# ROBOTIC PARKING SYSTEMS, INC. GARAGES:

# INHERENTLY SAFER, GREENER, MORE COMPACT, AESTHETIC & LOWER OPERATING COSTS

# A "PARKADIGM" SHIFT IN PARKING GARAGE DESIGN

ROGER C. COURTNEY, ESQ.
Attorney at Law
J.D., George Mason University School of Law

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# A "PARKADIGM" SHIFT IN PARKING GARAGE DESIGN ©

The U.S. Department of Transportation states that its **number one goal is *safety*.**[1] As it relates to transportation, reducing risks in a parking garage is also a primary concern. "Because parking facilities are more likely settings for crime – both violent and property – than all other real estate except residential, security is one of the most critical issues facing owners and operators of parking facilities today," according to the April 1996 National Institute of Justice research study.

Automated / robotic parking garage ("ARPG") vendors manufacture and operate robotic parking systems for vehicles in up to one third of the footprint of a conventional concrete ramp garage ("CCRG"). I believe that a number of these automated/robotic parking garages may meet the principles of "inherently safer design," "value engineering,"[2] and Crime Prevention through Environmental Design ("CPTED")[3]. This White Paper focuses specifically on the parking garage design and technology of Robotic Parking Systems, Inc. ("RPS").

Throughout this paper, these concepts and other benefits are discussed that show how robotic parking garages clearly outmatch CCRG designs. Statistics relating to how the design of a Robotic Parking System garage ("RPSG") prevents the potential for sexual and other assault, suicide, and vehicular damage and theft are presented. Premises liability and insurance costs for garage owners are reduced. Average retrieval time has been professionally certified for RPSGs at less than three minutes, with Peak Traffic ("PT") in-and-out performance certified at 425 cars per hour at a new 2,314 space federal courthouse RPSG in Kuwait.[4] Also, since vehicles are not in operation once they are moved for storage / retrieval, greenhouse gases ("GHGs") are reduced by over 90% vis-à-vis a CCRG of the same vehicle capacity. RPSG design allows for the facility to be at least 50% smaller allowing more spaces to be closer to desired locales. Since all vehicle occupants depart their vehicles at the entry/exit terminal, all spaces are handicapped accessible. Operating costs are 55% lower versus a same space CCRG, according to a well-documented study by Samuel I. Schwartz, PE. Façades are closed and can match adjoining buildings. RPSGs in mixed use buildings can also add significant LEED points to the overall project.

It is hoped that this White Paper will be the stimulus for the federal government, developers, hospitals, universities, and others to fully recognize the significant and, sadly, the well documented perils that exist

[1] https://www.transportation.gov/sites/dot.gov/files/docs/SecIII_Draft%20Strategic%20Plan%20OMB_508.pdf
[2] https://en.wikipedia.org/wiki/Value_engineering
[3] https://pdfs.semanticscholar.org/0c95/3588e001d886919c5a0f55ef3650d9d76957.pdf; http://www.cpted-security.com/security-design-cpted/; http://www.cptedtraining.net/index.php?page=cpted-professional-designation
[4] https://www.roboticparking.com/robotic_parking_projects_al_jahra.htm

today in CCRGs and to make a paradigm ("parkadigm") shift in thinking to seriously evaluate and acknowledge the beneficial design and technology advantages of RPSGs.

## Questions for Decision Makers About Parking Garage Design Choice

I have prepared the following checklist of questions for decision makers as to opinions and as to what their audiences (*e.g.*, garage patrons) want (and deserve) in a parking garage (and what analyses the federal government mandates.)

1. Since operating costs, including reliability and maintenance costs, have been professionally demonstrated to be 55% lower with RPSG vis-à-vis CCRG designs, as well as provide inherently safer outcomes (*e.g.,* no opportunity for rape, suicide), better aesthetics, smaller footprint and/or height, 90%+ lower greenhouse gases, greater uptime reliability (above 99.99%), and reduced premises liability exposure, what else do you need to know to approve an automated/robotic parking garage system?
2. Are you aware of the Restatement (Third) of Torts' 1998 legal treatise's "reasonable alternative design" ("RAD") design defect liability approach that has been adopted by the majority of courts across the U.S.? This well-accepted legal concept approach allows attorneys to plead that the person and/or entity being sued should have used or approved a robotic garage of "reasonable alternative design" if it can be professionally demonstrated to either prevent a death or loss or ameliorate the injury, and if a RAD design had been available and in use at the time of the litigated event
3. Did your consultant advise you that there are automated/robotic parking garage alternatives? Have you asked your consultant if they have knowledge of the legal, societal, liability, and operating cost benefits of RPSG design and technology?
4. Have you or your parking garage consultant researched the criminal (e.g., rape[5] and suicide [6]) statistics related to CCRGs? (RPSGs prevent such crimes, suicide, and accidents.)
5. When considering various automated/robotic parking garage vendors, have you asked for a list of vehicles that such automated parking garages can and cannot accommodate due to their design and technology? [7]
6. Have you asked for and been provided third party documented retrieval times – single car and number of cars per hour?
7. Do you prefer to build a parking garage that a) takes up less footprint, b) less excavation, c) can park up to 3 times the number of vehicles in the same volume of a comparable capacity CCRG and d) offers numerous other benefits? Is there any additional documentation you need to make a decision to approve an RPSG?
8. Are you aware of the **mandated/statutory** 1998 federal (and many states) "value engineering" (VE) law and regulations (OMB Circular A-131 (revised) that require operating/life cycle costs, functionality, quality, safety, environmental, and performance analyses be performed during

[5] https://www.parkingtoday.com/articledetails.php?id=235&t=making-safety-a-priority-in-parking-garages
[6] https://www.ncbi.nlm.nih.gov/pubmed/21916292
[7] http://wehoville.com/2016/10/13/opinion-wehos-parking-garage-gee-whiz-golly-gee/

the design phase and that such results be considered in making an initial project or product design decision? Was a VE analysis performed?

9. Do you believe it is "best practice" to continue to design, approve, or construct infrastructure projects, such as parking garages using a conventional design, when robotic parking's empirically proven "reasonable alternative design" and "inherently safer" parking garage design ***prevents*** crimes, meets CPTED principles, and may be required to be analyzed under "value engineering" legal and regulatory provisions?
10. Have you compared various ARPGs as to their scalability, ability to accommodate the widest wide range of makes and models of vehicles, fast retrieval, years of operation and long-term reliability? Please see www.RoboticParking.com for additional documentation.

## Conventional Concrete Ramp Garage Sexual and Other Assaults

U.S. Department of Justice statistics from 2004-2008 demonstrate that there were over 400,000 *reported* violent victimizations annually (*i.e.*, over 1,000 per day) in parking lots and garages, collectively, and over 2 million reported property victimizations per year during that same period. DOJ statistics also document that there was an average of over 223,000 *reported* sexual assaults in 2004 collectively across all parking lots, public areas, and garages.[8] It has been estimated that there are approximately 20,000 concrete ramp garages in the U.S.[9] Other sources state that 25% of all rapes and sexual assaults take place in concrete ramp parking garages, parking lots, and "public areas."[10] Almost all these tragic incidents can be prevented with RPSGs instead of parking lots and CCRGs.

Additionally, the published DOJ research shows that between 1992-2000 only 36% of all rapes, 24% of attempted rapes, and 26% of sexual assaults were reported.[11] The GAO Bureau of Justice Statistics reported that in 2006, about 323,000 individuals age 12 and older were victims of "sexual assault."[12] Assuming that figure is borne out, I assert that this research leads to the conclusion that there were ***approximately 1,700 to 2,500 CCRG, parking garage, parking lot, and public area rapes or sexual assaults per day*** in the U.S. during that time period. That conclusion suggests to me that there are likely 70-104 sexual assaults every hour or 1 to 2 every minute in U.S. CCRGs (and no robotic garages) and parking lots, or public areas (in the aggregate), with 63% occurring at night. A study by Liability Consultants, Inc. of more than 1,000 premises liability U.S. lawsuits between 1992 and 2001 "revealed that in almost one-third of all cases reviewed, the basis of the lawsuit was a murder, rape, robbery, or

[8] http://www.bjs.gov/content/pub/pdf/cv13.pdf
[9] https://www.ibisworld.com/industry-trends/market-research-reports/otherservices-except-public-administration/personal-laundry/parking-lots-garages.html
[10] http://www.bjs.gov/index.cfm?ty=tp&tid=44
[11] https://www.nij.gov/topics/crime/rape-sexual-violence/Pages/rape-notification.aspx
[12] https://www.gao.gov/products/GAO-19-259T

assault in a parking structure.[13] "Parking garages rank second when it comes to violent crimes,"[14] such as carjacking, murder, and forcible rape.[15]

College campus parking garages are common sites for rapes,[16] as are hospitals.[17] Just Google parking garage rape or sexual assault by locale to see the unfortunate number of incidents. Table 4 in the "Violent Victimization of College Students (1995-2002) research shows that 9% of all crimes occur in parking garage and parking lots (combined), which translates into 42,800 annually. I believe that one can safely estimate that at least 50% of these victimizations were in parking garages where perpetrators can hide. That would mean that an average of 21,400 violent victimizations occur annually in college CCRGs, because parking lots are more "open" to scrutiny from other people.

*U.S. News & World Report* reported in February 2019[18] that the U.S. Department of Education lists more than 4,000 degree-granting academic institutions. Assuming that there is at least one parking garage at each college or university, mathematically that equals 5.35 (21,400 / 4,000) violent crimes per year in each college CCRG. Applying this 5.35 violent crimes per CCRG to the approximately 20,000 concrete ramp garages in the US, we estimate 107,000 violent victimizations in CCRGs per year – about 293 per day. Statistically there are no CCRGs without violent victimizations while none have occurred in automated parking garages according to my research.

Knowing that college (and hospital and casino) parking garages are the most common parking venues for sexual assaults and suicides, it makes no sense to continue to build CCRGs since RPSGs can virtually *prevent* the occurrence of these tragic events.

In an International Association for Healthcare & Safety hospital crime survey, some 14% of sexual assaults, 31% of robberies, 39% of burglaries, and 54% of vandalism were reported to have occurred in parking lots or structures. Some 87% of reported auto thefts also occurred in hospital parking facilities. Employees were the victims of the above crimes in hospital parking facilities between 40% and 60% of the time. RPSGs reduce exposure to personal injury.

The background, safety, and reliability data of RPSGs have been available through Google and other search engines for at least 15 years.[19] These data should be a wake-up call for governments, developers, parking consultants, architects, planners, hospitals, casinos, colleges and universities, public-private partnerships, and others, especially considering the significant liability issues. Should governments

[13] http://www.liabilityconsultants.com/publications.html; http://www.parkingtoday.com/articledetails.php?id=235; http://www.buildings.com/article-details/articleid/14946/title/4-parking-security-essentials/viewall/true.aspx;
[14] http://www.parking-net.com/parking-industry-blog/safety-tips
[15] www.fox10tv.com/story/38371386/suspect-in-parking-garage-attack-on-woman-appears-briefly-in-court; http://6abc.com/news/suspect-charged-in-spring-garden-parking-garage-rape/458147/
[16] https://amp.knoxnews.com/amp/893166002
[17] https://www.ncbi.nlm.nih.gov/pubmed/21916292;https://www.baltimoresun.com/news/maryland/harford/aegis/ph-ag-david-corn-arrest-0708-20160708-story.html
[18] https://www.usnews.com/education/best-colleges/articles/2019-02-15/how-many-universities-are-in-the-us-and-why-that-number-is-changing
[19] http://www.roboticparking.com/reports/Automated_Parking_2_Year_Report_Card.pdf

continue to approve new CCRGs without CPTED and value engineering reviews or dismiss or not even consider automated/robotic parking when the evidence is so incontrovertible?

## Suicides Prevented with Robotic Design

Each year, more than one million Americans (2,740 per day) attempt suicide, and over 30,000 each year succeed, at a rate of about 82 per day, including over 20 per day for veterans![20] "Some of the most widely-used venues for suicides are parking garages. Many CCRG owners hope or believe that fencing will reduce such occurrences, but it is not a cure-all."[21] The mistake was building a CCRG instead of an RPSG. For example, in October 2017, the Ann Arbor Downtown Development Authority took up the issue of parking structure safety,[22] leading to installation of "suicide prevention fences."[23] Such fences have not been a panacea. Especially vulnerable to such suicide attempts are the parking structures of hospitals, because it has been established that most persons who have jumped to their deaths previously had been treated for a mental health condition."[24]

The Centers for Disease Control and Prevention (CDC) reports that suicide is the second leading cause of death among college-age students, which often occur in high, open-air campus parking garages (*i.e.,* CCRGs).[25] For example, The Ohio State University in 2018 had two separate apparent suicides days apart from their parking garages, prompting a mental health task force.[26] The closing of the top two floors was an attempt to prevent future suicides, but it is *not* a total solution. An RPSG's closed system design prevents parking garage suicide attempts, assaults and thefts.

The 2016 International Parking [and Mobility] Institute (IPMI) Report, ***"Suicide in Parking Facilities: Prevention, Response, and Recovery,"***[27] notes that 38% of respondents to an IPMI survey of its member organizations "experienced a suicide in one of their parking structures and an additional 10% experienced a suicide attempt." Of the respondents, 37% were in municipal garages and 38% were in university CCRGs.[28] Sadly, not specifically identified in the study were federal (*e.g.*, Veterans' Administration), or other hospital sites. As noted elsewhere in this document, the VA Parking Garage Design Manual (with a 2016 update) does not even include consideration of robotic parking garage design despite the inherently safer design evidence of RPSGs and other ARPGs. A review by Congress, the GAO, veterans' groups, and the VA of these issues is essential.[29] Suicide prevention approaches mentioned in the IPMI report included physical barriers – "fencing and screening," "signage,"

[20] https://www.researchgate.net/publication/51642315_Suicide_and_the_parking_garage
[21] http://www.mlive.com/news/ann-arbor/index.ssf/2017/05/preventing_suicides_from_ann_a.html
[22] https://localwiki.org/ann-arbor/Parking_structure_safety
[23] http://www.mlive.com/news/ann-arbor/index.ssf/2017/10/new_suicide-prevention_fences.html
[24] http://www.ncbi.nlm.nih.gov/pubmed/21916292
[25] http://www.parking.org/2016/05/12/suicide-parking-facilities-prevention-response-recovery/; http://www.parking.org/wp-content/uploads/2016/05/0416_Suicide_Book_web_final3.pdf
[26] https://www.dispatch.com/news/20180409/ohio-state-announces-mental-health-task-force-in-wake-of-two-people-jumping-or-falling-from-parking-garage?template=ampart
[27] http://www.parking.org/wp-content/uploads/2016/05/0416_Suicide_Book_web_final3.pdf
[28] *Id.*
[29] https://www.cfm.va.gov/til/dManual/dmParking.pdf

"geofencing" (*e.g.*, CCTV), and "equipment and operational abatement" (*e.g.*, staff).[30] See also these references.[31] These are serious – but inherently inadequate – attempts to compensate for the safety limitations of CCRG designs.

Larry Cohen, CAPP, Executive Director of the Lancaster (PA) Parking Authority, in his 2016 article, "*Saving Lives*" in *Parking* magazine,[32] noted that there were five suicides over a two-year period in one of the parking garages under his control. He formed a "Suicide Summit" of various professionals to develop prevention recommendations. One of the recommendations was a "zero-tolerance policy to keep anyone off the roof of the garage who wasn't coming to/from a vehicle."[33] Such policy, however, is not fool-proof. **Prevention was the overwhelming recommendation.** Why not just build RPSGs instead?

## Vehicle Damage, Theft, and Accidents Prevented Through RPSG Design

Due to the closed system design of many automated parking garage designs and technology, there is no opportunity for vehicle theft or damage after the patron-free vehicle leaves the entry terminal for storage. CCRG design, by its very nature, is a breeding ground for mischief. In a May 24, 2017 on-air report by Erin Richey and David Razig of KSDK TV in St. Louis, MO,[34] the reporters crunched three years of data to determine where cars are most likely to be stolen. The reporters quoted security expert Mike Barbieri, who they said taught them the "first real lesson" that in a parking garage, "even the best surveillance may not protect your car [or *you*!]" Barbieri was quoted as telling the two reporters that "[v]ery seldom do [police and CCTVs] catch someone breaking into the car with cameras, and by the time they call the security team to get down there, the car is gone [or the rape has occurred]."

Back over crashes in garages, parking lots, driveways, and on similar surfaces kill 200 and injure at least 17,000 each year as revealed in studies conducted by the U.S. Department of Transportation.[35] [36] Such incidents would not have occurred in a robotic garage.[37] Although now required by law, rearview camera systems are not a cure-all for back over crashes and accidents. RPSG design is.

## Federal Highway Administration: "Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance": What About Parking Garages?

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[30] *Id.*

[31] https://www.bing.com/search?q=%22countermeasures+for+suicide+prevention+2014&form=EDGNTT&qs=PF&cvid=16b28629b85d440089681c2058446754&cc=US&setlang=en-US&elv=AXXfrEiqqD9r3GuelwApulqda93cZDAw5Z37pYhAMBC2zTkZ7xGohSq*pWyM2XuRZvIVcjbfeTFbPeaOGGA1LUlyUI13IqjE9ZX4K86bhNCQ

[32] http://www.parking.org/2016/01/27/tpp-2015-08-saving-lives/

[33] *Id.* at 2.

[34] http://www.ksdk.com/mobile/article/news/local/5-on-your-side/where-are-st-louis-car-theft-hotspots/442318247

[35] https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/nhtsa-2006-25579-0001-2.pdf; https://www.rearviewsafety.com/safety/vehicle-safety-statistics-backovers/

[36] https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/811144

[37] *Id.*

Every uneven numbered year Department of Transportation's ("DOT") Federal Highway Administration ("FHWA") and Federal Transit Authority ("FTA") reports to Congress the conditions and performance of the U.S. "highways, bridges, and transit."[38] It seems odd or an unintended oversight that Congress does not include a specific requirement for consideration of parking modalities (CCRGs, lots, etc.) in its transportation legislation and statutes so that DOT and FTA could include collection of data, commentary, and recommendations on improved safety in parking facility design. Since parking garages or lots are the "first and last miles of travel" on highways and streets by the vehicles (*e.g.*, "dormant traffic"), DOT, FTA, FHWA, NHTSA, the VA and other agency responsibilities should specifically identify parking garages and parking lots. There should be a clear requirement that automated parking garage proposals be included in all RFPs and RFQs. Since Value Engineering is required in almost all federal projects, these agencies need to be aware that RPSGs are "reasonable alternative designs" and are "inherently safer," thereby reducing the costs of crime to society.

## Federal Highway Administration Goal – "Toward Zero Deaths"

The FHWA's "National Strategy on Highway Safety Toward Zero Deaths ("TZD")[39] approach "echoes the Department of Transportation's Strategic Plan, which articulates the goal of 'working toward no fatalities across all modes of transportation.'"[40] This logically includes parking garages and parking lots, in which vehicles are "dormant traffic." TZD also mirrors the DOT's stated primary goal of "safety." The FHWA's "strategic goal [is to ensure that] the nation's highway system provides safe, reliable, effective and sustainable mobility for all users."[41] Automated/robotic parking design and technology fulfills the ultimate safety goal of TZD since the RPSG design prevents deaths by restricting a vehicle's occupants or others from entering the storage space of the garage.

Federal and state governments regulate airbags, car bumpers, car seats, and highway guardrail designs. In keeping with DOT's #1 goal of "safety," its research efforts need to include safety, crime, and design comparisons between RPSGs and CCRGs to develop parking garage standards for DOT and state DOTs that include automated/robotic parking garage design. The same can be said for the VA and other federal agencies to conduct RPSG and CCRG comparative safety research as described below.

## Handicapped and Deaf Access

There often are inadequate numbers of available handicapped accessible parking spaces in CCRGs and parking lots. For many veterans and others who are handicapped/disabled, robotic parking garages are the easiest to use. A veteran and/or a caregiver would depart his/her vehicle at the entrance to the automated garage and not have to navigate a CCRG to and from the entrance. This reduces the chances that they would be late to their appointments – a major concern of many veterans who use CCRGs and parking lots.

[38] https://www.fhwa.dot.gov/policy/2015cpr/
[39] http://www.towardzerodeaths.org/; http://www.towardzerodeaths.org/partners/
[40] https://safety.fhwa.dot.gov/tzd/
[41] *Id.*

RPSG parking technology best complies with the concept of the *DeafSpace Guidelines* that were developed by Gallaudet University in coordination with DangermondKeane Architecture.[42] Since patrons exit and retrieve their vehicles at the entry/exit terminals, there is no walking to and from vehicles inside a CCRGs with their many structural, visual, auditory, and lighting shortcomings.

## Environmental Contributions of Robotic Parking Systems

Robotic Parking Systems are "green" products that conserve fuel and reduce pollution for a clean parking facility. Below is an example of emissions reduction and energy saved in a 1,000 space RPSG:

- Saves 13,750 gallons of gasoline annually in the parking process
- Quantity of toxic emissions eliminated are:
    - 2,001 lbs. of Hydrocarbons (HC) per year
    - 1,031 lbs. of Nitrogen Oxides (NOx) per year
    - 15,463 lbs. of Carbon Monoxide (CO) per year
    - 138 tons of Carbon Dioxide ($CO_2$) per year (*i.e.,* 90%+ reduction vs. a CCRG)
    - 4.9 tons of tire dust per year
    - 990 lbs. of brake dust per year

## "Costs of Crime to Society"

I believe that the 2010 NIH-supported research study on the "costs of crime to society" ("COCS") unequivocally demonstrates how concrete ramp parking garage design (CCRG) decisions by government, developers, and planners sadly and unavoidably are costing victims, next of kin, and taxpayer's lives and/or inordinate pain and unnecessary expenditures.[43] This NIH research translates the long-term costs of crime *(e.g*., sexual and other assault, murders, and thefts in parking garages), such as court costs, incarceration, recidivism, untested rape kits and PTSD.[44] For example, the cited NIH study (in 2008 dollars) estimated that the per person ("unit") COCS for murder was $8,982,097; rape/sexual assault $240,776; assault: $107,000; motor vehicle theft: $10,772; and robbery: $42,310. With the cost-of-living adjustment to 2019, the rape/sexual per unit COCS would be about $289,000. Therefore, conservatively estimating that only 25% of the 223,000 *reported* sexual assaults in 2004 across all parking garages, parking lots, and public areas occurred in CCRGs, that would mean costs, just for rapes and sexual assault, would be $289,000 per victim multiplied by a low estimate of 55,750 incidents each year in the U.S.

[42] http://dangermondkeane.com/deafspace-design-guide; https://www.curbed.com/2016/3/2/11140210/gallaudet-deafspace-washington-dc; http://www.deafspaceguidlines.com/about.html

[43] https://www.thestar.com/life/homes/2013/02/14/the_economic_trickledown_effect_of_construction_industry.html ; http://www.ncbi.nlm.nih.gov/pubmed/20071107; http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2835847/.

[44] http://www.ncbi.nlm.nih.gov/pubmed/20071107 ; http://www.ncbi.nlm.nih.gov/pubmed/24930620 https://www.thestar.com/life/homes/2013/02/14/the_economic_trickledown_effect_of_construction_industry.html; https://aacriminallaw.com/true-cost-crime-america; http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2835847/.

alone. That is over **$16 billion dollars per year**! This does not even consider all of the other crimes, suicides, and property losses that occur in CCRGs.

## "Crime Prevention Through Environmental Design" ["CPTED"]

The well-known concept in criminology, risk assessment, architecture, and site planning known as "Crime Prevention through Environmental Design" ("CPTED") has received considerable historical DOJ funding.[45] One of the key factors that inhibits crime is the design of a facility, such as an inherently safer RPSG design.[46] The April 1996 National Institute of Justice research study stated, "Because parking facilities are more likely settings for crime – both violent and property – than all other real estate except residential, security is one of the most critical issues facing owners [, operators and patrons] of parking facilities today."[47] From RPS' first garage that was built in 2002, it has demonstrated that its garage design best meets the criteria of CPTED by totally preventing internal parking garage crime and suicide. CPTED can reduce crime in CCRGs, but cannot prevent it. An excellent discussion of premises liability and its relationship to CPTED is contained in "The Expanding Role of [CPTED] in Premises Liability."[48] CPTED strategies, such as situational crime prevention and crime displacement, depend on the **capacity to impact offender decisions that *precede* criminal acts. *No opportunity* for crime in an RPSG equals *no* crime.** Studies have clearly demonstrated that many incidents of crime and suicide, because the impulse to commit the crime or complete a suicide often passes, **are *not* shifted to another venue or locale** as some commonly believe.[49]

The person who is the only architect and Ph.D. criminologist in the U.S., Randall I Atlas, Ph.D., AIA, LEED, a leading CPTED and security analyst, has written the seminal book/guide on CPTED. He speaks broadly across the U.S. and globally as well as serves as an expert in court relative to rape and sexual and other assault in parking garages. Dr. Atlas supports my view that RPSGs are of a "Reasonable Alternative Design" that meet CPTED criteria. Also, he concludes that,

> "A legal and physical benchmark puts essentially all of corporate America on notice to make their buildings [as] safe [as [possible]] against crime, not just safe against the remote occurrence of fire. Insurance companies are strongly supporting standards that they could measure a business against and reduce their losses and have less payout. … **The increased threat of premises liability litigation will be the strongest driving element for change.**"[50]

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[45] http://www.cpted-security.com/security-design-cpted/; http://www.cptedtraining.net/index.php?page=cpted-professional-designation

[46] http://www.jstor.org/stable/1147596?seq=1#page_scan_tab_contents; http://www.oxfordbibliographies.com/view/document/obo-9780195396607/obo-9780195396607-0040.xml

[47] https://pdfs.semanticscholar.org/0c95/3588e001d886919c5a0f55ef3650d9d76957.pdf;

[48] https://www.ncjrs.gov/pdffiles/cptedlia.pdf

[49] http://www.predpol.com/crime-displacement-predpol/; https://www.suicideinfo.ca/resource/siecno-20160094/

[50] 21st century security and CPTED: designing for critical infrastructure and crime prevention / edited by Randall I. Atlas. (2013)

## "False Choice" – Patrons Denied Inherently Safer Parking If Automated Option Not Disclosed

"In military terminology, 'false choice' is a factor that dramatically decreases the effectiveness of an item or group. Military examples include troop morale, reputation, training, and so on. A social force multiplier in this context would be an attitude, social expectation, or behavior that multiplied the force of conservation [safety] or efficiency efforts – or made conservation [inherently enhanced safety] or efficiency policy possible." [51] False choice is a type of informal fallacy in which something is claimed to be an "either/or" choice, when in fact there is at least one additional (and potentially superior) option that is not mentioned or offered.[52] The operation of this phenomenon in terms of the essential choice and selection of an obviously and inherently safer parking garage design can have real human and fiscal consequences and can arise when decision-makers and/or consultants neither present nor accurately discuss all viable parking garage designs.

## "Reasonable Alternative Design," "Inherently Safer Design" Risk

In product liability law, "product" includes "machinery," a major component of RPS garage design and technology. In terms of product liability under tort law, especially with regard to the "machinery" inclusion, I believe that the "reasonable alternative design" ("RAD") legal standard or test adopted in 1998 by the Restatement (Third) of Torts legal treatise of the American Law Institute, logically should be a recognized element in all parking garage liability lawsuits that relate to post-2002 parking garages, as issues of duty, foreseeability, and "risk-utility," in the context of parking garage liability, further evolve.[53] I posit that the Third Restatement's "risk-utility" analysis affords one of the rational means, at least in U.S. courts, along with Value Engineering ("VE") analysis, of evaluating the advantages and disadvantages of the parking garage designs in question. The discussion also revolves around how 'courts' reliance on 'custom' [as in 'by custom' or 'customary'] and conventional technologies [*e.g.*, CCRGs] as the benchmark for assigning tort liability chills innovation and distorts its path. This reliance taxes innovators and subsidizes users and replicators of conventional technologies." I agree with this view, as stated by Professors Gideon Parchomovsky and Alex Stein, in a 2008 *Michigan Law Review* article.[54] Further, I believe that the "product" distinction is an artificial one that otherwise might not recognize RPSG design and technology as a "product," unless it is recognized for its majority machinery

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[51] http://www.resilience.org/stories/2011-03-25/force-multipliers; http://roboticparking.com/news/newsletter/ParkSmart_issue_34.pdf

[52] http://www.txstate.edu/philosophy/resources/fallacy-definitions/False-Dilemma.html; https://en.wikipedia.org/wiki/False_dilemma;

[53] RESTATEMENT (THIRD) OF TORTS: PROD. LIAB. (1998), http://www.diogenesllc.com/liabilitytrends.pdf; Izzarelli v. R.J. Reynolds Tobacco Co., 321 Conn. 172, 2016 Conn. LEXIS 100 (Conn. 2016);Twerski & Henderson, Manufacturers' Liability for Defective Product Designs: The Triumph of Risk-Utility, 74 Brook. L. Rev. 1061, 1106-1108 (2009) ("The overwhelming majority of cases that rely on consumer expectations as the theory for imposing liability do so only in res ipsa-like situations in which an inference of defect can be drawn from the happening of a product-related accident"); [53] Branham v. Ford Motor Co., 390 S.C. 203; Branham v. Ford Motor Co., 390 S.C. 203; Hernandez v. Tokai Corp., 2 S.W.3d ; http://scholars.law.unlv.edu/cgi/viewcontent.cgi?article=1302&context=nlj

[54] https://scholarship.law.upenn.edu/faculty_scholarship/239/

components; and, therefore, relegated to less robust and clarifying legal analysis. RPSG design and technology is inherently safer, and arguably "liability-proof" design – a key qualifier in this professor's view and that of other legal scholars as to parity analysis. On that basis, I assert that courts should give RPSGs the same "custom" deference courts likely otherwise would give "customary" CCRG designs since RPSGS have been proven in operation as an inherently safer parking garage design since 2002. In that regard, I believe that such RAD evidence would provide plaintiffs' attorneys with a very sharp additional sword in seeking the judicial determination that CCRGs are "not reasonably safe" under current legal standards, or that CCRGs do not meet the accepted principles of "inherently safer design"[55] when compared to the inherently safer RPSG design and technology. Clearly, CCRGs have a documented history of assault, suicide, death, theft, serious property damage, and/or other preventable negative outcomes.[56] I believe that with regard to a cause of action relating to a CCRG, a post-2002 RAD element in a pleading would be substantial and likely irrebuttable in my opinion. In this situation, a plaintiff would demonstrate or establish through expert testimony that a safer, "reasonable alternative [RPSG] design" would have prevented the injury/death/loss through "products" and "machinery" [on which courts have determined can be relied upon based on "custom"] already available on the market [at the time of the alleged incident] that [serve] the same or very similar function at lower risk and at comparable cost."[57]

The concept of "inherently safer design" gained initial prominence in assessing the performance and safety of chemical and nuclear explosions and how to design chemical plants and nuclear reactors that are of "inherently safer designs" than the facilities that malfunctioned and caused deaths, injuries, environmental damage, and property losses.[58] The word "inherently" means "existing in something as a permanent and inseparable element, quality, or attribute,"[59] or "existing as an essential constituent or characteristic; intrinsic."[60]

The "'inherently safer design" [terminology or nomenclature incorporates the sense that essential] consideration is given [or attributed] to **safety** when designing a process." [61] It focuses on "design that eliminates or minimizes hazards."[62] It is **"safety … that is 'built in, not 'added on' … to eliminate or minimize hazards rather than control [or attempt to compensate for recognized and historically identified] hazards."**[63] It is "integral to the product, process, or plant – [that] cannot be easily [or

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[55] https://www.researchgate.net/publication/267344271_348788_Inherently_Safer_Design_Lessons_Learned_about_the_Principle_of_Simplification; https://risk-engineering.org/safe-design/

[56] Note, The Increasing Acceptance of the Restatement (Third) Risk Utility Analysis in Design Defect Claims, 4 Nev. L.J. 609, 616, 625 (2004) ("an increasing number of jurisdictions recognize the usefulness of the Restatement's risk-utility analysis," and "[o]f the jurisdictions that continue to explicitly or implicitly reject the risk-utility analysis set forth by the [Third Restatement], the courts provide little justification for their holdings and bind themselves by nothing other than outdated precedent").

[57] https://www.natlawreview.com/article/raising-bar-design-defect-claims-new-jersey-judge-puts-plaintiffs-feet-to-fire

[58] https://risk-engineering.org/safe-design/;https://www.semanticscholar.org/paper/Selection-of-inherently-safer-process-routes%3A-a-Palaniappan-Srinivasan/11e790b306508208bdde489e516588887593fb0a

[59] http://www.dictionary.com/browse/inherently

[60] http://www.thefreedictionary.com/inherently

[61] https://www.collinsdictionary.com/dictionary/english/inherently-safer-design

[62] *Id.*

[63] www.sache.org/links/Pike21Jul2004/**Inherently Safer Design**.ppt

permanently] defeated or changed without fundamentally altering the process or plant [*e.g*., parking garage] design."[64] RPSG design and technology elements are an inseparable and integral blend of "passive" and "active" safety strategies. As a "passive" safety strategy, it "[eliminates or] minimize[s] hazard[s] using process or equipment **design** features [that] reduce [**or eliminate**] frequency or consequence [*e.g*., sexual assault, theft] without the active functioning of any hazard-controlling device [*e.g.,* CCTVs, fences, lighting]." As an "active" safety strategy, it "prevent[s] incidents or mitigates the consequences of incidents." The four "inherently safer design" strategies are "minimize, moderate, substitute, and simplify."[65] (emphasis added)

Using this concept of "inherently safer design" in conjunction with the legal standard of "reasonable alternative design," I believe one necessarily is forced to own how these two constructs forcefully establish the obligation of duty holders to fully comprehend the significant inherent safety design distinctions and necessary risk assessments between CCRGs and automated parking garages and make a paradigm (parkadigm) shift in their analysis and act accordingly by choosing an RPSG or other ARPG design.

The RAD requirement is, in effect, "an exemplification of risk-utility analysis predicated on the notion that if a product's foreseeable risks could have been avoided by adoption of a 'reasonable alternative design,' then the product's risks must have outweighed its utility." Twerski & Henderson, *supra,* at 1076-77. *Williams v. Bennett,* 921 So.2d 1269 (2006), at 1077, noted that design defect cases occupied a "special place" in the product liability field:

> "More than any other type of product liability case, a trier of fact in a design defect case depends on **'objective evidentiary mechanisms' to determine liability.** The court further stated that "design defect cases require **some outside, external, objective standard** for defectiveness, which cannot be found in generalized references to industry expectations. **Instead that standard must be found in reasonable alternative designs."[66]** (emphasis added)

I assert that the Third Restatement's RAD comments complement and echo Value Engineering analysis and CPTED criteria.[67] Add to these considerations the real additional economic and societal costs of inevitable litigation, the long-term emotional and physical tolls of rapes/assaults, deaths, suicides, and lost productivity from wasted and riskier travel/walking time to and from parked vehicles inside a CCRG. I believe that recent court judgments[68] suggest significant and even more costly financial outcomes in future RAD-based court decisions for CCRG owners and operators, developers, governments, and planners for injuries or deaths in CCRGs for not adopting, endorsing, or otherwise choosing inherently safer "reasonable alternative design(ed)" automated parking garages over CCRGs.[69]

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[64] *Id.*
[65] *Id.*
[66] *Id.*
[67] http://www.value-eng.org
[68] https://www.legalexaminer.com/?s=slip+and+fall+cases+in+parking+garages
[69] Branham v. Ford Motor Co., 390 S.C. 203; Branham v. Ford Motor Co., 390 S.C. 203; Hernandez v. Tokai Corp., 2 S.W.3d; http://scholars.law.unlv.edu/cgi/viewcontent.cgi?article=1302&context=nlj

The law firm Reed Smith published "On Alternative Design" in 2013, by James M. Beck, Esq., by focusing on strict liability,[70] followed in February 2017, with "On Alternative Design, Take Two – Negligence." The 2013 commentary took "the [reasonable] alternative design requirement for strict liability as a given" and "concentrated on the proposition that an "alternative" design must actually constitute a different design for the same product category" [*e.g.,* a parking garage].[71] Again, I assert that RPSG design and technology, on the basis of its machinery, qualifies as a "product" in terms of product liability in tort. The 2017 commentary examines whether "an alternative design is also an element of a design-related claim sounding in negligence." The 2017 Reed Smith commentary posits that,

> "the overwhelming weight of nationwide precedent established that ***negligent*** design claims require the plaintiff to **establish the existence of a feasible [or reasonable] alternative design that would have prevented the plaintiff's injuries."** For example, the commentary stated that in Pennsylvania, "[t]he determination of whether a product was negligently designed turns on whether an alternative, feasible, safer design would have lessened or eliminated the injury plaintiff suffered."[72] (emphasis added)

Lawsuits by patrons (or their next of kin) of CCRG parking facilities are clearly increasing, with allegations of premises liability for deaths, sexual assaults and other injuries, and property damage or loss caused by structural defects/collapses,[73] criminal acts or other hazardous conditions. A $4M "trip and fall" South Carolina court judgment,[74] a July 2017 $39 million Wisconsin Court of Appeals verdict against the builder of a parking garage where a 15-year old was killed in 2010 when a 13-ton concrete slab in a CCRG fell, and a $26.5M settlement in the fatal collapse of a Miami-Dade College CCRG under construction,[75] among others, validate this trend and likely are just the "tip of the iceberg" in what I predict will be significant RAD-based parking garage litigation and plaintiff success well into the future since there are many CCRGs built since 2002 when the first RPSG began operation. Also, one must be reminded of the positive impact of RPSG design that prevents the occurrence of rape and that the lifetime cost of rape per victim [76] which court judgments don't fully account for, but are real in terms of lost productivity and pushed off on the victim, city governments, insurance companies, and others.

There is a well-documented history of liability being attached to defendants for failing to adopt measures to avoid future harm-causing injury or known security and safety deficits that might have prevented harm from being inflicted upon guests, including a recent $6.6M Boston Radisson hotel rape judgment. The case's lead counsel and the principal of Atlanta's Keenan Law Firm, Don Keenan, suggested that jurors in that case placed all the blame on the corporate owners of the Radisson hotel because the hotel

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[70] https://www.druganddevicelawblog.com/2013/08/on-alternative-design.html

[71] https://www.druganddevicelawblog.com/2017/02/on-alternative-design-take-two-%E2%88%92-negligence.html

[72] *Id*.; *Berrier v. Simplicity Manufacturing, Inc.*, 563 F.3d 38, 64 (3d Cir. 2009) (emphasis original).

[73] https://www.2keller.com/library/parking-garages-and-premises-liability-indiana-slip-and-fall-lawyer.cfm/

[74] http://www.injuryclaimcoach.com/parking-lot-injury.html#; http://www.mklawsc.com/wp-content/uploads/2015/03/SC_2014_WL_7934110_BURKE_v_REPUBLIC_PARKING_SYSTEM_INC.pdf

[75] https://www.osha.gov/doc/engineering/2013_r_02.html; http://www.insurancejournal.com/news/southeast/2015/05/14/368124.htm; http://www.enr.com/articles/2149-builders-26-5m-settlement-will-rebuild-college-s-collapsed-garage?v=preview;

[76] https://www.nsvrc.org/statistics

had not adequately enhanced security protocol after a similar attack on another woman by the same rapist only 12 days before his client was assaulted. Police had asked the hotel not to mention the earlier attack while they were investigating the first attack. However, it is my view that if an RPSG had been built, there never would have been a sexual assault case brought because none would have occurred.

The duty may arise when the **"totality of the circumstances"** are considered or the owner or operator knows or has reason to know of prior incidents of the same or similar kind committed on the premises, as was the case in the Boston Radisson Hotel case. My question is whether, with all of the published reports of sexual assaults and suicides in CCRGs, courts will begin to hold defendants to the "should have known" foreseeability standard for such incidents in CCRG by design, when a RAD garage (*e.g*, an RPSG) could have been built at the time of the litigated incident.

## Risk Management: Tolerance of Risk; "Reducing Risk, Protecting People

The United Kingdom, through its Health and Safety Executive (HSE), established under the Health and Safety at Work Act 1974,[77] (HSW) prepared *Reducing Risks, Protecting People* ("R2P2") in 1999 and revised it in 2001,[78] to set out how statutory bodies should approach making decisions about the management of risk required under the HSW Act, including "proposing new laws and standards, conducting research and providing information and advice." A major purpose was to ensure consistency and coherence across a full range of risks within the scope of the HSW Act, based on a framework and method that HSE applies to the control of risk at nuclear power stations, first published in 1988 as *"The Tolerability Of Risks from Nuclear Power Stations (TOR)***."** [79]

> **"**The public is … more aware that, given [that] few activities are without any risk, there must be a balance between the health and safety measures introduced to eliminate or control risks … [80]
>
> "[R2P2] introduces the **concept of tolerability** which is central to the document. This concept refers to a **willingness to live with a risk so as to secure certain benefits."** [81] (emphasis added)

Or, I believe that one could also restate this concept as an *unwillingness [or lack of necessity]* to live with a risk that compromises safety to secure certain benefits if there is an *inherently safer and cost-effective alternative.* In fact, RPSGs *prevent – not just lower the risk as low as is reasonably practical or achievable.*

The HSE framework establishes the requirement that both the level of individual risks and societal concerns engendered by the activity or process (*e.g.* a parking garage) must be empirically evaluated through objective evidence-based criteria when "deciding whether a risk is unacceptable, tolerable or

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[77] *Health and Safety at Work Act 1974* SI 1974/1439; The Stationery Office 1974 ISBN 0 11 141439 X.
[78] *Reducing Risks, Protecting People*, 1999, at http://www.hse.gov.uk/risk/theory/r2p2.pdf
[79] *The Tolerability of risks from nuclear power stations,* HSE Books 1992 ISBN 0 11 886368 1, *Id.*, at v.
[80] *Reducing Risks, Protecting People*, 1999, at http://www.hse.gov.uk/risk/theory/r2p2.pdf, at v-vi.
[81] *Id*., at 2.

broadly acceptable" and that "the decision-making process and criteria adopted are such that action taken is inherently precautionary." [82]

This HSE approach mirrors the U.S. legal system that looks at prior incidents and reasonably foreseeable events to attach liability to duty holders, but in the U.S., there also are mandates to conduct environmental and value engineering analyses for federal and many state projects. In my opinion, the HSE protocol should be an essential element in any utility/risk analysis required to be undertaken in the U.S. It is logically consistent with the concept of "Reasonable Alternative Design:"

> "Once the problem has been characterized [the HSE directorate reviews] the **options available for managing the risks**. These can range from doing nothing to introducing measures (whether non-regulatory or regulatory) **to get rid of the [root] cause of the problem altogether**, or to reduce it to one which people are prepared to live with so as to secure certain benefits and in the confidence that the risk is one that is worth taking and **that it is being properly controlled.**[83] (emphasis added)

It is useful reviewing how the HSE frames the analyses in terms or "hazard" and "risk," as follows:

> "Hazard and risk are used interchangeably in everyday vocabulary. Nevertheless, it has proved useful to HSE to make a conceptual distinction between a 'hazard' and a 'risk' by describing a hazard as the potential for harm arising from an intrinsic property or disposition of something to cause detriment, and risk as the chance that someone or something that is valued will be adversely affected in a stipulated way by the hazard. HSE – as far as the health, safety and welfare of people is concerned – frequently makes use of the above conceptual distinction in its guidance by requiring that hazards be identified [and] the risks they give rise to are assessed and appropriate control measures introduced to address the risks."

HSE further discusses individuals' perception of risk and whether they (consciously or not) assume certain risks. It is particularly relevant when decision makers have had the choice – or should have been presented the choice (*Cf*., the "false choice" dilemma) to approve a product, such as an RPSG that is of an "inherently safer design" vis-à-vis a CCRG that poses reasonably foreseeable risks that the RPSG, by design, does not. The true and obvious "control measure" needed is to have a **firm policy for evidence-based methods to objectively evaluate ARPGs vis-à-vis CCRGs**.

Relative to the issue of due diligence and responsible decision-making by duty holders, the R2P2 document includes the following:

> "The **process of assessing risks needs to take account of the possibility of uncertainty.** For example, the science underpinning the assessment may be complex, ambiguous or incomplete and/or the necessary data may not be available. (emphasis added.)

[82] http://www.hse.gov.uk/risk/theory/r2p2.pdf, at 3.
[83] *Id.*, ¶ 96, at 32.

> "**We must first distinguish between uncertainty and ignorance**. The latter refers to a lack of awareness of factors influencing the issue. This is a well-recognized weakness in risk assessment – that the identification of hazards may be incomplete. The measures needed to counteract ignorance are a wide engagement of different disciplines and communities of interest in the characterization of the issue. … A **further measure is to practice openness to the greatest degree possible so that thinking can be exposed to alternative views at an early stage** [and the mandate of Value Engineering in federal and many state project proposals]."[84, 85] (emphasis added)

In "Reducing Risks, Protecting People," [86] HSE concludes that there are many courses of action that can be taken, including ***requiring*** **decision makers to *only approve* those products or processes that meet the inherently safer design decisions of HSE, banning non-compliant designs**, using the concept of "reasonable practicability," and relying on case law, qualified by "so far as is reasonably practicable" or "as low as is reasonably practicable, on a case-by-case basis (*Cf.,* "RAD"), to determine if there has been compliance with the Act. Key considerations include risks that arise out of reasonably foreseeable events and behavior and risks that are under the control of the duty-holder (*i.e.,* jurisdiction, developer, and/or consultant). In addition, "cost-benefit analysis" ("CBA") is used in decision-making in **assessing acceptable risk and what is "tolerable," the "Value of Preventing a Fatality" ("VPF"), and "whether costs are grossly disproportionate to benefits**."[87] (emphasis added)

HSE, at ¶ 103, states that:

> **"[w]hen an option produces the benefit of preventing fatalities [*e.g.,* RPSGs],** this requires putting a monetary value on achieving a reduction in the risk of death… There may also be potential benefits in terms of not having to take measures, [such as LED lights, wayfinding, internal garage security guards] which otherwise would be needed [in a CCRG] to reduce the effects on health and safety following an incident" [88] [or the elimination of the risk of death due to the use of the RPSG design and technology]." (emphasis added)

Duty holders must fully absorb the discussion of HSE's "**framework for the tolerability of risk**"[89] as a comparable U.S. decision-making basis for assessing risks. For this discussion, "the present situation in the duty holder's undertaking" would be the decision to approve and/or build a CCRG. I assert that the CCRG option fails the "gross disproportion" test when the RPSG option is openly and objectively evaluated during the due diligence process.

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[84] *Id.,* ¶¶ 86-87, at 27.

[85] Office of Science and Technology *Guidelines 2000: Scientific Advice and Policy Making 2000.* Available from the UK Department of Trade and Industry.

[86] *Id.*

[87] *Id*.

[88] *Id.,* ¶¶ 103, 104, at 36.

[89] *Id.*, ¶¶ 122-127, at 42-43.

## "Value Engineering "VE" – Performance, Safety, Quality, Reliability, and Lower Operating Costs

Value engineering had its genesis at General Electric during World War II. Because of the war, there were shortages of skilled labor, raw materials, and component parts. Value engineering began with an inventive, team-based approach that allowed the generation of many alternatives that fostered the development/creation of an enhanced functional solution within cost and time constraints. Later in the 20th century, value engineering started to spread across the world. But because of the differences between the mindset and culture of American companies vis-à-vis European companies, value engineering, as developed in the U.S. had to undergo some adjustment, which led to VE being "applied as a broad, high-order description which encompassed all value techniques, whether applied at a strategic or tactical level." [90]

I am convinced that RPS' garage technology fully comports with the **Federally-mandated** (*e.g.,* OMB, GSA, VA, DoD, DHS, DOJ/FBI, DOT/FTA) Value Engineering protocols that ***require*** full and documented consideration of "**alternative design**" solutions to "**optimize the expected cost/worth ratio**" of projects at completion for the purpose of achieving "**essential functions** at the **lowest life cycle costs** consistent with required performance, quality, reliability, and **safety**." [91] (emphasis added) Furthermore, all Federal agency decision-makers and VE consultants are required to sign their names to their recommendations and justify VE analysis or justify why they have decided that VE is not appropriate. It is my belief that many Federal officials have failed to abide by this requirement regarding parking garage design. The 2014 revision of OMB Circular A-21 openly states that the use of VE has "waned" over the years, despite being "mandated" by federal law since 1996. [92] So, what gives? As Stephen King wrote in his novel, *11/22/63*, "[r]esistance to change is proportional to how much the future might be altered by a given act."[93]

Although widely used in construction as a purchasing approach to reduce costs, VE is now "regaining its stature as a key modern project management technique," such as "project sustainability, addressing material sustainability (*e.g.*, life cycle, carbon, health and biophilic [*i.e.*, a strong attraction for or emotional attachment to the living world] impacts, … low carbon solutions, … social impact [inherent safety, wellness, local, skills, transport, community impact],"[94] and functionality.

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[90] https://en.wikipedia.org/wiki/Value_engineering

[91] NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 1996. PUBLIC LAW 104–106—FEB. 10, 1996.
https://www.transit.dot.gov/funding/procurement/project-management-oversight-pmo;
https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Project_and_Construction_Mgmt_Guidelines_2016.pdf;
https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FINAL_FTA_QMS__Guidelines_December_2012.pdf;
https://www.transit.dot.gov/funding/procurement/value-engineering-ve-transit-projects
https://www.gpo.gov/fdsys/pkg/USCODE-2009-title41/html/USCODE-2009-title41-chap7-sec432.htm;

[92] https://www.federalregister.gov/documents/2013/12/26/2013-30816/value-engineering

[93] King, S. (2011). *11/22/63: A novel*. New York: Scribner

[94] *Id.*

However, even though various articles have mentioned how value engineering can be useful in designing a "safe" (CCRG) parking garage,[95] I have not found any Federal agency or state entity that has employed value engineering in comparing CCRG and robotic parking garage projects, despite the landmark 1996 Federal law and succeeding VE regulations.

I am convinced that for new parking garages since 2004, if VE had been employed as required by law, many automated/robotic parking garages would have received positive VE reviews and be in operation in Federal, State, local, and private sector situations across the U.S.

VE analysis does not require cost as the only factor in the mandated evaluation, but, as noted earlier, below-ground RPSG applications also have lower CAPEX and OPEX than CCRG applications, due to less excavation. Also, above ground CCRG applications are much taller and/or have larger footprints than RPSGs space-for-space. RPSG aesthetics are optimized with *closed* façades that can mirror adjoining buildings which is especially important in historic communities.

In their book, Brynjolfsson and McAfee, state that "the best way to accelerate progress is to increase our capacity to test out new combinations of ideas (*e.g.,* **'recombinant innovation'**). One excellent way to do this is to involve more people in the testing process."[96] I assert that is the essence of value engineering, which federal legislators and others forcefully acknowledged by mandating in statute and regulations that VE analyses ***must*** be utilized in ***all*** relevant Federal contracts and many State contracts. It also echoes the legal community's development of the **"reasonable alternative design"** standard that rewards innovators whose products enhance safety.

As not to "beat a dead horse," as noted above*,* ***value engineering is specifically mandated*** for Federal agencies by section 4306 of the National Defense Authorization Act for Fiscal Year 1996,[97] which amended the Office of Federal Procurement Policy Act (41 U.S.C. 401 et seq.):

> "Each executive agency ***shall*** establish and maintain cost-effective value engineering procedures and processes … As used in this section, the term 'value engineering' means an analysis of the **functions** of a program, project, system, product, item of equipment, building, facility, service, or supply of an executive agency, performed by qualified agency or contractor personnel, directed at ***improving performance, reliability, quality, safety, and life cycle costs***."[98] (emphasis added)

DoD updated its "INSTRUCTION" [NUMBER 4245.14, October 26, 2012].[99] Noteworthy are two passages from that document that include reference to "functional requirements":

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[95] http://www.buildings.com/article-details/articleid/14946/title/4-parking-security-essentials/viewall/true.aspx

[96] Erik Brynjolfsson and Andrew McAfee, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, (New York: W.W. Norton & Company, 2014) p. 83.

[97] NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 1996. PUBLIC LAW 104–106—FEB. 10, 1996. https://www.gpo.gov/fdsys/pkg/FR-1996-07-26/pdf/96-18497.pdf.

[98] https://www.federalregister.gov/documents/2013/12/26/2013-30816/value-engineering; https://www.law.cornell.edu/uscode/text/41/1711

[99] http://www.dtic.mil/whs/directives/corres/pdf/424514p.pdf

- "A Government-only VE program **shall** be used to eliminate costs and improve value in the development, procurement, acquisition, and life-cycle support of services, materiel, and facilities." …
- "Use VE program requirements (VEPRs) to identify opportunities for savings in contracts consistent with the ***functional requirements*** of the end item of the contract to include production, support, and service contracts." (emphasis added)

The Office of Management and Budget (OMB), in its "CIRCULAR No. A-131 (REVISED)," December 26, 2013,[100] (effective January 13, 2014) also made the following key points:

- "… provides guidance to support the **sustained use of value engineering** (VE) by Federal Departments and Agencies to reduce program and acquisition costs, improve performance, enhance quality, and **foster the use of innovation** and to ensure VE is considered and integrated, as appropriate, into the planning and development of agency programs, projects, activities, as well as contracts for supplies and services, including **performance based**, architect-engineering, and construction contracts."
- "The results of VE may be indicated when **best value requires an initial [additional] expenditure of funds in order to meet basic functions at a lower cost over the life of the project, program, or systems**."
- "VE can result in the **increased use of innovative materials, technologies or practices, and environmentally-sound and energy-efficient practices and materials.** For example, the application of VE to facilities construction can yield a better value when the development, design, acquisition, and construction phases of the project are approached in a manner that **considers community and environmental commitments and project constraints** and incorporates environmentally-sound and energy-efficient practices and materials."[101] (emphasis added)

Each "Chief Financial Officers Act of 1990" Federal agency (*e.g.,* DoD, DOJ, DOT, VA, EPA, GSA, NSF, OPM)[102] is required each Fiscal Year to report to the OMB by December 31st of each calendar year the FY results of using VE. Net life-cycle cost savings, including a description of the top five projects utilizing VE, must be reported, showing cost savings, cost avoidances, and quality improvements achieved through application of VE. To obtain a fuller sense of OMB's guidance for all federal departments and agencies, it is worthwhile to read the entire document.

A **Georgia DOT's VE analysis saved over $100 million -- *217 times* the cost of VE analysis** in FY 2010 over 44 projects.[103] Clearly, many deferred infrastructure projects and repairs across the country could be completed using such savings from VE analysis. Shocking for me to hear was the emphatic (but

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[100] https://www.federalregister.gov/documents/2013/12/26/2013-30816/value-engineering;
[101] *Id.*
[102] https://en.wikipedia.org/wiki/Chief_Financial_Officers_Act;
[103] http://jacksonville.com/news/georgia/2011-06-18/story/georgia-dot-value-engineering-saved-millions; http://www.sas.usace.army.mil/Portals/61/docs/SHEP/Reports/GRR/2%20Value%20Engineering%20Study%20Summary%20Report%20SHEP%20June%202008.pdf

discouraging) statement from a certified VE consultant in Northern Virginia that the Federal Transit Administration (FTA), as well as independent architects and contractors, seem to have openly ignored the VE mandate in designing and/or approving Federal projects under their jurisdictions.[104] The GAO has stated that VE should be used more.[105] My view is that the DOT Inspector General and GAO immediately should investigate and quantify each Federal agency's use or non-use of VE regarding parking structures since 2002, the first year a U.S. RPS robotic garage was built after the 1996 law was enacted.

Federal Transit Administration (FTA) Circular 4220.1E, Section 7(g) sets forth the imperative for value engineering clauses in construction contracts:

> *"g. Use of Value Engineering in Construction Contracts:*
>
> *"Grantees are encouraged to use value engineering clauses in contracts.* ***FTA cannot approve a New Starts grant application for final design funding or a full funding grant agreement until value engineering is complete.*** *(see* Circular 5010)." [106]

To determine if the Federal Transit Administration (FTA) failed to consider value engineering, NEPA, and general air quality considerations in analyzing a project, as required by law, I reviewed the FTA Region III "Finding of No Significant Impact" statement, approved June 7, 2011,[107] for the Ardmore Transit Center, the applicant for which was the Southeastern Pennsylvania Transit Authority (SEPTA). The FTA stated that the "Ardmore Transit Center Project was not expected to result in adverse air quality impacts for transportation-related pollutants." I respectfully disagree.[108]

A 2008 summary of State VE requirements prepared by the U.S. Department of Transportation is available.[109] A training PowerPoint from the Florida DOT makes it clear that **"[VE's principal goal] is not cost reduction!!!** Value Engineering is the **systematic application of function-oriented techniques** by a multi-disciplined team to analyze and **improve the value of a product, process or service**" that is the key reason to do value engineering studies. The Federal Highway Administration (FHA) published a paper in 1999 ("Value Engineering: An Incredible Return on Investment"), noting that "a record $750 million was saved in fiscal 1998 by implementing VE in highway projects." It further stated that the **"return on investment was more than 120 to 1."**[110] In that same 1999 FHWA article:

> "Virginia Department of Transportation (VDOT) Management Services Administrator Larry D. Jones, who [oversaw] VE programs [in that 1999 time period], noted that **VE is not simply a cost-reduction program; it is a way of determining maximum value**.

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[104] To protect his company's position as a leading VE consulting firm, the VE consultant requested anonymity.
[105] http://www.gao.gov/products/120241
[106] http://www.wsdot.wa.gov/Design/ValueEngineering; http://www.dot.state.oh.us/Divisions/ConstructionMgt/Pages/ValueEngineering.aspx
[107] https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/Ardmore_TC_Signed_FONSI_06_07_11.pdf
[108] *Id*.
[109] https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/content/designsupport/projectreview/valueeng/reports/annualreport16-17.pdf?sfvrsn=a865fac5_0
[110] https://www.fhwa.dot.gov/publications/publicroads/99septoct/valu-eng.cfm

> "Most often, cost reductions are recommended, but in some instances, we'll recommend an increase," he said. "Because, while short-term costs are increased on a specific project, **if that means that bridge or road lasts longer and we'll need less ongoing maintenance**, we'll pay less throughout the lifetime of the facility. We call that a **life-cycle cost reduction."**[111]

Interestingly, the Washington State DOT provides specific guidance on value engineering for projects with a total estimated cost of $25 million or "[a]ny other projects the [state] or FHWA determines to be appropriate."[112] If a parking garage project in Washington State was estimated to cost at least $25 million, I expect that the required value engineering analysis would discover an ARPG design and technology that would be inherently safer and provide lower operating costs, as well as other meaningful benefits. Also, if projects are estimated to cost at least $5 million and are "major structures" or "New/Reconstruction projects," the Washington State manual states that the project(s) should consider VE.[113]

Under explicit Federal guidelines, if the VE analysis determines that there is only one product that can **properly meet all of the functional** or other VE criteria and at a **life cycle cost no greater than other "alternative designs," *a "sole source" contract*** can be authorized for a specific product.[114] I believe that RPS' parking garage technology justifies the award of "sole source" contracts for garages of 300 or more parking spaces.

Additionally, **GSA encourages local and State governments, as well as private firms and contractors, to embrace VE requirements** as fully as the Federal government is required to do. I could not be any more enthusiastic about such strong federal mandate to utilize and enforce VE design principles that address social imperatives, such as safety. However, it seems that value engineering is being "blown off" with abandon when a federal or state agency doesn't want to build something that is different than what they had already decided to do.

Big ticket projects, like the LaGuardia Airport Terminal Redevelopment Program should have a Value Engineering requirement, because the architect, HAKS, a proponent of VE, is a principal architect for the project and there are two parking garages (*i.e.*, 1,100 and 3,130 spaces) included in the redevelopment proposal for LGA.[115] Also, expansion plans for parking at JFK, O'Hare, Norfolk, and DCA, and elsewhere should be VE analyzed. Other prime candidates are the Washington, DC Amtrak Union Station redevelopment project, Metro North sites in New York, expansion plans for regional transit, hospitals, campuses, courthouses, and casinos (because of high suicide parking garage rates), the new

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[111] *Id*.

[112] http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/310.pdf

[113] *Id*.

[114] https://www.transit.dot.gov/funding/procurement/third-party-procurement/sole-source-procurements; https://www.ofm.wa.gov/about/procurements-sole-source-contracts-and-intergovernmental-agreements http://www.fhwa.dot.gov/construction/cqit/vecp.cfm

[114] https://www.transit.dot.gov/funding/procurement/third-party-procurement/justifying-sole-source-procurements

[115] http://www.haks.net/project.php?mark-sub=mark-sub4&scat_id=19&pro_id=190;

Transportation Security Administration (TSA) headquarters in Northern Virginia, and other projects with high risks for terrorism.

## "Value Engineering Change Proposal" (VECP) Provision

Federal Transit Administration's ("FTA's) **VECP provision** [116] promotes post-award value engineering proposals by construction contractors during construction. It is described in 23 CFR 627.3(g)[117] as a "construction contract change proposal submitted by the construction contractor based on a VECP provision in the contract." In the design phase of Federal building development, properly applied value engineering is required to investigate and evaluate **"alternative design"** solutions to optimize the expected "cost/worth" ratio of projects at completion.[118] (*See* also **"Reasonable Alternative Design"** legal issues, *supra*). Value engineering elicits ideas on ways of maintaining or enhancing results while reducing life cycle costs. In the construction phase, GSA Public Building Service "contractors are encouraged through shared savings [*e.g.,* 55% to the contractor] to draw on their special 'know-how' to propose changes that **cut costs while maintaining or enhancing quality, value, [safety], and functional performance**."[119] (emphasis added)

## Emerging Technologies and Autonomous Vehicle Considerations

Autonomous driving and electric vehicles can be accommodated in robotic garages more cost-effectively and efficiently than in CCRGs, with significantly less investment. Current RPSG technology and infrastructure allows patrons to connect to the cloud for (1) self-driving vehicles, (2) reservation and payment systems, and (3) car sharing fleets and services for vehicles. There can be autonomous driving into the RPSG – partnership with Bosch – and automatic Level 2 electric charging.

In the July 25, 2016 *Car and Driver* article, "The Parking Garage of the Future: Big Makeover Coming in Autonomous Age," Pete Bigelow states that **"like every other aspect of transportation being upended by technology, parking garages will be no different," further noting that "as that transition continues, existing structures need to be retrofitted, and new ones rethought from the ground up."** Brian Wright, founding Principal of Town Planning & Urban Design Collaborative, states that "It's not even the clients pushing us, it's the investment group bringing the dollars to the table, and they're saying, 'We need you to take this into consideration.'" Wright further states that "It really is a paradigm shift." [120] Russell Preston, the head of the urban design firm, Principle Group, in Boston, predicts that the proposed fully autonomous parking garage he envisions would be 38% the volume of a traditional CCRG. However, the RPSG in Kuwait stores 3.4 times the number of vehicles in the same volume of the integrated CCRG

[116] https://www.transit.dot.gov/funding/procurement/bppm-procurement-object-types-special-considerations
[117] https://www.law.cornell.edu/cfr/text/23/627.3
[118] https://www.transit.dot.gov/funding/procurement/bppm-procurement-object-types-special-considerations, at (§6.1.5).
[119] www.gsa.gov/portal/category/21589; http://www.gsa.gov/portal/content/101197; http://www.gsa.gov/portal/content/101697
[120] https://www.caranddriver.com/news/parking-garages-poised-for-big-makeover-in-autonomous-age

directly below. Stated another way, the same number of vehicles could be stored in a similar RPSG that is 30% of the volume as a CCRG of the same vehicle capacity.[121]

Further, I believe that RPS' parking technology is consistent with current research interests of the National Academies of Science's activities of: (1) its Transportation Research Board's Committee on Emerging and Innovative Transport and Technologies (*e.g.*, "new concepts and technologies related to … facilities … and transit technology integration with land use" and "smart parking")[122] and (2) its TRB's Committee on Application of Emerging Technologies to Design and Construction (*e.g.*, "newly available and emerging technologies from fields other than transportation, such as… robotic[s].") [123]

Although individual car ownership may be reduced over time the cars that will be needed for car sharing, fleets, autonomous driving vehicles and electric cars as well as the "conventional cars" – all these need to be parked and serviced somewhere. The better a garage is equipped to service these needs, the better the garage will be utilized. I am confident that an RPSG – in contrast to a conventional one – will be the preferred choice for the future and for decades to come.

## Return on Investment and Accelerated Depreciation

Return on Investment (ROI) and accelerated depreciation are key considerations for both private and public entities when deciding what type of structure to build.[124] The McKinsey Global Institute has estimated a 20 percent rate of return on well-designed infrastructure projects.[125] Construction, development, and operating costs need to be detailed comparing a CCRG and a robotic parking garage. Using automated parking, developers can increase ROI by lowering operating costs, thereby significantly lowering development costs.[126] As noted previously, Samuel I. Schwartz, PE, in *Parking* Magazine, March 2009, concluded that operating costs for RPSGs were 55% less vis-à-vis CCRGs of the same vehicle capacity.[127]

The IRS provides seven years of accelerated depreciation for robotic parking machinery versus 39 years for CCRGs.[128]

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[121] *Id.*

[122] http://www.trb.org/AFH30/AFH30.aspx

[123] https://sites.google.com/site/trbafh30/

[124] https://www.irs.gov/businesses/small-businesses-self-employed/a-brief-overview-of-depreciation

[125] https://www.bing.com/news/search?q=Larry+Summers+Infrastructure&qpvt=larry+summers+infrastructure&FORM=EWRE; , http://www.globalinfrastructureinitiative.com/ ; http://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights

[126] http://roboticparking.com/robotic_parking_increase_revenue.htm

[127] Schwartz, P.E., Samuel I. "The Garage of the Future Must Be Green,"*Parking*, March 2009; https://parkithere.wordpress.com/2011/11/01/comparison-of-operating-costs-of-conventional-vs-automated-parking-garage/; https://www.youtube.com/watch?v=uapA9DQ03KI

[128] https://www.irs.gov/businesses/small-businesses-self-employed/a-brief-overview-of-depreciation

## "LEED," "Innovation in Design," and "ParkSmart" Certifications

RPSGs designs can earn between 10 to 17 additional LEED points in a mixed-use project. As an example, RPS analyzed a proposal for a CCRG in a mixed-use project. The architect for the garage determined that his CCRG design would earn LEED Silver; however, it was determined that an RPSG design likely would qualify for LEED Gold, and possibly LEED Platinum status. RPSGs may also add up to four (4) "Innovation in Design" Program points.[129]

The U.S. Green Building Council ("USGBC") awarded its first "green garage" awards, but they were all CCRGs.[130] RPS is working with the USGBC on its "ParkSmart" program scorecards to incorporate additional elements that automated/robotic parking garages contribute such as eliminating toxic emissions and tire and brake dust inside the garage; reducing gasoline consumption and reducing land consumption.

## Aesthetics: RPSG Façades Eliminate Visual Blight

Customizable RPSG façades can match surrounding buildings. Who hasn't seen the ugly, "white elephant," even newly constructed, CCRGs next to beautifully designed buildings? At night, they look like cruise ships docked perilously next to highways. There is no need to even *try* to camouflage a CCRG by putting "lipstick on a pig."[131] Even with the most awesome, or, some say, "iconic" CCRG façade, the endemic and reasonably foreseeable risks of assault, suicide, and property damage and loss will continue to persist in CCRGs. How many planning bodies and citizen groups have rejected a CCRG proposal on the aesthetics issue alone? Some major cities already require enclosed façades for all garages to attempt to have them blend into the architectural fabric of the environment to avoid or mitigate blight appearing and unaesthetic looks.[132]

## Traffic Congestion Costs and Wasted Space

A 1999 DOT/MIT Volpe Institute report estimated that "… over 50% of the traffic in typical downtowns is simply on the road, cruising around the block search for vacant, convenient parking spaces."[133] The Urban Land Institute, reported that 15% to 45% were doing the same in New York City.[134]

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[129] http://www.usgbc.org/node/1732608?return=/credits/new-construction/v2009/innovation

[130] http://www.greenlodgingnews.com/USGBC-Clarifies-New-Innovation-Design-Points-Program

[131] http://www.roboticparking.com/robotic_parking_flexible_facade.htm
https://www.washingtonpost.com/lifestyle/travel/miami-has-designer-everything-else--why-not-parking-garages/2016/05/12/63ed406c-0358-11e6-b823-707c79ce3504_story.html

[132] http://www.roboticparking.com/robotic_parking_flexible_facade.htm

[133] http://www.roboticparking.com/robotic_parking_green_parking.htm;
www.roboticparking.com/news/newsletter/ParkSmart_issue_28.pdf

[134] *Id.*

An IBM Global Business Services report stated that congestion costs up to 4% of GDP and went on conclude that, "[i]n the U.S., congestion in urban areas results in annual costs of 4.2 billion hours of wasted time and $87 Billion each year from wasted fuel and lost productivity."[135]

One of the most important positive impacts that can occur on urban fabric is that automated parking garages can consume up to 50-60% less footprint than same-space CCRGs. They allow for same capacity garage development on land that is not possible with CCRGs. As such, more convenient, closer in parking can be provided in areas that are plagued with parking shortages and handicapped access issues. All RPSG parking spaces are handicapped accessible.

The National Parking Association commissioned PricewaterhouseCoopers in 2018 to "conduct global research to identify trends, causes, economic impact, and potential solutions for urban congestion." For example, the report, "An Ecosystem Approach to Reducing Congestion," suggests increasing on-street parking rates and possibly reducing street parking and introducing new parking garage design and technology. The report acknowledges that "high occupancy parking structures may require valet stacking parking," an obvious reference to one of the key attributes of RPSGs. The PwC authors do recognize that "automated parking technologies" are currently available to "pack vehicles more tightly increasing parking densities [otherwise not possible with] current [CCRG] facilities. Also, it was a welcome statement in the report that such automated/robotic technology "could further help in [the] planning process as less real estate [*i.e.,* footprint] would be needed to create the same amount of parking [capacity]."[136]

## "Root Cause Analysis"

"Root Cause Analysis" is a method of problem solving used for identifying the root causes of faults or problems.[137] I assert that CCRG building designs are the "root cause" of CCRG sexual assault, suicide, theft and property damage. Further, I believe that if RPSG designs were selected, the root causes of these negative outcomes created by CCRG design would **remove the problem-fault-sequence**,[138] that would prevent inevitable undesirable events (*e.g.,* rape, suicide, theft) from occurring or recurring.

## Lower Insurance Premiums for Automated Parking Garages

Automated parking garages can lower insurance hazard risks. A.M. Best, using its well-known underwriting guide, reviewed the design and processes of the RPSG design and was very favorable. In its detailed review, the RPSG design and technology approach was assigned a low hazard risk in several categories.[139] In a research study on safety and environmental considerations regarding automated

[135] *Id.*
[136] https://www.strategyand.pwc.com/report/ecosystem-approach-to-reducing-congestion
[137] http://www.brighthubpm.com/monitoring-projects/67628-written-root-cause-analysis-example/; https://en.wikipedia.org/wiki/Root_cause
[138] *Id*.
[139] http://www.roboticparking.com/robotic_parking_reduce_liability.htm

garages, the author, Samuel I. Schwartz, PE, in the same March 2009 study noted above, concluded that "[automated/robotic] parking will be an insurance company's dream."[140]

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This author wishes to thank all the researchers and others who made this White Paper possible. Comments, corrections, and additional references are encouraged so that this document can be a useful reference guide for construction of what I believe are the inherently safest, greenest, and most operating cost-effective parking garages currently available.



*The foregoing statements and materials do not provide legal advice and do not create an attorney-client relationship. If you need legal advice, please contact an attorney directly.*

Nothing stated in this document is intended to interfere with any existing contract or business expectancy. The views expressed in this document are solely those of the author and do not necessarily represent those of Robotic Parking Systems, Inc. However, they are made for the purposes of advancing safety, preserving life, reducing environmental impact, and conserving future long-term financal resources.

Roger C. Courtney, Esq.
Attorney at Law
roger@rogercourtney.com
703-764-3777

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[140] Schwartz, P.E., Samuel I. The Garage of the Future Must Be Green, *Parking*, March 2009.