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CDRA Organizes C&D Relevant COVID-19 Resources into One Link

The National Trade Association Dedicated to the Construction & Demolition Recycling Industry

The CDRA has made it easy for its members to peruse important information for C&D recyclers during the pandemic by placing them in one spot on the association's main website. Please go to <u>https://cdrecycling.org/news/covid-19-resources/</u> to see the large amount of resources available to help members navigate during this difficult time.

It Will Pay Off to Help CDRA Grow its Membership

CDRA has launched a contest whereby \$1000 will be awarded to the company that brings in the most memberships to the organization by the time of the association's March 2020 Annual Meeting in Austin.

CDRA Member R&B Debris is funding the contest, designed to help the CDRA continue its membership growth curve while trying to get more member companies involved in the activities of the only association that serves the C&D industry.

R&B, based in Hainesport, NJ, is also having an internal contest to gain CDRA memberships. "I have challenged my team to get me 10 new memberships before the end of the year," says John Thomas, President of R&B Debris. "And if they do it I will take the entire management staff in our Folsom office to Austin with me."

The company is adding a CDRA membership link on its website and is promoting the CDRA through its monthly company newsletters. Along with placing the company newsletter in its customers' statements, it also places a CDRA membership application in there as well.

More details of this contest will come out shortly, but take a minute to think about who could benefit from joining the CDRA, from the generators of the incoming material to the users of the end products. The CDRA provide a wealth of information and research for those interested in the C&D industry and those companies could benefit from learning more about the marketplace.

In fact, we have released or are about to release two new documents:

- A roadmap to proper regulatory and legislative steps to support legitimate C&D recycling while increasing local recycling rates;
- A guideline on how to develop an end market for a specific material.

Both are only available to members, though the former is also available for any government officials. We urge you to take advantage of these, and all the other materials available to members at <u>www.cdrecycling.org</u>. Also, always feel free to call the staff at CDRA if you have any problems or issues, and they will try to help.

CDRA Report Pandemic Effect on C&D Industry 5/15/2020

Incoming tonnages to C&D recycling facilities remain down compared to a year ago levels, according to the participants in the C&D Recycling Association's recent biweekly conference calls with recyclers across the United States to determine the effects the pandemic has had on the C&D industry. Some of the recyclers remain 50% off their usual levels this time of year, others only 20%. But the incoming tonnages are creeping up from the previous call, as most report they are at least 50% of the usual, though sometimes it is still government restrictions on construction keeping the amount of material being generated at a higher rate. As recently as a month ago some of the recyclers were at 20% to 30% of their usual volume.

But the big question is, how will it be from here on out? Probably the best guess is to throw a dart at a dartboard, but nobody is expecting the economy and construction to come roaring back any time soon. This is an important question because businesses need to budget for the rest of this year, and for 2021.

The consensus on incoming tonnages for next year is at best 80% of 2019, a good year. If a company wants growth in tonnages, it will have to go the M&A route.

Much, of course, depends on the economy. Also, how does the construction industry handle social distancing? For example, what about high-rise construction jobs? If only one person is allowed in an elevator at a time, and there are 50 workers supposed to work 8 hours on the 40th floor, how do they get up there and back during a shift?

Many aggregate recyclers are seeing their yards getting slammed with material as much roadwork has continued, though some of that may be because as schools and universities have shut down early, paving projects there have started early instead of in the summer as originally planned.

But several recyclers are concerned that right now they are seeing construction projects starting up and material coming in, which is good, but that may only last for a few months. The backlog of projects starting up is dwindling now, especially the big ones, and unless the economy comes back strong and excites developers and the like to keep projects going, the current flow of materials to C&D facilities will fall in a few months. The recyclers find this extremely worrisome.

Markets remain steady, at best. OCC prices are still good, but metals, despite a slight price hike, remain relatively low. Wood remains a challenge. There have been reports that because auto shredders were shut down, meaning a reduction in auto fluff that was used for ADC, C&D fines have found a renewed outlet in some areas.

Bringing Them Back

It is a mixed bag on employees. Some have reported that because of the generous unemployment benefits being offered right now, those workers laid off at the start of the pandemic are in no hurry to come back. But when they do, companies must have in place policies that follow government guidelines and requirements as far as social distancing and PPE requirements. Not only does that protect the employees, but is the only way to protect the business from lawsuits if somehow an employee catches the virus, whether at work or at home.

Some states, notably California and Illinois, are now saying it doesn't matter where the employee is infected if he or she comes down with it; they are to be counted against the businesses' workers comp insurance, effectively relieving the state of the financial burden.

But even when workers are back on the job, this is no time to get complacent about following the virus protection rules. The whole company's team, especially all management, must be on board with the program and familiar with the social distancing and PPE requirements and stay on top of it all the time. Letting one's guard down even for one day invites disaster.

CDRA Member Spotlight: Boe & Terrie Bland Bland Recycling



Bland Recycling Herriman, Utah

What materials do you recycle? Concrete/Asphalt/Rebar/Some soils. More than 300,000 tons per year. How did you get started in the business?

I grew up as a kid around crushing with my dad and grandparents in the mining industry in the Utah desert. I would get to go ride dirt bikes and play in the desert while they were doing their mining. My dad was also a demolition contractor when he wasn't helping his parents with the mining operation. He also started a C&D landfill for the demolition business and my main job at that point was being a dozer operator for the landfill. The landfill ended up becoming so busy with other contractors bringing in materials. So, he closed down the demolition company to focus primarily on landfill management. I become a certified manager of operations for the

landfill where I ended up managing for

quite a few years after that. We could see a growing need of recycling of asphalt and concrete instead of burying it and taking up valuable landfill space, so the landfill ended up buying an impact crusher and start recycling. After recycling for about a year, it was determined that landfilling the concrete and asphalt was about even with the cost of recycling it without the headaches of upkeep with the crushing operation, and my dad was losing interest in recycling it. It was 1996 and I could envision the possibility that crushing concrete could turn into a big thing eventually, and I was 27 years old, my wife was 26 and pregnant with our first child and we were ready to venture out on our own. We purchased the recycling equipment and ended up moving to where we are today and eventually grew into another location a year later. We have now been crushing for more than 20 years.

What are the biggest challenges in your market and C&D recycling?

For us, if you were to be in the center of the Salt Lake Valley, it is surrounded by good quality virgin aggregates in any direction and there is a gravel pit located within a close proximity which keeps the prices cheaper because of competition. **How long have you been a member of CDRA?**

Since 1999. I served on the CDRA board for several years.

What inspired you to join CDRA?

I contacted the old CMRA after we ran into some permitting issues with one of our recycle yards. Bill Turley helped refer me to a study that had been done by a university on the same type of materials and I was able to provide some of that information to help educate our regulators on our type of operation. This helped us so much that I decided that keeping in contact, reading and being part of an organization that stays up to date on what is happening in our industry is an absolute must. Since being a member, we have met other recyclers across the nation that we have become good friends with and will look for advice and share some of our issues and remedies with.

What do you find most rewarding about working in this industry?Turning a waste material into a good quality reusable product.What challenges have you faced over the years and how have you

overcome them? We have faced trying to get our end product materials accepted in a highly

competitive environment and have been successful by always choosing to manufacture the end product at the highest possible level of quality.

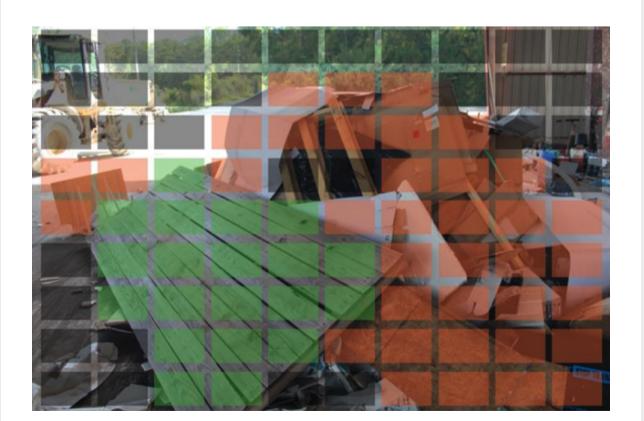
What's something about you (a fun fact) that not many people know? I love desert racing, spending time with my high school sweetheart and kids, and spending time in the Utah mountains looking for old Spanish gold mines. How do you think the industry is changing and what trends do you see coming up on the horizon?

Recycled materials are getting more popular and acceptable. In our area, the larger contractors are reusing the materials onsite, which could eventually force us into portable crushing if our yards end up slowing down too much.

What advice would you give to someone interested in this industry? Keep yourself open to changing with the times as recycling has become more popular there will be more competition as well as more opportunities. Best piece of business advice you've gotten or learned over the years?

Stay level headed. Try not to get wrapped up with the highs and the lows of the swing of things. Keep things as simple as possible, and most importantly, turn work off at the end of the day and enjoy a personal life aside from business.

Would you like to have your company in a spotlight like this? Contact CDRA Executive Director William Turley at <u>turley@cdrecycling.org</u>; 630-585-7530.



We Built This: Using Artificial Intelligence and Virtual Reality to Improve C&D Debris Management

By Jon Powell, Ph.D., P.E.

Nearly two years ago, my eyes lit up when a colleague forwarded me an announcement saying the US EPA was soliciting grant proposals for new environmental technologies, including the topic area of C&D debris. I'd developed a concept in graduate school, which I had to table because it did not fit within my broader research plan, that seemed perfect for the call for proposals.

As a bit of background—about <u>569 million tons of C&D debris</u> were generated in the US in 2017. Much of it was recycled, but about 20% still sent to disposal. A healthy portion of those discarded materials have value as a recyclable commodity, and a typical first step to improve diversion from disposal is to conduct a detailed waste characterization study to understand what is being missed. Characterization studies are normally beyond the budget of the typical operating facility but are occasionally funded as part of policy and goal development, typically at the state level. Although great information can be gleaned to support diversion goals, even very detailed characterization studies measure about 1-2% of inbound materials, leaving a tremendous knowledge gap and a great deal of uncertainty.

In addition to missed recycling opportunities, other discarded materials when disposed could pose a near- or long-term risk to the environment, especially if the disposal site does not have a bottom liner and leachate collection system to capture leachate that is produced over time. To decrease the risk of potential environmental impacts, many states require the use of "spotters," employees trained to identify and remove problematic or prohibited materials delivered to the landfill. Lists of prohibited materials can be extensive, and challenges with employee turnover and training could harm the continuity and efficacy of a site's spotting program.

With this background in mind, we return to my grad school concept: What if we could automate the process of detecting what arrives at C&D debris landfills, capturing information on all inbound materials with the dual goal of identifying prohibited and recyclable materials, which could then be used by site operators to take action? My statistics coursework and some additional digging indicated we were at a point where contemporary statistical techniques and computing power enabled advanced applications of artificial intelligence (AI) to handle problems like analyzing images. In this case, the idea was that you could take an image of every incoming load of waste and have it immediately characterized by a trained AI rather than a human.

I located an expert in AI and digital technologies, Prof. Angelos Barmpoutis at the University of Florida, and we submitted a proposal to the US EPA's <u>Small Business</u> <u>Innovation Research (SBIR)</u> program in summer of 2018. The program provides grant funding to early-stage companies developing promising environmental technologies. Like many similar grant programs, the idea is to help de-risk the early stages of technology development and explore the commercial potential if the technology is successful and needed by the target market. While awaiting the results of the proposal evaluation, my company provided seed funding to Prof. Barmpoutis through a product development program at University of Florida, which resulted in building out the initial framework for the image detection system that we dubbed Waste.AI. Thrillingly, we were notified in spring 2019 that the SBIR proposal was selected for funding, marking the genesis of our product development journey.

The Waste.Al System

To meet the objectives of building out a new technology platform that can help to identify and manage prohibited and recyclable C&D materials, we identified three key areas of need:

- 1. Image Capture. We needed a way to effectively capture an image of each load of incoming waste.
- 2. Characterize the Waste in the Image. We needed to build an AI that was trained to identify C&D debris components like concrete, wood, roofing, and others.
- User Interface and Platform. Once the AI did its thing, we needed a way for the user to receive the information and act on it.

The three pillars above represent categorical areas of development, but under the hood of each there was a tremendous amount of "figuring out" needed to select the right approach or technology, to make the technology work, and assembling the pieces in a way that would be compatible with a busy landfill's site operations. Further, we had to identify specific areas of development and prioritize – in our stage-gate analysis, the critical initial step was to build out the image classification system to a level of performance that could enable us to perform a pilot trial at an operating site. To do this, we needed the classification system to not only work, but to perform at a level that was better than random chance (i.e., >50% accuracy).

Our team was able to leverage a fairly extensive data set of C&D characterization photos and data from a statewide study conducted in the US. Having these data was critical, as image classification systems must have lots of data to "train" the model, then ultimately to "test" the accuracy of the model. Building an image classification system from the ground up required extensive planning, programming, and multiple iterations, and there are many detailed considerations that must be developed that we as humans may take for granted. For example, one of the challenges we had to address was ensuring that when our system analyzed a photo of mixed C&D debris that the system only characterized the waste pile. Think of all of the potential distractors that we had to eliminate—the sky, a treeline on the horizon, a piece of heavy equipment nearby, perhaps even people-but eventually we overcame this and other hurdles like it. Ultimately, our system was built to subdivide each analyzed photo into a 12x12 grid, then using characteristics of the image in each of the grid cells (e.g., texture, color, properties at the edges), assign a probability as to the dominant material (e.g., wood, concrete, etc.) within that cell. Then, our system computed the results of each classified cell to indicate the overall composition. We were thrilled that our testing showed image classification accuracy of nearly 80% for up to 10 different material types.

As our image classification system was being built, we began addressing the two other pillars of our technology—obtaining good images at the landfill site and enabling an onsite worker to act upon receiving the image classifier's results. Addressing these challenges required extensive research on facility operations. We pored over thousands of pages of site permits, inspection reports, and site drawings for C&D debris landfills in Florida, our initial target market. This helped us to understand important aspects like variable sizes of a landfill's working face (which is the area at which we would capture the photo), incoming waste rates, employee head counts and job functions, and several other factors. Additionally, we drew heavily on product development frameworks to perform customer research, identify potential bottlenecks, and get early feedback on some of our development ideas. I'd like to specifically mention a couple of great resources, *Talking to Humans* by Giff Constable and the *Disciplined Entrepreneurship Workbook* by Bill Aulet, both were quite valuable in helping us frame out our development approach.

For image capture, we had a range of ideas, ranging from very basic (e.g., have a site worker snap a photo of each load with a mobile phone) to the wild (e.g., a drone flyover at a set schedule). Eventually, based on our research and customer discussions, we determined that the image capture would need to take place in an automated way and would need connectivity. We designed a layout whereby one or two cellular network-connected high-resolution cameras would capture images of the working face of the landfill at a set interval, beaming images to our classification system for processing.

Addressing the challenge of our third pillar, facilitating prohibited or recyclable material removal after delivery to the landfill, emerged as a key workstream as we made headway on our image classifier and as we received feedback from potential users. I can paraphrase a common refrain as follows: "OK, if your image classifier works, how can we take action at the site?" This seemingly straightforward question begat a series of ideas and scenarios for how we can make this happen. One approach we modeled out was creating a user interface that would be loaded on the heavy equipment, so after the image was taken and classified, the equipment operator would receive the results that showed which materials in the load could or should be removed based on potential hazard or recyclable value. While this was probably the most interesting deployment, we saw a very long development timeline, requiring us to turn to other ideas.

Eventually, we elected to develop a virtual reality (VR) environment for Waste.AI that would give the site user the ability to interface with the image classification results and ultimately take action. In the 1990s VR in video games and other applications enjoyed brief popularity, but it never really took off. VR has enjoyed a resurgence in recent years, owing to improved computing power, better headset design, and a wider range of potential applications (including industrial). In fact, you may have seen that Facebook acquired Oculus, a leading VR provider for \$2.3 billion, a big bet on the wide-scale adoption of VR. While discussing options for delivering image classification results to a site user, we found there was very little excitement to simply review the information on a computer. However, people got really excited about the idea of integrating the results into a VR environment—there was something about the intrigue of the platform that tipped us off and confirmed this as a great direction to build out this pillar.

Our team worked diligently to build out the VR piece of the system, which guided the user on how to use the VR unit, review images, videos, and other multimedia. Further, we built out complementary components that helped to reinforce information gleaned from the characterization data, along with a gamified material sorting challenge that enables the user to sort C&D and non-C&D materials along a moving belt, akin to those at C&D MRFs. Once developed, the life-cycle use case we envisioned involved capturing an image at the site automatically, beaming the image to our classifier to be characterized, then the user receiving the results within the VR platform, at which point they could notify another site worker (e.g., communicating with a heavy equipment operator via two-way radio) of materials to identify or separate. We had what we considered the minimum viable pieces of the system in place, but our challenge was to secure a pilot project to test our hypotheses and make the system work.

What Happened and What's Next?

Spoiler alert: Our platform did not reach commercial viability. Early on, we decided the need to generate revenues early on to prove out customer willingness-to-pay. We used the runway from our SBIR grant to build out our AI system, develop our image capture concept, and build out the VR environment, and design a pilot project whereby we could test out our system and gather valuable information on user preferences (and additional photos to continue training our AI). Unfortunately, we were unable to secure a pilot site within our desired timeframe, due in part to a few different circumstances.

First, although we achieved good accuracy with a targeted list of C&D materials, our performance fell short of expectations (some indicated they wanted accuracy greater than 90%). Further, it should be mentioned that we initially trained our classifier to learn 10 types of C&D materials. When we compare this scope of materials to that characterized in human-led characterizations studies (which often look at 40 or 50+

types of materials, including key submaterials like "painted wood", "treated wood", etc.), our capabilities likewise fell short. Thus, on balance, it was viewed that having good characterization information on a relatively small mass of materials (e.g., a typical waste characterization study may examine several hundred loads at one or more sites, which normally comprises about 1-2% of all inbound materials) was preferred over having less-granular characterization information on a far greater mass of materials.

One other objection that limited our ability to pilot was a skepticism about what could happen if detailed information was captured for every single load. There was some concern about potential future liability if (for example) some material considered to be acceptable now was later found to be environmentally problematic. Although we considered this angle early in our development, we viewed it in the opposite way, meaning that having good characterization data could guard against potential future liability by demonstrating inbound materials were analyzed and (in success) properly managed. This observation supports the tremendous importance of testing product assumptions with actual customers, as their perspective may be quite different than you think.

Although I am incredibly proud about the Waste.AI system that our team built, our lack of securing a pilot demonstration precluded our ability to see how well the full system would perform "out in the wild". We viewed early 2020 as our final chance to deploy our system, but the emergence of the COVID-19 pandemic was the final limiter leading us to wind down the project. Despite not achieving our goal of commercial success, we think that there are several valuable pieces of information that we can share with the world:

- 1. We still think that the concept of characterizing materials in the manner we envisioned at C&D debris landfills has merit. It will take a technological breakthrough to move the needle to help redirect valuable recyclables back into higher and better uses, while also reducing the deposition of potentially problematic materials. It may be possible that some of the leading AI and robotics companies who are solving for material separation challenges at MRFs (e.g., AMP Robotics, Waste Robotics, Zen Robotics, and others) can apply their image recognition technologies to develop solutions at landfills.
- 2. We found a tremendous excitement around using VR as a delivery system for our Waste.AI technology. There may be additional innovations and applications that could be considered for the recycling and waste industry at large, and we are at an early "second wave" whereby there is a lot of room for breakthrough ideas to be delivered through the medium.
- 3. There may be emerging platforms that could better address the problem that we were solving. For example, new augmented-reality (AR) headsets and technologies could be integrated with image capture systems, sensors, and deliver a feedback module, representing an "all-in-one" package that would enable detection, characterization, and management of C&D debris in the manner we proposed.

We are still deciding how all of the work we've done should live going forward, and are considering open-sourcing some of our code, applications, and other information. I encourage CDRA members to reach out to me with any questions on what we built and what we learned in hopes that the industry can benefit from our team's efforts.

Jon Powell was the Founder and CEO of PTP Strategy and holds a PhD in Chemical & Environmental Engineering from Yale University and a ME and BS in Environmental Engineering Sciences from the University of Florida. He is currently VP at <u>Closed Loop</u> <u>Partners</u> – you can reach Jon at jon@closedlooppartners.com.

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Industry News

Interesting article on DTG, which won C&D Recycler of the Year from CDRA earlier this year:

Doing It Their Own Way

CDRA Hall of Fame member and past board member Ken Hoving is starting up a mixed C&D recycling facility and transfer station in Kalamazoo, MI: <u>\$4M specialized recycling center proposed in Kalamazoo Township</u>

The Romans were probably the first recyclers, according to an article about recent findings at Pompeii:

Pompeii Ruins Show that the Romans Invented Recycling

Some interesting end products from across the pond: Not Just Another Brick in the Wall

Submit Newsletter Content

Do you have industry content to be considered for CDRA's monthly e-Newsletter? We encourage you to submit ideas as often as you have them. Although not every news item is shared, we will review each submission based on our audience's interests and information needs. Thank you!



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