived social impact, and perceived social worth. The 135

CE is viewed as a concept that can change the world; accordingly, there is a need to understand how this will impact how workers in the CE experience their jobs as meaningful. First, for the concept of the CE to impact workers, workers must be

familiar with the concept of the CE, therefore the survey measures an employee's CE familiarity. Secondly, an employee's perception of the potential benefits of the CE can also be relevant, therefore the survey measures their perception of impacts to society and perception of impacts to the environment. Third, employees should know about their organization's contribution to the CE and their own contribution, which is referred to in this research as the perception of self-contribution to CE and perception of an organization's contribution to CE. Lastly, and inferring from Grant's theory of relatedness, what others think of the CE can also affect an employee's experience of meaningful work. Thus, the last construct to measure was the perceived societal value of the CE. 3.2.3 Selection and Development of Measures for each Construct To measure the constructs found most relevant to explain experienced meaningfulness on the job (Section 3.2.2), the questionnaire used existing measures from the literature, since these have been previously validated and enable comparison with previous studies. However, for the CE construct, three-item measures were developed since there are no pre-existing measures in the literature. This section explains the sources for all of the measures that are utilized in this study. Job Characteristics Construct: Measurement To identify the factors that are most important for explaining meaningfulness in CE jobs, and the role of CE familiarity (RQ 1), the questionnaire adopts concepts identified by Hackman and Oldman (1975), Kahn (1990), and Grant (2008) to measure meaningfulness in the workplace. These include

decision-making autonomy, task significance, task identity, feedback from the job, job complexity , 78
skill variety, and **specialization**

(see Table 3.3). Except for task significance, which is a four-items measure (Morgeson & Humphrey, 2006), each construct is a three-item measure

using a 7-point Likert scale where 1 represents strongly disagree and 7 represents strongly agree 5

(Morgeson & Humphrey, 2006). For example, in order to calculate the total score for decision-making autonomy for a given participant, the average score indicated for each of the following three statements is taken: "the job gives me a chance to use my personal initiative or judgment in carrying out the work" (score of 1 – 7), "the job allows me to make a lot of decisions on my own" (score of 1 – 7), and "the job provides me with significant autonomy (independence) in making decisions" (score of 1 – 7). These measures were all taken from Morgenson and Humphrey (2006), as this study is the most recent adaptation of the job design questionnaire (Hackman & Oldham, 1975), and was validated with 540 participants for reliability, convergent validity, and discriminant validity. A measure for worker-role fit was included to account for role characteristics in Kahn's (1999) framework, which was obtained from May (2004). Other measures taken from May (2004) account for work interactions and relate to the quality of relationships at work. Two constructs, each utilizing three items and a Likert Scale of 1 – 7, were included to account for work interactions: (1) co-worker relations; and (2) supervisor support. Lastly, measures of

perceived social impact and perceived social worth were adapted from **Grant (2008). Perceived social impact** 4

accounts for

the extent to which employees are aware of how **their work** may benefit others, **and** 160

whether they feel they

have a positive impact on others. Perceived social worth 139

refers how employees feel others value or appreciate their work. Given that perceived social worth is a two-item measure in Grant (2008), a third statement was added to make it a three-item measure and maintain consistency throughout the questionnaire. Table 3.3: Job Characteristics Constructs and Measures Job Characteristics Research Question Construct Measured # Item Item Source Type of Data (per item) Type of Data (Construct) RQ1 Autonomy (

Decision-Making Autonomy) 1 2 3 **The job gives me a chance to use my personal initiative or judgment in carrying out the work. The job allows me to make a lot of decisions on my own. The job provides me with significant autonomy** (independence) **in making decisions** 3

. Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous RQ1, RQ2

Task significance 1 2 3 4 The results of my work are likely to significantly affect the lives of other people. The job itself is very significant and important in the broader scheme of things. The job has a large impact on people outside the organization. The work performed on the job has a significant impact on people outside the organization 3

. Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous RQ1

Task identity 1 The job involved **completing a piece of work that has an obvious beginning and end** 13

. Morgenson and Humphrey, 2006 Ordinal - Likert scale (1-7) Continuous

2 The job provides me the chance to completely finish the pieces of work I begin 74

. Morgenson and Humphrey, 2006 Ordinal - Likert scale (1-7)

3 The job is arranged so that I can do an entire piece of work from beginning to end 60

. Morgenson and Humphrey, 2006 Ordinal - Likert scale (1-7) RQ1

Feedback from the **Job 1 2 3 The work activities themselves provide direct and clear information about the effectiveness (e.g., quality and quantity) of my job performance. The job itself provides feedback on my performance. The job itself provides me with information about my performance** 3

. Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous RQ1

Job Complexity 1 2 3 **The job requires that I only do one task or activity at a time. The tasks on the job are simple and uncomplicated. The job comprises relatively uncomplicated tasks** 41

. Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous RQ1

Problem Solving 1 The job involves solving problems that have no obvious correct answer 13

. Morgenson and Humphrey, 2006 Ordinal - Likert scale (1-7) Continuous 2 The job requires me to be creative. Morgenson and Humphrey, 2006 Ordinal - Likert scale (1-7) 3

The job requires unique ideas or solutions to problems 6

. Morgenson and Humphrey, 2006 Ordinal - Likert scale (1-7) RQ1

Skill Variety 1 2 3 **The job requires a variety of skills. The job requires me to utilize a variety of different skills in order to complete the work. The job requires me to use a number of complex or high-level skills** 13

. Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Continuous RQ1 Specialization **1** 2

2 3

The job is highly specialized in terms of purpose, tasks, or activities. The tools, procedures, materials, and so forth used on this job are highly specialized in terms of purpose. The job requires very specialized knowledge and skills 6

. Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006 Morgenson and Humphrey, 2006

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous RQ1

Rewarding co- worker relations 1 2 **My interactions with my co-workers are rewarding** . I believe that **my co-workers** 30

appreciate who I am. May, 2004 May, 2004

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous 3

I sense a real connection with my co- workers 151

. May, 2004 Ordinal - Likert scale (1-7) RQ1 Supportive supervisor relations 1 2 3 My supervisor praises good work.

Employees are treated fairly by my supervisor. My supervisor is committed to protecting my interests 30

. May, 2004 May, 2004 May, 2004

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous RQ1 Worker role fit

1 2 3 My job ‘fits’ **how I see myself. I like the identity my job gives me. The work I do on this job helps me satisfy who I am** 32

. May, 2003 May, 2003 May, 2003

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous RQ1 Perceived social impact 1 2 3

I am very conscious of the positive impact that my work has on others. I am very aware of the ways in which my work is benefiting others. I feel that I can have a positive impact on others through my work 4

. Grant, 2008, Spreitzer (1995) Grant, 2008, Spreitzer (1995) Grant, 2008, Spreitzer (1995)

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Continuous **1** 2

I feel that others appreciate my work RQ1 Perceived social worth 2

I feel that other people value my contributions at work 3 **I feel that** 4

others are

aware of the ways in which my work is benefiting society **and** 4

the environment. Grant, 2008 Grant, 2008 Created for this study

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Continuous **Ordinal - Likert scale (1-7** 2

) Meaningfulness Construct: Measurement Understanding the factors that influence meaningful work in the CE, and how the CE awareness can increase meaningfulness, are the main objectives of this research (RQ1, RQ3). Having a reliable measure for meaningful work is critical. For this reason, meaningfulness is measured using six items rather than 3-items. Consistent with the job characteristics measures in the questionnaire, meaningfulness is also measured on 7-

point Likert scale where **a score of** "1" **represents** "strongly disagree", **a score of** "7" **represents** "strongly agree", and **the** total score **is** 45

averaged over the six items. The measurement model for meaningfulness was taken from May (2004), since this study is more recent than Hackman and Oldman (1975) and has a strong focus on meaningfulness. For a graphical representation of the measurement model for meaningfulness refer to Figure 3.2. Experienced Meaningfulness on the Job Item 1 Item

1: The work I do on this job is very important Item 2 **to me** . Item 2: **My job activities are personally meaningful** Item 3 **to me** . Item 3: **The work I do on this job is worthwhile** 21

. Item 4 Item

4: My job activities are significant to me . Item 5: **The work I do on this job is meaningful to me** . Item 6: **I feel that the work I do on my job is valuable** . Item **6** Item 5 21

Latent variable Observed variable Path Figure 6: Graphical representation of the measurement model for meaningfulness (May, 2004) 29 Table 3.4: Meaningfulness Construct and Measures Meaningfulness Construct Research Question Construct Measured Item Source Type of Data (per item) Type of Data (Construct)

1 The work I do on this job is very important to me 43

. May, 2004 Ordinal - Likert scale (1-7)

2 My job activities are personally meaningful to me 63

. May, 2004 Ordinal - Likert scale (1-7) RQ1, RQ2, RQ3 Experienced meaningfulness 3 4

The work I do on this job is worthwhile. My job activities are significant to me 30

. May, 2004 May, 2004

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous 5

The work I do on this job is meaningful to me . May, 2004 Ordinal - **Likert scale** 85

(1-7) 6

I feel that the work I do on my job is valuable. May 43

, 2004 Ordinal - Likert scale (1-7) 30 CE Construct: Measurement The previous section (3.2.2) described how the six CE awareness and perception measures were developed using the literature and deductive reasoning. Since these constructs are new, the measurement model for each construct was developed for this study. Each measure

consists of 3-items measured on a 7-point Likert scale to 95

maintain consistency throughout the questionnaire, e.g., our first measures CE awareness includes the following three items: “I have a general understanding of what the CE is”, “I understand the basic idea behind the CE”, “I have basic knowledge of what the CE is.” The six CE constructs included in the questionnaire are: CE awareness, perception of CE impacts on society, perception of CE impacts on the environment, awareness of organization’s contribution to a CE, awareness of self-contributing to CE and societal value of CE. Table 3. 5: CE Constructs and Measures CE Constructs Research Question Construct Measured Item Name Item Source Type of Data (per item) Type of Data (Construct) RQ1, RQ2, RQ3 CE awareness/familiarity CE_Fam1 CE_Fam2 CE_Fam3 I have a general understanding of what the CE is. I understand the basic idea behind the CE I have basic knowledge of what the CE is. Created for this study Created for this study Created for this study

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous RQ1, RQ2, RQ3 Knowledge of CE The CE entails all of the following (select all that you believe apply) Reuse Repair Created for this study Created for this study Created for this study Categorical Categorical (yes =1, no=0) Categorical (yes =1, no=0) Categorical Repurpose Created for this study Categorical (yes =1, no=0) Remanufacture Created for this study Categorical (yes =1, no=0) Recycle Created for this study Eliminate waste Created for this study Categorical (yes =1, no=0) RQ1, RQ2, RQ3 Perception of impacts of the CE CE_Imp1 CE_Imp2 CE_Imp3 I think the CE has the potential to bring all kinds of benefits to society. I believe society will be positively impacted by a transition to a more CE. I feel a transition to a CE will NOT have a positive impact on the world. (Reverse scored) Created for this study Created for this study Created for this study

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous RQ1, RQ2, RQ3 Perception of impacts of the CE in the environment CE_Env1 CE_Env2 CE_Env3 I think a more CE will have positive impacts on the environment. I believe the CE will reduce human impacts on the environment. I feel the CE will greatly help to protect the environment. Created for this study Created for this study Created for this study

Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7) Ordinal - Likert scale (1-7 2

) Continuous RQ1, RQ2, RQ3 Perception of organization as part of CE OrgCE1 The organization I work for uses one or more CE strategies. Created for this study Ordinal - Likert scale (1-7) Continuous OrgCE2 The organization I work at contributes to a more CE. Created for this study Ordinal - Likert scale (1-7) OrgCE3 The organization I work at is helping to advance the CE. Created for this study Ordinal - Likert scale (1-7) SelfCE1 Through my work at, I am helping advance the CE. Created for this study Ordinal - Likert scale (1-7) Continuous RQ1, RQ2, RQ3 Perception of self as part of CE SelfCE2 I am helping to create a more CE through my work. Created for this study Ordinal - Likert scale (1-7) SelfCE3 Through my work, I am contributing to a CE. Created for this study Ordinal - Likert scale (1-7) RQ1, RQ2, RQ3 Perception of societal value of CE CE_SocV1 CE_SocV2 CE_Socv3 I feel people in general think the CE is positive. I think people view CE strategies such as reuse, repair, remanufacture positively. I think most people acknowledge the benefits of the CE. Created for this study Created for this study Created for this study

Ordinal - Likert scale (1- 7) Ordinal - Likert scale (1- 7) Ordinal - Likert scale (1- 7 2

) Continuous Demographic Measurement Demographic questions were included at the beginning of the first questionnaire to have a general understanding of the sample of participants. These demographic variables enable the comparison of this sample to other studies and help reveal any siginficant differences between

the participants in the treatment **and control groups** . In **the** event that **two**	65

groups had a statistically significant difference in any of the demographic characteristics, this characteristic could be included in the regression model and tested for statistical significance. The demographic information collected in the questionnaire included information on age range, education level, gender, number of dependents, employment status, and years on the job. Table 3. 6: Questionnaire Demographics Demographics RQ Construct Measured # Item Item/ Question Text Source Type of Data (per item) Type of Data (Construct) Descriptive statistics of the sample Company What is the name of the company you work for? (Fill in the blank) Created for this study n/a Categorical Descriptive statistics of the sample Job Title What is your current job title? (Fill in the blank) Created for this study n/a Categorical Descriptive statistics of the sample Company division (only Company B) What division are you part of? Donated Goods Retail Business Services Workforce Development/Human Services/ HR Administration (including accounting, IT, marketing, facilities) Created for this study n/a Categorical Descriptive statistics of the sample Time on the Job

How long have you worked at this job? Ten years or more At least 6 years, but less than 10 years	1

Created for this study n/a Ordinal

At least 3 years, but less than 6 years At least 1 year, but less than 3 years At least 3 months, but less than 12 months At least 1 month, but less than 3 months Less than a **month**	1

Descriptive statistics of the sample Age What is your age? 18-24 25-34 35-44 45-54 55-64 Above 64 Created for this study n/a Ordinal Descriptive statistics of the sample Gender

What gender do you identify as? Male Female Non-binary/third gender Prefer not to say	73

Created for this study n/a Categorical Descriptive statistics of the sample Education Level

Indicate the highest level of education that you have completed (please check only one box): Less than a 1 **High School Diploma High School Diploma**

Undergraduate Degree Graduate Degree (Master's, PhD) Created for this study n/a Ordinal Descriptive statistics of the sample Dependents How many dependents do you have? 0 1 2 Created for this study n/a continuous 3 4 5 or more Descriptive statistics of the sample Employment Status

What is your employment status? Full-time employment Part-time employment 114

Contract/temporary Created for this study n/a Categorical 3.2.4 Video Intervention A short video was developed to introduce foundational concepts and aspects of the CE to non- experts in the treatment group. The objective was to increase CE awareness of employees in the treatment group who viewed the video; the control group did not watch the video. After the treatment, the effect of the video was measured to see whether the introduction of foundational CE information led to any observed change in

task significance , meaningfulness, **perceived social impact, and perceived social worth** 4

. Given that very little is expected to have changed within a week, and that whatever changes did occur would be present in both the control and treatment groups, by comparing the change in meaningfulness in the treatment group and control group it is possible to isolate the impact of the video on meaningfulness. Any personal situations that could affect an individual employee's experienced meaningfulness should be averaged among the groups through the randomization of the treatment. Variables and Constructs of Interest The use of the video intervention allowed for the manipulation of six different CE variables hypothesized to be relevant to an employee's experienced meaningfulness. The six variables are: (1) CE familiarity; (2) perception of the CE impacts the environment; (3) perception of the CE impacts to society; (4) contribution of self to the CE; (5) contribution of organization to the CE; and (6) societal value of the CE. The CE familiarity (Variable 1) refers to whether employees recognize and understand what the CE is. To affect this variable, the video included a basic explanation of the CE (see Appendix C slides 1 to 17). Perceptions of the impacts of the CE on society and the environment (Variables 2 and 3) measures if employees believe the CE will bring positive impacts, which was addressed in the video by explaining the potential benefits of a more CE to people and the environment (see Appendix C slides 30 to 41). The self-contribution to the CE construct (Variable 4) assesses whether employees see themselves as a contributor to the CE through their work. The organization's contribution to CE (Variable 5) refers to whether employees believe their organization contributes to the CE. To influence the variables of self and organization as part of the CE, the video explicitly gives examples of reuse and remanufacturing organizations contributing to a CE, and how employees of these organizations are contributing to the CE through their work (see Appendix C slides 18 to 21). Finally, the societal value of the CE (Variable 6)

captures whether employees feel that other people see the CE as important, and this construct was addressed in the video by explaining the importance governments and business give to the CE as a path to a more sustainable world (see Appendix C slides 42 to 44). 3.2.5 Reliability and Validity of Measurements This section discusses the importance of testing

the reliability and validity of the survey	measures using	**the study's sample**	104

rather than some external measure of validity and reliability. The methods used to test the reliability and validity of these measures are then described. Score reliability measures the precision, consistency, and repeatability of a measure (Kline, 2019). Internal consistency reliability is a specific type of reliability that refers to the consistency within the items that measure the same concept, e.g., to measure meaningfulness our study uses a total of six different items (statements). If there is a strong correlation between the six items, the measure is said to have a high internal reliability. On the other hand, if participants score 37 differently on items that measure the same construct, then there is no evidence that the measure is different from a random number. Coefficient alpha (

Cronbach's alpha), the most common	test	**of internal consistency reliability**	58

(Kline, 2019), was calculated for all our measures using the psych::alpha function in R (see Table 4.14 in Section 4.4). A correlation matrix was

used to	examine	**the convergent validity of the constructs. Convergent validity**	is observed **when**	105

two variables that are theoretically related to each other are at least moderately correlated (Kline, 2019). 3.2.6 CE Measurement Model To evaluate whether the CE measures are distinct from one another, a correlation matrix was constructed (see Table 3.7) including each of the three items used to measure each of the CE constructs e.g. to measure CE awareness/familiarity three different item measure were used: ? CE_Fam1: I have a general understanding of what the CE is. ? CE_Fam2: I understand the basic idea behind the CE ? CE_Fam3: I have basic knowledge of what the CE is Table 3.5 contains all of the CE constructs and the names given to each item within the construct, e.g. CE_Fam1. Table 3.7 contains the correlation matrix for all CE constructs. The numbers in the diagonal of the matrix encased in a black rectangle represent the intercorrelation of the items pertaining to the same construct. For the first construct, CE familiarity (CE_Fam), the intercorrelation between items ranges between 0.92 for CE_Fam2 and CE_Fam3 to 0.89 between CE_Fam1 and CE_Fam2. The correlation between CE familiarity items and the other CE constructs is 0.78 or lower, a 10-point difference between the intercorrelation among CE familiarity items themselves, indicating that CE familiarity is a separate construct, although still very correlated with the other CE constructs. With regards to CE_Imp, or the perception of the potential impacts of the CE on

society, the third item which is reverse scored (CE_Imp3R) has a very low correlation with the other two items of 0.18 and 0.15, indicating that the reverse wording of the question may have been confusing to participants, resulting in CE_Imp3R not being a good measure of perception of CE impacts construct (CE_Imp). To confirm if the reverse coding was a problem only for this item, the only other reverse scored item in the survey – i.e., complexity – was considered. The complexity items had the lowest correlation with other job characteristics, indicating there may also have been a confusion with this measure because it was reverse scored. In the case of the CE_Imp3R, the item was dropped altogether. With regards to the distinctiveness between CE impacts to society and the other constructs, the correlation between CE Impacts and CE_Env are between 0.9, 0.89, 0.87, and 0.78, indicating these may be too similar to be considered as separate constructs. Apart from OrgCE2, which has a correlation of 0.90 with CE_Imp2, the correlation values between CE_Imp and the other items are less than 0.80. The items in OrgCE have a high correlation amongst themselves of above 0.91, but they also have similar correlations with SelfCE measures, indicating these two measures may be very similar and could be combined. Lastly, CE_SocV, or societal value of CE, has correlations of 0.81 and above among items, and correlations of 0.79 with OrgCE measures, and with CE_Imp2. 38 Table 3. 7: CE Construct Items Correlation Matrix 39 To test whether combining certain measures together would improve the model, three different regression models were tested: ? Model 1: Six CE constructs were used as separate independent variables to predict task significance. These include: CE familiarity, perception of societal impacts of the CE, perception of environmental impacts of the CE (CE_Env), perception of an organization's contribution to the CE (Org_CE), perception of self-contributing to the CE (SelfCE), and perception of societal value of the CE (CE_SocV). $Rark\ Riakiaiaakaa = \alpha CCCal + \alpha CCIll + \alpha CCalv + \alpha OraCC + \alpha RakaCa + \alpha CC\_RkaV$? Model 2: The perception of the CE's impacts on society and to the environment were combined as one new term called ImpactCE. The perception of an organization's contribution to the CE and self-contribution to the CE were also combined into a new term called Contribution. The CE familiarity (CE_Fam) and perceptions of the social value of the CE (CE_SocV) were included as separate terms. In summary, model 2 regresses task significance on four CE constructs: CE familiarity, perception of the CE impacts, perception of contribution to the CE, and perception of societal value of the CE. $Rark\ Riakiaiaakaa = \alpha CCCal + \alpha IkkaarCC + \alpha Ckkrriarrikk + \alpha CCSlav$? Model 3: model combined all CE variables into one single construct, CE_All. $Rark\ riakiaiaakaa = \alpha CCAll$ Model 1, which contain the six CE constructs separately has the highest R-squared and adjusted R-squared (see Table 3.8), which suggests that each different construct does include some nuance that increases the prediction of task significance when each construct is considered separately. In model 1, three variables were statistically significant: contribution of self to the CE (SelfCE), perception of environmental impacts of the CE on the environment (CE_Env), and the societal value of the CE (CE_SocV) (see Table 3.9). The perception of environmental impacts of the CE on the environment variable has a negative relationship with task significance in this model (see Table 3.9), which is not expected theoretically. The fact that the predictors have high correlations between themselves may be affecting this relation. For model 2, perception of the societal value of the CE (CE_SocV) is the only statistically significant term (see Table 3.10). For model 3, the CE_All term, which is the average of all CE constructs put together is not statistically significant (see Table 3.11). 40 Table 3. 8: CE Constructs Model Comparison

R-squared	Adjusted R- squared	F-statistics	p-value	Model 1

: 6 factors 0.297 0.2569 7.395 1.292e-06 Model 2: 4 factors 0.2346 0.2059 8.197 8.338e-06 Model 3: 1 factor 0.1977 0.1904 27.11 9.037e-07 Table 3. 9: Regression output for Model

1 Estimate Std. Error t-stat p-value Intercept 3.3058 **0** .4706 **7** 112

.025 CE Familiarity 0.1808 0.1253 1.443 0.1520 Organization contribution to CE -0.2167 0.2281 -0.950 0.3443 Self-contribution to CE 0.5175 0.2064 2.507 0.0137* Perception of CE Impacts on society 0.1929 0.2943 0.655 0.5136 Perception of CE impacts on environment -0.6397 0.2861 -2.236 0.0274* Perception of societal value of CE 0.4115 0.1458 2.823 0.0057** Table 3. 10: Regression Output for Model 2

Estimate Std. Error t-value p-value Intercept 3 .3730 **0** 15

.5252 6.410 CE Familiarity 0.1627 0.1124 1.447 0.1508 Contribution to CE 0.1205 0.1744 0.691 0.4912 Perception of CE Impacts -0.2021 0.2290 -0.883 0.3795 Perception of societal value of CE 0.3217 0.1465 2.196 0.0303* Table 3. 11: Regression Output for Model 3

Estimate Std. Error t-value p-value Intercept 3 .23156 **0** 15

.47553 6.796 5.79e-10 CE All 0.43021 0.08263 5.206 9.04e-07

3.3 Data Analysis 3.3.1 Data Cleaning **The** first step **of the** 110

data cleaning involved eliminating all unanswered questions from the dataset—this was done for the data set used for RQ1, RQ2, and RQ3. The next step was to understand the final sample sizes that would be used for each of the tests conducted. For RQ3, the study design required within-sample comparisons, meaning that the same participant is compared before and after the treatment (video intervention). Therefore, this involved eliminating participants that did not complete both surveys or could not be matched to the previous survey. To do this, each participant was asked to create a private self-generated code that was then entered into both survey 1 and 2. To answer RQ3, response sets that indicated the same code for both the pre- and post-test surveys were used. Another data cleaning operation involved synthesizing the job titles per organization in order to understand the overall organizational structure of the sample. Since each participant manually wrote their specific job title, this involved using deductive reasoning to group similar job titles. For example, for Company A, 37 different occupation titles were registered; the variety of occupations is sometimes due to differences in typing, e.g., “uph”, “upholstery”, “upo”. The 37 different occupations were grouped into eight occupations. Top management included Directors,

the President, and Vice-Presidents. All occupations that had the word manager in the job title were grouped as Managers. The same approach was taken for Administrative and Plant worker positions. Company B respondents provided 74 different occupations. The same deductive reasoning approach was used to group them into three main categories (Top Management, Middle Management, and Other), and 14 subcategories (Top Management, Director, Associate Director, Manager, Supervisor, Assistant Manager, Coordinator, Assistant, E-commerce, Liaison, Processor, Receptionist, Retail, and Other). The actual values for each occupation are presented in Section 4.2 in Tables 4.8 and 4.9. 3.3.2 Data Analysis Methods The first step of the data analysis involved looking at

the mean, median, standard deviation, and	general distribution	**of the data**	143

collected. To do this, the R function Desc( ) from the DescTool package was used. Three core research questions are explored using three different data analysis methods. To understand the factors that are most important in explaining meaningfulness in CE jobs (RQ1), a linear regression was used that included all the variables considered relevant to explain meaningfulness from a theoretical perspective. These included all the job characteristics and meaningfulness constructs, as well as the six CE constructed developed for this study. Linear regression models have two main objectives: (1) to test a hypothesis about the relationships between an outcome variable and other independent variables of interest, and (2) to develop a forecast or prediction of an outcome variable (Cohen et al., 2003). In this study,

the purpose of the	regression model	**is to gain**	an	**understanding of the**	59

relationship between experienced meaningfulness on the job (outcome variable), and the job characteristics and CE constructs (the independent variables). Independent variables were included in the regression based on the theoretical foundation of factors that influence meaningfulness, derived from the organizational behavior literature (Grant, 2008; Hackman & Oldham, 1975; Kahn, 1990; May et al., 2004). Given that

the main	interest	**of this research is to**	understand	**the impact of**	CE constructs	**on**	16

meaningfulness, a model was run to test the relationship between the CE variables and experienced meaningfulness. A second model was then run that excluded variables with high multicollinearity. To understand the mechanisms through which a CE awareness affects the experience of meaningfulness (RQ2), mediation analysis was used, which is a type of path analysis. Mediation models are used in research to understand the process by which one variable affects another—in a mediation relation a certain variable affects the mediator which then affects the outcome variable (MacKinnon et al., 2012). A mediator variable is one that “that transmits the effect of an independent variable to a dependent variable” (MacKinnon et al., 2012, p. 2). For this study, a mediation model was used to test the hypothesis that CE awareness and perception had a

positive effect upon an employee's experienced meaningfulness on the job by influencing task significance—i.e., the impact they feel they have in the world. In other words, this research tests the extent to which task significance mediates the relationship between an awareness of the CE and experienced meaningfulness. Figure 7 represents a general mediation model. Here, path a

represents the total effect of the independent variable x on the dependent variable 86

x, without considering other variables.

Path a', represents the effect of x on x once **the** effect of the **mediator** variable **is** also considered. **The** 92

path a represents the effect of x on the mediator variable and **path** a **the effect of the mediator on the dependent variable** 31

(see Table 3.12). A full mediation occurs when path c' disappears (i.e., all

of the effect of x on y is **through the** 67

mediator variable). A partial mediation occurs when a significant portion of

the effect of x on x **is through** the **mediator variable** (axa). A) x 57

a B) a Mediator variable (Me) a x a' x x Figure 7: General Mediation Model Table 3. 12: Explanation of General Mediation Model Path Description of Effect

Path c Total effect of x on y Path c' Direct effect of x on y when considering **the effect of the** 8

mediator variable on y Path a First stage

effect of x on mediator variable **Path b** Second stage **effect of mediator on** 31

y Three regression equations are used to represent the

mediation analysis. The relationship between the independent variable (X) and the **dependent variable (Y** 51

) is tested using Eq. 1, where

the dependent variable (Y) **is** experienced meaningfulness **on the** job, **and the independent variable** (X) **is** 38

CE awareness and perception, a

is the total effect of x on x, and a **is the** residual variance. X 11

= i1 + aX + a1 Eq. 1

The relationship between the independent variable (X) and the mediator variable (**M** 7

) is tested using Eq. 2, where the mediator variable (M) being tested is task significance,

a represents the effect of x on x, **and** a is **the** residual variance. M 115

= i2 + aX + a2 Eq.2 Finally, the combined relationships of

the independent variable (X), the dependent variable (Y), and the mediator variable (M), are 81

tested using Eq.3, where a' is

the direct effect of x on x when considering **the effect of** the mediator **M on x** which **is** 84

represented by a. X = i3 + a'X + aM + a3 Eq. 3 In Eq. 3, both CE awareness and perception

and task significance are included as **predictors of experienced meaningfulness** , where each predictor **is a** 121

partial regression coefficient (MacKinnon et al., 2012), meaning that each coefficient represents

the effect of that predictor on the dependent variable when **controlling for the** other predictor. **The** 7

indirect effect of CE All on meaningfulness was calculated by taking

the difference between the total effect , a, **and the** indirect **effect** , a', **and** by multiplying **a** $*$ a. To test **the** statistical significance **of** 31

the mediation effect, the Sobel's test was used: a×a(lr a−a') raa = $SCaa$ Eq. 4 The variable $RCaa$ represents the pooled standard error and is calculated using the following formula: $RCaa$ = √a2ra2 + a2ra2 Eq. 5 Where ra2 is the variance of path a, and ra2 is the variance of path b. The variance was calculated by squaring the standard error provided in the regression output (see Table 4.16). The calculation performed was as follows: $RCaa$ = √0.742 $*$ 0.082 + 0.442 $*$ 0.062 = 0.067 Eq. 6 raa = a×a(lr a−a') 0.32 = 4.77 $SCaa$ = Eq. 7 0.067 The choice of task significance as a mediator variable was done based on deductive reasoning— i.e., that employees who have a better understand of the CE will be able to better understand the impact they have in the world and in turn find their jobs more meaningful. To assess whether an increase in an employee's awareness of CE would have a significant effect on that employee's experienced meaningfulness, a quasi-experimental research design was developed (see Section 3.1). This research design involves measuring employees' CE measures of awareness and perception, as well as meaningfulness,

using a pre-test survey **and** a **post-test** survey. Interpretation of **the results** 172

involved three main steps: (1) Compare the pretest scores of the treatment and control groups by main variables of interest using a t-test to test the effectiveness of participant randomization. An insignificance t-test indicates the two groups are statistically equal (and therefore comparable). (2) Test the effect of the video on the treatment and control group, separately, to determine if there was a change in meaningfulness and CE variable responses in each group, before and after the video intervention. (3) Test the effect of the video by looking at both treatment and control groups together. Here the effect of video on the responses of the control group are subtracted from the effect of video on the responses of the treatment group, thereby leaving the net effect of the video on the treatment group. To calculate the effect size, the following formula was used to calculate Cohen's D: $(Okrrvirhviaal - Oravirhviaal) - (Okrrllviaal - Orallviaal)/RCOkkkaa$ The pooled standard deviation was calculated used the following formula: $RCllllaa$ = $\sqrt{(ltraatlalt-1l)tSrCata2rtalaatllta+llt+al(lltarllllt-r2ll-1)SCa2lltrll}$ Eq. 8 The formula of independent samples t-test was used to calculate the t-statistics and corresponding p-value: $r - rrarirriar$ = $(Plrrvith\ viaal - Pravith\ vSiaDalll)l-la(aPlrrll\ viaal - Prall\ viaal)$ Eq. 9 $\sqrt{ltraatlalt+}\ lalltrll$ 4. Results 4.1 Overview

This section first **describes the characteristics of the** sample collected **in** both **the**	69

pre- and post- test surveys and explains the sample size used to respond to each research question. Then, the demographics

of the sample **are discussed, followed by descriptive statistics** of **the** data collected. Lastly, **the**	36

results pertaining to the research questions are addressed. 4.2 Sample and Demographics The sample consisted of employees from two different CE companies in the US. Since two surveys were conducted before and after the video intervention, there is more than one sample size for each survey. Table 4.1 provides

an overview of the sample size used **to answer** each **research question** and reflects **the**	35

combined data from the two CE companies. The data analysis conducted to respond to RQ1 and RQ2 uses only responses from the pre-test (survey 1), and the final sample size (n) after eliminating incomplete responses was 111 participants. The analysis undertaken to address RQ3 assessed the change in experienced meaningfulness and CE awareness before and after the video intervention. Therefore, it required analyzing a sample that consisted only of participants who completed both

the pre-test (survey 1) and post-test (survey 2 33

), and where those participants successfully input their self-generated code to enable the connection of pre- and post-test responses. The sample size to respond to RQ3 was not equally divided between treatment and control groups, since the response rate was lower for participants receiving the video (see Table 4.3). The final participant sample size (n) was 21

for the treatment group, and 36 **for the control group** . As shown **in** 61

Table 4.2, the completion rate of the survey was higher for survey 1 (71%) than for survey 2 (56%) across all groups. In addition, the completion rate in survey 2 for both companies decreased for participants that received the video intervention. For Company A, the completion rate in the treatment group (with the video) was 46%, while the completion rate in the control group (without the video) was 68%. For Company B, the completion rate

for the treatment group was 38%, **and for the control group** 61

it was 66%. Table 4.1: Sample Size Overview Reflecting Combined Responses from Company A and B Research Questions RQ1 RQ2 RQ3 Sample All completed responses for pre-test All completed responses for pre-test All responses that completed both pre-test and post-test Test Regression Analysis Mediation Analysis Cohen's D t-test Sample Size (n) n = 111 n = 111 n treatment group = 21 n control group = 36 Table 4.2: Response Rate Pre-test Company A Company B Total Started Pre-test 54 Completed Pre-test 37 Pre-test Completion Rate 69% 102 74 73% 156 111 71% Table 4.3: Response Rate Post-test Company A Company B Total

Treatment group - started **post-test Control group** - started **post-test** Total started **Treatment Group** 27

- Completed post-test Control Group - Completed post-test Total completed Completion Rate Treatment Group Post-test Completion Rate Control Group Post-test 28 34 28 58 56 92 13 13 19 38 32 51 46% 38% 68% 66% 62 86 148 26 57 83 42% 66% Table 4.4:

Sample Size for **Participants who completed** both **the Pre-test and Post-test** 49

Treatment group (with video) Treatment Company A Treatment Company B Control group (w/out video) Control Company A Control Company B Total Sample (Treatment + Control) 21 12 9 36 15 21 57 The survey 1 sample consisted mostly of people above the age of 34 (76% of the sample) and had a slightly higher proportion of females (60%) than males and other genders (see Table 4.1). The sample has education levels similar to those of the average US population: only 6% of the sample had less than a high school diploma (8.9% of the population did not graduate from high school). A large proportion of the sample (42%) have an undergraduate degree or a more advanced degree, while 37.9% of the US population have an undergraduate degree or higher. With regards to dependents, slightly above half of participants (53%) reported having no dependents. Almost all participants (97%) were full-time employees and a high percentage had been in their job for a long time: 37% have been in their job for ten years or more, and 11% had at least six years, but less than 10. Table 4.5: Demographics Variables n n/a Frequency % Company A B

Age 18 -24 **25-34 35-44 45-54 55-64** Above 64 **Education Less than** a **High School** 29
Diploma **High School**

Diploma Undergraduate Degree Graduate Degree (Master's, PhD)

Gender Male Female Non-binary/third gender Prefer not to say 39

Dependents 0 1 2 3 4 5 or more **Employment Status Full-time** employment **Part-time** 34

employment Contract/temporary Year on the job

Ten years or more At least 6 years, but less than 10 years At least 3 years, but less than 6 years At least 1 1
year, but less than 3 years At least 3 months, but less than 12 months At least 1 month, but less than 3 months Less than a **month**

111 111 111 110 111 111 111 0 37 74 0 7 9 19 30 37 9 0 7 58 42 4 1 41 67 1 1 0 59 22 13 9 7 1 0 108 3 0 41 12 17 33 5 3 0 33% 67% 6% 8% 17% 27% 33% 8% 6% 52% 38% 4% 37% 60% 1% 1% 53% 20% 12% 8% 6% 1% 97% 3% 0% 37% 11% 15% 30% 5% 3% 0% Table 4.6: Company A Demographics Variables n n/a Frequency %

Age 18 -24 **25-34 35-44 45-54 55-64** Above 64 **Education Less than** a **High School** 29

Diploma **High School**

Diploma Undergraduate Degree Graduate Degree (Master's, PhD)

Gender Male Female Non-binary/third gender Prefer not to say 39

Dependents 0 1 2 3 4 5 or more **Employment Status Full-time** employment **Part-time** 34

employment Contract/temporary Year on the job

Ten years or more At least 6 years, but less than 10 years At least 3 years, but less than 6 years At least 1 1
year, but less than 3 years At least 3 months, but less than 12 months At least 1 month, but less than 3 months Less than a **month**

37 37 36 37 37 37 0 3 3 6 18 7 0 2 15 19 1 1 24 12 0 0 0 18 8 4 4 3 0 36 1 0 29 1 3 3 1 0 0 8% 8% 16% 49% 19% 5% 41% 51% 3% 67% 33% 0% 0% 49% 22% 11% 11% 8% 97% 3% 78% 3% 8% 8% 3% 0% 0% Table 4.7: Company B Demographics Variables n n/a Frequency %

Age 18 -24 **25-34 35-44 45-54 55-64** Above 64 **Education Less than** a **High School** 29
Diploma **High School**

Diploma Undergraduate Degree Graduate Degree (Master's, PhD)

Gender Male Female Non-binary/third gender Prefer not to say 39

Dependents 0 1 2 3 4 5 or more **Employment Status Full-time** employment **Part-time** 34

employment Contract/temporary Year on the job

Ten years or more At least 6 years, but less than 10 years At least 3 years, but less than 6 years At least 1 1 **year, but less than 3 years At least 3 months, but less than 12 months At least 1 month, but less than 3 months Less than** a **month**

74 0 74 0 74 0 74 0 74 0 74 0 7 6 16 24 19 2 5 43 23 3 17 55 1 1 41 14 9 5 4 1 72 2 0 12 11 14 30 4 0 3 9% 8% 22% 32% 26% 3% 7% 58% 31% 4% 23% 74% 1% 1% 55% 19% 12% 7% 5% 1% 97% 3% 0% 16% 15% 19% 41% 5% 0% 4% With regards to the occupational structure, a high proportion of respondents (41% in Company A and 70% in Company B) held some form of management position (Tables 4.8 and 4.9, respectively). For Company A, plant workers made up the next largest category (24%) followed by Designers (14%) (see Table 4.9). For Company B, Top Management, which included CEOs, directors, and associate directors, was 19% of the sample, and middle management was 51% (see Table 4.9). Table 4.8: Company A Survey 1 Participants by Job Title Job Title Top Management Manager Administrative Designer Mechanic Plant worker Other Total Frequency % of Total 4 11% 11 30% 4 11% 5 14% 1 3% 9 24% 3 8% 37 100% Table 4.9: Company B Survey 1 Participants by Job Title Job Title Frequency % of Total Top Management Top Management Director Associate Director Middle Management Manager Supervisor Assistant Manager Coordinator Other Assistant E-commerce Liaison Other Processor Receptionist Retail Total 14 19% 2 3% 6 8% 6 8% 38 51% 18 24% 8 11% 8 11% 4 5% 22 30% 1 1% 5 7% 1 1% 9 12% 4 5% 1 1% 1 1% 74 100% 4.3 Descriptive Statistics Table 4.6. and 4.7 show the mean, median, standard deviation, lowest, 25th, 50th, 75th, and highest values for the constructs measured in survey 1, separated by treatment and control groups. All the variables measured had a mean of above 4.5 on a 7-point Likert scale, indicating that, on average, the sampled population had strong agreement with job characteristics, high experienced meaningfulness, and high CE knowledge and perception. The treatment group had a mean of 5.8 on experienced meaningfulness, and a 25th percentile of 5.5, indicating that most of the sample scored high on the dependent variable (experienced meaningfulness) in the treatment group. The average experienced meaningfulness was even higher for the control group (6.0) and the 25th percentile (5.9). CE familiarity which measures an employee's familiarity with the concept of the CE, was also high for both treatment (5.7) and control (5.3) groups. CE perception measures were also high for both groups, indicating that the respondents already had a good perception of the potential impacts a transition to a CE could have on people and the environment. Summary statistics for both treatment and control group combined in the pre-test are presented in Table 4.8, and for the post-test in Table 4.9. The data represented in Table 4.8 was used to respond to RQ1 and RQ2 (n=111), where participants who only participated in the pre-test are considered. For Table 4.6 and 4.8, only participants

who completed both the pre-test and the **post-test** are **included** 117

. Table 4.6: Treatment Group Survey 1 Summary Statistics for Combined Companies A and B Variables n 1 Autonomy IV 21 2 Task Identity IV 21 3 Task Significance IV 21 4 Feedback from the Job IV 21 5 Complexity IV 21 6 Problem Solving IV 21 7 Skill Variety IV 21 8 Specialization IV 21 9 Co-worker relations IV 21 10 Supervisor Relations IV 21 11 Worker-role fit IV 21 12 Perceived Social Impact IV 21 13 Perceived Social Worth IV 21 14 Experienced Meaningfulness DV 21 15 CE Familiarity IV

21 Perceived Impact of CE to 16 Society IV 21 Perceived Impact of CE to the 17 Environment IV 21 18 Self-contribution to CE IV 21 19 Organization contribution to CE IV 21 Mean 5.8 5.2 5.5 4.9 5.3 5.2 5.8 5.0 5.1 5.2 5.3 5.7 5.0 5.8 5.7 5.9 5.9 5.5 5.7 20 Perceived social worth of CE IV 21 5.5 Note: IV = Independent Variable, DV = Dependent Variable. SD Min. 1.2 2.7 1.2 3.0 1.3 2.0 1.4 2.3 1.3 2.0 1.4 2.7 1.3 2.0 1.1 2.0 1.6 2.0 1.3 3.0 1.4 2.0 1.2 2.7 1.4 2.3 1.2 2.0 1.5 1.7 1.5 1.5 1.6 1.3 1.5 2.3 1.7 1.3 1.5 2.3 25th 50th 5.7 6.0 4.3 5.3 5.0 5.8 3.7 5.3 5.0 5.3 4.7 5.7 5.0 6.0 4.7 5.0 4.0 5.7 4.3 5.3 4.3 5.7 5.3 6.0 3.7 5.3 5.5 6.0 5.3 6.0 5.5 6.5 5.7 6.7 4.0 6.0 4.0 6.3 4.0 6.0 75th 6.7 6.0 6.0 6.0 6.3 6.0 7.0 5.3 6.0 6.3 6.3 6.3 6.0 6.7 7.0 7.0 7.0 7.0 7.0 7.0 Max 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 Table 4.7: Control Group Survey 1 Summary Statistics for Combined Companies A and B

Variables n Mean SD Min. 25th 50th 75th Max 165

1 Autonomy IV 36 5.8 1.0 3.3 5.3 5.7 6.7 7.0 2 Task Identity IV 36 5.4 1.4 2.3 4.6 5.7 6.7 7.0 3 Task Significance IV 36 5.6 1.2 2.8 4.8 6.0 6.3 7.0 4 Feedback from the Job IV 36 5.3 1.3 1.7 4.7 5.5 6.0 7.0 5 Complexity IV 36 4.5 1.5 1.0 3.3 4.8 5.7 7.0 6 Problem Solving IV 36 5.5 1.1 3.0 4.9 5.3 6.4 7.0 7 Skill Variety IV 36 5.9 0.9 3.3 5.3 6.0 6.7 7.0 8 Specialization IV 36 5.2 1.2 2.3 4.6 5.3 6.0 7.0 9 Co-worker relations IV 36 5.7 1.1 2.0 5.0 6.0 6.4 7.0 10 Supervisor Relations IV 36 5.9 1.2 3.3 4.7 6.3 7.0 7.0 11 Worker-role fit IV 36 5.4 1.4 1.3 4.8 6.0 6.3 7.0 12 Perceived Social Impact IV 36 5.8 1.0 3.0 5.3 6.0 6.7 7.0 13 Perceived Social Worth IV 36 5.4 1.1 3.3 4.6 5.3 6.2 7.0 14 Experienced Meaningfulness DV 36 6.0 1.2 2.2 5.8 6.3 7.0 7.0 15 CE Familiarity IV 36 5.3 1.6 1.0 4.3 6.0 6.7 7.0 16 Perceived Impact of CE to Society IV 36 5.7 1.3 2.5 5.0 6.0 7.0 7.0 Perceived Impact of CE to the 17 Environment IV 36 5.7 1.3 2.0 4.9 6.0 7.0 7.0 18 Self-contribution to CE IV 36 5.5 1.3 2.3 4.3 6.0 7.0 7.0 19 Organization contribution to CE IV 36 5.6 1.4 2.3 4.3 6.0 7.0 7.0 20 Perceived social worth of CE IV 36 5.4 1.3 2.3 4.6 5.7 6.3 7.0

Note: IV = Independent Variable, DV = Dependent Variable. Table 4 62

.8: Survey 1 Summary Statistics for Combined Companies A and B, Including Treatment and Control Groups (n=111) Variables

1 Autonomy 2 Task Identity **3** Task **Significance 4 Feedback from the Job** 6

5 Complexity 6 Problem Solving 7 Skill Variety 8 Specialization 9 Co-worker relations 10 Supervisor Relations 11 Worker-role fit 12 Perceived Social Impact 13 Perceived Social Worth 14 Experienced Meaningfulness 15 CE Familiarity 16 Perceived Impact of CE to Society Perceived Impact of CE to the

IV IV IV IV IV IV IV **IV IV IV IV IV IV DV IV IV**

75

n 111 111 111 111 111 111 111 111 111 111 111 111 111 111 111 111 17 Environment IV 111 18 Self-contribution to CE IV 111 19 Organization contribution to CE IV 111 20 Perceived social worth of CE IV Mean SD 5.9 1.2 5.3 1.5 5.6 1.3 5.3 1.5 4.6 1.6 5.5 1.1 5.9 1.2 5.2 1.3 5.6 1.3 5.6 1.4 5.5 1.4 5.9 1.2 5.3 1.4 6.0 1.3 5.5 1.6 5.7 1.4 5.7 1.3 5.6 1.4 5.7 1.5 111 5.5 Min. 25th 1.0 5.7 1.0 4.3 1.0 4.8 1.0 4.5 1.0 3.3 2.7 5.0 1.0 5.3 1.0 4.7 1.0 5.0 1.0 4.7 1.0 4.3 1.0 5.3 1.0 4.3 1.0 5.7 1.0 4.3 1.5 5.0 1.3 5.0 1.0 4.7 1.0 4.7 1.4 1.0 50th 75th 6.0 6.7 5.7 6.7 6.0 6.8 5.7 6.3 5.0 5.7 5.7 6.3 6.0 7.0 5.3 6.3 6.0 6.7 6.0 7.0 6.0 6.3 6.0 7.0 5.7 6.7 6.5 7.0 6.0 7.0 6.0 7.0 6.0 7.0 6.0 7.0 6.0 7.0 4.2 6.0 Max 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 6.8 7.0

Note: IV = Independent Variable, DV = Dependent Variable. Table 4.9: Survey **2 Summary** 62

Statistics for Combined Companies A and B, Including Treatment and Control Groups

Variable n Mean SD Min. 25th 50th 75th Max 161

1 Task Significance 77 5.4 1.3 2.0 4.3 5.3 6.5 7.0 2 Perceived Social Impact 77 5.6 1.2 2.3 4.7 5.7 6.7 7.0 3 Perceived Social Worth 77 5.2 1.4 1.0 4.3 5.7 6.0 7.0 4 Experienced Meaningfulness 77 5.8 1.3 1.7 5.0 6.0 6.8 7.0 5 CE Familiarity 77 5.7 1.4 1.0 5.0 6.0 7.0 7.0 6 CE Impacts to Society 77 6.0 1.1 3.0 5.5 6.0 7.0 7.0 7 CE Impacts to Environment 77 6.0 1.1 2.3 5.7 6.0 7.0 7.0 8 Self-contribution to CE 77 5.6 1.4 2.0 4.7 6.0 7.0 7.0 9 Organization contribution to CE 77 5.9 1.3 2.0 5.0 6.0 7.0 7.0 10 Perceived social worth of CE 77 5.6 1.2 2.3 5.0 5.7 6.7 7.0 Note: Table also includes responses to Survey 2 that could not be matched to Survey 1 (eliminated from the final sample used in RQ3). 4.4 Reliability and Validity of Measures

The reliability of the measures is reported in parenthesis in **Table** 65

4.10, using measures of raw alpha or Cronbach alpha. All constructs, except problem solving, have a raw alpha of above 0.76, indicating a high internal consistency reliability. The reliability for the CE constructs created for this study are all above 0.93. Convergent validity of the measures is assessed with an intercorrelation matrix (see Table 4.10). The intercorrelations of meaningfulness and all non-CE variables—except complexity—are 0.48 or above, indicated convergent validity. Worker role-fit and perceived social impact have the highest correlation with meaningfulness (0.85), followed by task significance (0.80). Meaningfulness has correlations between 0.36 and 0.47 with CE constructs, having the highest correlation with the societal value of CE. The mediator variable, task significance, also has moderate correlations of above 0.5 with all job characteristics and relational characteristics. Table 4.10: Intercorrelations and Reliability of Measures Notes: Reliability coefficient in parenthesis. n=124. 56 4.4 Research Question 1: Experienced Meaningfulness in CE Jobs A regression analysis was used to understand which factors are important to explain the extent to which workers performing CE jobs in CE

companies experienced meaningfulness (RQ1). In Model 1, all variables collected were included as independent variables and experienced meaningfulness was the dependent variable. To test for problems of

multicollinearity, the variance inflation factor (VIF) was calculated for 142

Model 1 using R software (see Table 4.11). Variables with VIF factors higher than 5 are highly correlated. Table 4.11: Regression Results for Model 1 Estimate s.e. P-value VIF (Intercept)

Autonomy Task Identity **Task Significance Feedback from** the **Job Complexity Problem Solving Skill Variety Specialization** 6

Co-Worker Relations Supervisor Relations Worker Role Fit Perceived Social Impact Perceived Social Worth CE Familiarity CE Impact to Society CE Impact to Environment Self-Contribution to CE Org. contribution to CE Societal Value of CE

R^2 Adj. R^2 -0 .05 **0** .30 **0** .04 **0.07 -0** .02 **0** .04 **0** .07 **0** 82

.07 -0.04 0.06 0.01 0.04 0.03 0.06 0.03 0.07 -0.08 0.05 -0.10 0.06 0.12 0.05 0.43 0.06 0.62 0.10 -0.13 0.07 -0.00 0.05 -0.02 0.13 0.14 0.13 -0.13 0.09 0.03 0.10 0.05 0.06 0.90 0.88 0.8602 0.5190 0.6196 0.3510 0.4589 0.8108 0.6261 0.6545 0.1064 0.1173 0.0254 * < 0.001 *** < 0.001 *** 0.0528 0.9894 0.8959 0.2887 0.1502 0.7933 0.4028 3.7 2.3 5 4.4 1.8 2.2 3.3 2.2 3.9 3.2 3.5 6.7 5.2 4.3 17.8 17.1 8.6 11 4.7 *

Statistically significant <0.1 ** Statistically significant <0.05 * Statistically significant <0.01** 47

CE variables had moderate to very high correlations, therefore, to correct for this the CE variables were combined into one term by averaging all CE measures into a new variable, CE_All, for regression Model 2. Perceived social impact and perceived social worth also has high VIF factors (6.7 and 5.2) therefore these terms were excluded from the regression Model 2 (see Table 4.12). In Model 2, autonomy, task significance, and worker role fit were statistically significant at α = 0.05, and CE All was found to be significant at α = 0.1. Some terms that were expected to lead to an increase in meaningfulness have a negative co-efficient and this is most probably due to still having variables in the equation that measure very similar things. 57 Table 4.12: Regression Results for Model 2 Estimate s.e. p-value VIF Autonomy Task Identity Task Significance Feedback Complexity Problem Solving Skill Variety Specialization Coworker Relation Supervisor Relations Fit CE All $R2$ Adjusted $R2$ F-statistic 0.20 0.07 -0.03 0.05 0.33 0.07 -0.10 0.07 0.01 0.04 0.02 0.07 0.02 0.08 -0.04 0.06 -0.04 0.07 0.07 0.06 0.48 0.07 0.09 0.05 0.0056 0.5120 0.0000 0.1478 0.7425 0.8064 0.7788 0.5112 0.5521 0.2483 0.0000 0.0756 0.8377 0.818 42.57 ** **

** * 2.96 2.21 2.77 3.67 1.66 2.15 2.99 1.99 2.96 2.80 3.30 1.58 * Statistically significant <0.1 ** Statistically significant <0.05

4.5 Research Question 2: The Role of Task Significance as a Mediator

Table 4 .13 **summarizes the results of the** mediation **analysis** conducted to assess **the** 171

extent to which task significance mediates the relationship between circular economy awareness and perception and meaningfulness. Figure 8 is a graphical representation of the mediation analysis and includes the values for

the total effect (path c), the **direct effect (path c') and** values for **path** "a" **and** "b". 89 **The**

indirect effect of circular economy on meaningfulness is calculated by adding path a and b or subtracting c' from c. The indirect effect of circular economy on meaningfulness was found 0.32, meaning that a large part of the total effect of circular economy on meaningfulness (path c = 0.41) is mediated by task significance. The direct effect of circular economy on meaningfulness (c') is very small (0.09) and insignificant (p=0.146). The direct effect (c') represents the effect of circular economy on meaningfulness when the effect of task significance on meaningfulness is also considered. Lastly, the indirect mediation was found to be statistically significant (p-value < 0.0001), supporting our hypothesis that task significance mediates the relationship between circular economy awareness and perception and meaningfulness. A) CE All Meaningfulness a = 0.41 B) a = 0.44 Task Significance a = 0.74 CE All a' = 0.09 Meaningfulness Figure 7: Path Diagram for Task Significance as aaM'ediator of CE Table 4.13: Mediation

Analysis Results Estimate Std. Error t-value p-value 167

Total effect

First stage effect Second stage effect Direct effect Indirect effect 136

CE_All ? Meaningfulness path c 0.41 CE_All ? Task significance path a 0.44 Task significance ? Meaningfulness path b 0.74 CE_All ? Meaningfulness path c' 0.09 $a - a'$, or $a + a$ 0.32 0.08 0.08 0.06 0.06 0.067 4.97 5.174 11.82 1.465 4.77 <0.00001 <0.00001 <0.00001 0.146 <0.00001 4.6 Research Question 3: The Effect of CE Awareness on Experienced Meaningfulness Before determining if increasing CE awareness has an effect upon the meaningfulness experienced by workers performing CE jobs, the treatment and control groups were checked to ensure there was no statistically significant difference between

them (see Section 4.6.1). Section 4.6.2 then explores the impact of the video intervention on the treatment and control groups separately. Lastly, Section 4.6.3 analyzes the combined effect of the intervention by testing if the changes observed

between the pre-test and post-test were statistically different **for the** treatment **and control groups** 97

. 4.6.1 Randomization Check Randomization was used to generate two similar participant groups (treatment and control) prior to the intervention. The two group's

pre-test scores were compared using independent samples t- test 127

for all collected variables (see Table 4.14).

No statistically significant differences were **observed between the two groups** at the α = **0.05** level, indicating that **the** 22

randomization was effective and the two groups were similar to each other. The variable that had the largest difference between groups was supervisor relations, which was 0.66 points higher in the no video group (t = -1.96 / p = 0.55). Table 4.14: Pre-test

Comparison of Treatment and Control Groups Treatment Group Control Group 130

Variable Mean sd Mean sd t-test

Autonomy Task Identity **Task Significance Feedback from** the **Job Complexity Problem Solving Skill Variety Specialization** 6

Co-worker Relations Supervisor Relations Worker Role Fit Perceived Social Impact Perceived Social Worth Meaningfulness CE Familiarity CE Impact on Society CE Impact on Environment Self-Contribution to CE Org. contribution to CE Societal Value of CE 5.83 1.20 5.22 1.19 5.45 1.30 4.90 1.43 5.34 1.26 5.19 1.37 5.76 1.33 4.95 1.13 5.06 1.62 5.21 1.26 5.30 1.42 5.68 1.21 5.02 1.44 5.83 1.24 5.71 1.49 5.90 1.51 5.87 1.55 5.51 1.54 5.70 1.69 5.49 1.51 5.83 0.95 5.42 1.44 5.56 1.18 5.26 1.29 4.49 1.51 5.53 1.06 5.94 0.94 5.22 1.17 5.69 1.13 5.87 1.19 5.43 1.43 5.84 0.99 5.39 1.12 6.03 1.21 5.31 1.64 5.69 1.31 5.69 1.25

5.54 1.34 5.64 1.38 5.41 1.29 -0.03 -0.55 -0.30 -0.94 2.28 -0.97 -0.53 -0.86 -1.55 -1.96 -0.32 -0.51 -1.02 -0.61 0.94 0.53 0.45 -0.07 0.14 0.21 4.6.2 Intervention Effect After confirming the randomization process was effective, the effectiveness of the video in both treatment and control groups was tested. To assess whether increased CE awareness, via the treatment video, had an impact on experienced meaningfulness,

there needs to be a statistically **significant increase in** meaningfulness in **the** 138

treatment

group. Table 4 .15 **shows the** results **for each group** , along with **a** 72

two-sided t-test and corresponding p-value for each variable.

In the treatment group , meaningfulness **was** maintained, and **in the control group** it decreased. **The** decrease in **the** 53

control group

was statistically significant at α = **0.05** (p=0.01). **The** control **group also** experienced **a** 55

decrease in task significance (-0.38), perceived social impact (-0.35), and perceived social worth (-0.13). The treatment group had an increase in task significance (0.16 points on 7-point Likert scale) and perceived social worth (0.10). With regards to CE variables, most variables had a statistically significant increase in the post- test at α = 0.05: perception of the CE impact on society (d = 0.5, p = 0.04), perception of the CE impact on the environment (d = 0,54, p = 0.02), perception of an organization's contribution to the CE (d = 0.54, p =. 0.03), and perception of the societal value of the CE (d = 0.49, p = 0.03). In contrast, CE familiarity (p = 0.07) and perception of self-contribution to the CE (p = 0.08) were only significant at α = 0.1. In summary, at α = 0.1, the treatment group (with-video) had a significant increase in all CE measures. In the no-video group, only CE familiarity (p = 0.9) and perception of the CE impact on society (p = 0.09) had a statistically significant increase at the level of alpha 0.1. Table 4.15: Mean Difference, Paired Sample T-test by Intervention Condition Treatment Control Variables d (

μ) sd t-stat . p-value d (**μ) sd t-stat** . Task Significance **0** 147

.16 0.81 0.90 0.38 -0.38 0.99 -2.30 Perceived Social Impact -0.10 0.79 -0.55 0.59 -0.35 0.55 -3.83 Perceived Social Worth 0.10 0.82 0.53 0.60 -0.13 0.72 -1.08 Experienced Meaningfulness 0.00 0.51 0.00 1.00 -0.31 0.68 -2.68 CE Familiarity 0.46 1.09 1.93 0.07* 0.30 1.03 1.73 CE Impact on Society 0.50 1.05 2.18 0.04 ** 0.17 0.92 1.09 CE Impact on Environment 0.54 1.01 2.44 0.02 ** 0.07 1.04 0.43 Self-contribution to CE 0.43 1.06 1.85 0.08* 0.04 0.81 0.28 Org. contribution to CE 0.54 1.07 2.32 0.03** 0.17 0.96 1.04 Societal Value of CE 0.49 1.00 2.25 0.04 ** 0.17 1.08 0.92 CE_All 0.49 0.95 2.38 0.03 ** 0.15 0.76 1.18 p-value 0.03** 0.00** 0.29 0.01** 0.09* 0.09* 0.67 0.78 0.31 0.36 0.25 *

Statistically significant <0.1, ** Statistically significant <0.05, * Statistically significant <0.01** 47

4.6.3 Effect of the Intervention in Treatment vs. Control group RQ3 asks if increasing CE awareness and perception leads to greater experienced meaningfulness in CE jobs. Even though the intervention was not successful in increasing experienced meaningfulness within the treatment group (see Section 4.6.2, Table 4.15), this study tested if there were statistically significant differences in the changes that were noted

before and after the intervention video **between the treatment and control** 53

groups for all variables of interest.

An independent samples t-test was used **to compare the** effect of **the** intervention **on the** 98

treatment group against the control group (see Table 4.16). The between-subjects difference was calculated using the following formula: $(Okrrvirhviaal - Oravirhviaal) - (Okrrllviaal - Orallviaal)$ All CE variables, except CE awareness, presented

a statistically significant difference between the treatment **and control group (p < 0.05** 23

). CE workers' mean perception of the CE impact on society increased 0.33 points more

in the treatment group than in the control group (p=0	113

.02), workers' mean perception of environmental benefits of the CE increased by 0.47 points more in the treatment than control group (p=0.00), workers' perception of self as part of the CE increased by 0.39 points more in the treatment group (p=0.01), workers' perception of their organization's contribution to the CE increased by 0.39 more points in the treatment group (p=0.01), and workers' mean perception of the societal value of CE increased by 0.33 points (p=0.03). As described in the previous section, CE awareness increases substantially in

both the treatment and control groups , therefore **the** effect **of the**	40

video is not statistically significant for CE awareness. A statistically significant

difference was also **found between the** treatment **and control groups with** regards **to**	24

task significance (p=0.00), perceived social impact (p=0.04), and experienced meaningfulness (p=0.03).

It is important to note, that though a statistically **significant difference between** treatment **and**	118

control groups was found in these variables, the treatment group did not experience a mean increase in perceived social impact and meaningfulness, rather the control group experienced a substantial decrease, resulting in a statistically

significant difference between the two groups . Therefore, **the results** show **that**	22

the video intervention may have prevented a decrease in reported task significance and meaningfulness in the treatment group, rather than the hypothesized increase. Table 4.16: Comparing Treatment and Control Group Effects Variables With Video No Video Comparison of Treatment and Control Groups Pre Post Pre Post Pooled Cohen's (μ) (μ) (μ) (μ) Diff. SD D t-test p-value Task Significance 5.45 5.61 5.56 5.18 0.54 1.23 0.44 3.29 0.00 sd. 1.30 1.18 1.18 1.32 n 21 21 36 36 Perceived Social Impact 5.68 5.59 5.84 5.49 0.26 1.08 0.24 1.80 0.04 sd. 1.21 1.35 0.99 1.17 n 21 21.00 36 36 Perceived Social Worth 5.02 5.11 5.39 5.26 0.22 1.25 0.18 1.36 0.09 sd. 1.44 1.41 1.12 1.18 n 21 21 36 36 Exp. Meaning (DV1) 5.83 5.83 6.03 5.73 0.31 1.22 0.25 1.89 0.03 sd. 1.24 1.19 1.21 1.29 n 21 21 36 36 CE Awareness 5.71 6.17 5.31 5.61 0.16 1.59 0.10 0.78 0.22

sd. 1.49 1.16 1.64 1.32 n 21 21 36 36.00 CE Impact on Society 5.90 6.40 5.69 5.86 0.33 1.23 0.27 2.05 0.02 sd. 1.28 0.96 1.31 1.20 n 21 21 36 36 CE Environment 5.87 6.41 5.69 5.77 0.47 1.23 0.38 2.86 0.00 sd. 1.55 1.09 1.25 1.23 n 21 21 36 36.00 Self as part of CE 5.51 5.94 5.54 5.57 0.39 1.23 0.32 2.40 0.01 sd. 1.54 1.34 1.34 1.41 n 21 21 36 36 Org as part of CE 5.70 6.24 5.64 5.81 0.37 1.23 0.30 2.29 0.01 sd. 1.69 1.18 1.38 1.27 n 21 21 36 36.00 Societal Value of CE 5.49 5.98 5.41 5.57 0.33 1.23 0.26 2.00 0.03 sd. 1.51 1.20 1.29 1.18 n 21 21 36 36 5. Discussion

The CE is seen as a new economic **paradigm that** 155

may enable more sustainable forms of development. Sustainable development involves “enhancing human well-being to more equitably meet the needs of both current and future generations” (Clark & Harley, 2020, p. 333). From the eudemonic perspective, well-being involves the realization of human potentials and living a purposeful life, rather than simply having more positive than negative effects. The broad objective

of this research is to understand how **the transition to a** more **CE** 133

could impact well- being, as understood from a eudemonic perspective. This approach is different from how well- being is normally conceived in the sustainability literature, since the predominant view uses inclusive wealth theory that measures well-being through economic measures (Clark & Harley, 2020). This perspective, though convenient, influences what is measured and what is valued from a societal perspective. This study incorporates constructs that are not measured in monetary terms and are therefore harder to evaluate and interpret. Nevertheless, this study attempts to give meaning to well-being by carefully exploring what makes work meaningful in a CE. Further, it is believed this is the first study to explore whether CE companies and CE jobs may present an opportunity to increase the experience of meaningfulness for workers. This study investigates meaningful work by exploring which job characteristics are most relevant in explaining meaningful work in CE jobs (RQ1), understanding how CE awareness leads to more meaningful work (RQ2), and testing whether increasing CE awareness can lead to more meaningful work in CE jobs (RQ3). RQ 1 Based on the analyses presented in Section 4, the following insights were observed: of all the job characteristics in the literature found relevant to explaining experienced meaningfulness through work, three—i.e., task significance (p = <0.001), worker role fit (

p = <0.001), and autonomy (**p = 0** .0056)—were **statistically significant in** 170

explaining experienced meaningfulness in the sample of 111 CE workers (see Table 4.11). In addition, CE awareness and perception were also found to be statistically significant in explaining experienced meaningfulness on the job at α = 0.1 (p = 0.07), even when considering all the job characteristics found in the literature. Therefore, this study suggests that CE

companies that intend to increase the wellbeing of workers through more meaningful work should focus on increasing autonomy, task significance, worker role fit, and CE awareness. Increasing meaningfulness on the job has also

been found to increase job satisfaction , engagement, and commitment (**Allan et al., 2019** 120

), therefore by addressing meaningfulness companies will also benefit from a more engaged and committed workforce. Though the impact of CE awareness on experienced meaningfulness on the job is small (b = 0.09), this can be explained by the fact that other variables, such as task significance, are capturing much of the variation in experienced meaningfulness. For this reason, RQ 2 uses a mediation analysis to understand the relationship between CE awareness and meaningfulness. RQ2 The mediation analysis found that task significance is a mediator of CE awareness and meaningfulness, which suggests that the path through which CE awareness affects experienced meaningfulness is in a large part through task significance (see Section 4.5). This supports the initial hypothesis that the path through which CE awareness affects meaningfulness is by increasing the impact employees feel they have in the world (task significance). Looking at the big picture impact of the CE, this research shows promising results for the potential of the CE to increase well-being by increasing meaningfulness in CE jobs through task significance. Therefore, companies with that intent to increase workers experience of meaningfulness on the job should communicate to their workforce about how the CE enables them to impact the world through their work. In this study, this was done through a five-minute video which is discusses under RQ3 subtitle. Nevertheless, there are many other ways in which companies can make employees aware of their impact. Some alternatives are to communicate monthly or weekly some kind of CE metric that provides information of the impact of the company in the world (e.g., reduced waste, people aided by lower product cost). These kinds of metrics may not be in place yet or may be saved for sustainability reports, but this study encourages companies to communicate their impacts within the company, to their workforce. RQ3 Lastly, through the quasi-experiment it was observed that a simple five-minute video intervention was effective in increasing CE awareness and perception (see Table 4.16) in CE workers. Nevertheless, this increase did not translate directly to an increase in meaningfulness in the treatment group—experienced meaningfulness was maintained when comparing

pre-test and post-test values. **On the** other hand, **the control group** had **a** 27

statistically significant decrease in meaningfulness. This finding was unexpected since there was only a one-week

difference between the pre-test and post-test; the expectation was that **the control group** 40

would maintain their levels of experienced meaningfulness. The strength of

the pre- and post-test control group design meant **the** impact **of the** 126

CE video could be measured on the treatment group (i.e., workers maintained their experienced meaningfulness) against the control group (i.e., workers reduced their experienced meaningfulness). When accounting for the combined effect of the video on the treatment and control group (see Table 4.16), meaningfulness was found to have a statistically significant effect (p = 0.03) in helping maintain meaningfulness in the treatment group, rather than having it drop as with the control group (see Section 4.6.3). Other constructs

found to have a statistically significant effect when observing **the** combined effect **of the** 119

video on treatment and control group were task significance (mean increase = 0.54 on 7-point Likert scale, p = 0.00), perceived social impact (mean increase = 0.26, p = 0.04), and all the CE constructs except CE awareness. Therefore, the quasi-experiment shows that increasing workers' knowledge of the CE, its potential benefits, and how workers are contributing to the CE through their work, can help increase workers' task significance and perceived social impact, both of which are important for experienced meaningfulness. These results are important for companies looking to increase worker well-being, since well-being is most closely tied to meaningfulness from the eudemonic perspective of well-being (Ryan & Deci, 2000a). Sample From the descriptive statistics (see Section 4.3), it was apparent that the survey participants began with high levels of CE awareness and perception, high levels of meaningfulness, and high levels of all CE job characteristics measured. These high levels—mean experienced meaningfulness pre-test = 6.0 on a 1-7 Likert scale (see Table 4.8)—may have reduced the potential increase in each variable in the post-test. Thus, it may help to explain why the intervention video did not increase meaningfulness in the treatment group, but only maintained it (see Table 4.15). The initial high levels of CE awareness may also have reduced the potential for the video to have a substantial impact on CE awareness. The expectation for one of the companies was that most employees would not be familiar with the concept, and therefore the introduction of this new concept would have a larger positive impact on their task significance and in turn in their experienced meaningfulness. A potential explanation for the very high initial levels for all measured variables observed in the sample is the large portion of the sample composed of top and middle managers, rather than front line workers. Another explanation is the For Company A, this composition reflected 41% for top and middle managers, 24% plant workers (see Table 4.9), the composition was 70% and 30% for Company B, respectively (see Table 4.8). 5.1 Study Limitations The control group reported an unexpected decrease in

task significance, perceived social impact, perceived social worth, and 4

meaningfulness (see Table 4.15, Section 4.6). Given that the two survey measurements were taken only one week apart, no significant changes were expected for this group. Some events may have taken place within these companies in the course

of the week causing participants to report changes in experienced meaningfulness, perceived social impact, and social worth. The potential for survey fatigue to have influenced these results was considered; however, survey fatigue should also have caused a decrease in CE measures that were the last items in the survey. Regardless of the cause, both the treatment and control groups had the same experience with different results. The treatment group presented an increase in mean task significance and perceived social worth, no change in the meaningfulness, and a decrease in perceived social impact. 6. Conclusion This research explored

the potential of the **CE to contribute to the** social dimension of **sustainability**	159

by investigating the most cited social benefit of the CE—jobs in the CE—through a quasi-experimental survey of two CE companies in the US. Experienced meaningfulness on the job was explored because from a eudemonic perspective, enhancing well-being is mostly related to meaningfulness and is the main aim of sustainability. The concept of experienced meaningfulness and the main job characteristics that affect meaningfulness were taken from the organizational behavior literature (Hackman & Oldham, 1975). A quasi-experiment involving

a pre-test post-test control group design conducted on	25

two CE companies in the US showed increasing CE awareness and perception has the potential to maintain meaningfulness, increase task significance (i.e., the impact employees feel they have in the world), and perceived social impact. Therefore, if a CE transition involves making workers

more aware of the impact they are having in **the**	158

world (task significance) through their contribution to a CE, then the CE has great potential to increase worker well-being, and therefore contribute to social sustainability. Nevertheless, task significance is only one of the components of meaningfulness—to maintain or increase meaningfulness CE companies should also consider increasing worker autonomy (the level of decision-making workers have), and worker role fit (how identified employees feel with their role), which were the characteristics found to have statistical significance in our sample. This study does not imply linear jobs are necessarily less meaningful, since there maybe linear jobs that are more meaningful than circular jobs. For example, a teacher may experience a higher level of meaningfulness than a mechanic that fixes electric cars in a circular economy. What this study demonstrates is that the mechanic (or other CE worker) can increase their baseline meaningfulness by understanding their own contribution to this new concept called the circular economy. Another important contribution of this research is to bringing attention to the importance of considering what gives work and life meaning and connecting this to the discussion of what constitutes well-being. Defining well-being is challenging, but only focusing on economic measures of well-being

may not necessarily lead to a more sustainable world. 6.1 Future Research There are four future adaptations that could be advanced to improve the study. First, it is recommended that a pilot test is undertaken to test the key variables on a subset of the sample. The pilot study for this research was undertaken with acquaintances and not with a subset of the target population, which means key worker insights may have been missed. Second, rather than targeting the whole company, future work might target, exclusively, frontline workers who may not have CE knowledge. Further, this population may potentially experience having less meaningful jobs. Third, reduce the length of the questionnaire to increase survey participation and reduce survey fatigue. This can be done by eliminating the questionnaire section regarding job characteristics, and instead focus exclusively on the impact of CE awareness on meaningfulness. Another alternative would be to eliminate constructs that are very similar to one another, for example

task significance , meaningfulness, **perceived social impact and perceived social worth** 4

all measure very similar constructs. For CE constructs, the number of constructs measured could be reduced from six similar constructs to two or three more different constructs. This would also help to reduce the multicollinearity of variables that makes the interpretation of the regression model more complicated since some variables showed negative sign when the expectation is that they have a positive impact on meaningfulness. Finally, to better control who watches the video, the treatment group could watch the intervention video all together, with the control group watching another control video in separate location. References Aguilar-Hernandez, G. A., Dias Rodrigues, J. F., & Tukker, A. (2021). Macroeconomic, social and environmental impacts of a circular economy up to 2050: A meta-analysis of prospective studies. Journal of Cleaner Production, 278. https://doi.org/10.1016/j.jclepro.2020.123421 Allan, B. A., Batz-Barbarich, C., Sterling, H. M., & Tay, L. (2019). Outcomes of Meaningful Work: A Meta-Analysis. Journal of Management Studies, 56(3), 500–528. https://doi.org/10.1111/joms.12406 Baumeister, R. F., Vohs, K. D., Aaker, J. L., & Garbinsky, E. N. (2013). Some key differences between a happy life and a meaningful life. Journal of Positive Psychology, 8(6), 505–516. https://doi.org/10.1080/17439760.2013.830764 Brundtland, G. H. (1987). Report of the World Commission on Environment and Development: Our Common Future. Campbell, A. (1976). Subjective Measures of Well-Being. Chaudhary, R. (2019). Corporate social responsibility perceptions and employee engagement: role of psychological meaningfulness, safety and availability. Corporate Governance (Bingley), 19(4), 631–647. https://doi.org/10.1108/CG-06-2018-0207 Chipman Koty, A. (2021, July 16). China's Circular Economy: Understanding the New Five Year Plan. China Briefing. https://www.china-briefing.com/news/chinas-circular-economy- understanding-the-new-five-year-plan/ Circle Economy, & UNEP. (2022). The Circular Jobs Methodology. https://assets.website-files.com/5d26d80e8836af2d12ed1269/61af7196f9833e9eb597931e_20211203%20- %20CJI%20Brief%20-%20Methodology%20-%20297x210mm.pdf Clark, W. C., & Harley, A. G. (2020). Annual Review of Environment and Resources Sustainability Science: Toward a Synthesis. https://doi.org/10.1146/annurev-environ- 012420 Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences. Lawrence Erlbaum Associates, Inc. Commission, E. (2018). Impacts of circular economy policies on the labour market Final report. Corlett, R. T. (2015). The Anthropocene concept in ecology and conservation. Trends in Ecology and Evolution. Corvellec, H., Stowell, A. F.,

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Appendix A - Information Sheet and Consent Form The following information sheet was the first page of each survey sent out: Information Sheet for Participation in a Research Study Principal Investigator: Dr. Jennifer Russell | jdrussell@vt.edu Other study contact: Isabella Cricco | isabellacricco@vt.edu I am a master student at Virginia Tech, and this survey is part of my thesis work on Jobs and Well-being. We invite you to participate in this study because of our specific interest in the work that is performed within your organization. In total three organizations are being studied in this research. This research has been reviewed and approved by Virginia Tech's Virginia Tech Human Research Protection Program (HRPP), under IRB #22-361. What should you know? Participation in this study consists of completing two online surveys with a one-week separation between completing the first survey, and completing the second survey. The first survey includes some basic demographic questions, as well as your perceptions of the tasks you perform at work, a reflection of your experience on the job, and some questions regarding your familiarity with concepts we are studying. The second survey includes similar question and may include asking you to watch a short video of no more than 4 mins. Participants who agree to, and successfully complete both surveys will be entered into a raffle for a $50 gift card; each entry has a minimum chance of 1/30

in winning the gift card raffle. You will have the opportunity to opt-in to this raffle, and it is not a requirement. The survey has implemented filters and mechanisms to reject responses that appear to be random, or careless answers. Only respondents who fully and appropriately compete both surveys will be entered into the raffle. Each survey will take approximately 20 minutes to complete. Your participation in this study is voluntary and you can decide to withdraw from the study at any time without consequences of any kind. We do not anticipate any risks from completing the study. Your responses will be kept completely anonymous, even to the research team; in addition, only aggregated data sets (representing the combined responses of all participants) will be shared with your organization. We are actively assuring your responses will not be identifiable by anyone but you. Confidentiality Data of this study will be handled exclusively by the PI and student researcher. You will be asked to input an identifying/security code specific to your survey responses in order to link your first survey to your second survey. Initially, this code will be temporarily linked to your email or a provided mobile phone number to allow for us to send the second survey; however the link to your email or mobile phone number will be destroyed once the two surveys have been completed. Who you can talk to? If you have any questions and concerns regarding the research, you can reach out to Isabella at isabellacricco@vt.edu or Dr. Jennifer Russell at jdrussell@vt.edu. Consent If you consent, please click the next button to continue. Otherwise, do not continue and close your browser. Appendix B – Email Communication to Participants The following emails were drafted for each of the companies to send to their employees with the link to the survey's embedded: Dear Company A Associates, We greatly appreciate the time you already invested in completing the first survey. We invite you to complete the second part survey which is very similar to the first one and should therefore go more quickly. Participation is voluntary and consists of survey questions on your perceptions and experiences at work and it may include a video of no more than 6 mins. Participants who agree to, and successfully complete both surveys will be entered into a drawing for a $50 gift card; each entry has a minimum chance of 1/30 in winning the gift card drawing. You will have the opportunity to opt-in to this draw, and it is not a requirement. If you which to participate, access the survey here: Link to the English version survey: Survey Part 2 Link to the Spanish version survey: Encuesta Parte 2 Your participation in this study is voluntary and you can decide to withdraw from the study at any time without consequences of any kind. Thank you for your time! Dr. Jennifer Russell and Isabella Cricco Licensing your original work with a Creative Commons License http://www.creativecommons.org The six Creative Commons licenses permit varying types of uses. The following chart illustrates the permissions, requirements, and restrictions of the CC licenses, from the least restrictive, to the most restrictive. Link Icon Licenses Author allows users to Author requires users to Author restricts users from Link CC BY Copy, distribute, display, perform, and remix the work. Attribute or credit the author as requested. Link CC BY-SA (CC BY Share Alike) Copy, distribute, display, perform, and remix the work. Attribute or credit the author as requested. Apply the same CC license used by the author to the derivative work. Link CC BY-NC (CC BY Non- Commercial) Copy, distribute, display, perform, and remix the work. Attribute or credit the author as requested. Copying, distributing, displaying, performing, or remixing the work for commercial purposes. Link CC BY-ND (CC BY No Derivative Works) Copy, distribute, display, and perform verbatim (unchanged) copies of the work. Attribute or credit the author as requested. Remixing or creating derivatives of the work. Link CC BY-NC-SA (CC BY Non- Commercial, Share Alike) Copy, distribute, display, perform, and remix the work for non-commercial purposes. Attribute or credit the author as requested. Apply the same CC license used by the author to the derivative work. Copying, distributing, displaying, performing, and remixing the work for commercial purposes. ©Anita Walz CC BY http://creativecommons.org/licenses/by/4.0 Office of Scholarly Communications, University Libraries, Virginia Tech

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