Towards Developing an Assessment System for Smart Sustainable Cities

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Abstract. Population growth, urban sprawl, and excessive use of non-renewable resources have led to pressure on human and environmental resources of all kinds, which affected the stability of the environment and led to the phenomenon of global warming. Therefore, achieving sustainability requires precise indicators and standards, which can be achieved through information and communication technologies (Internet of Things). and stimulating and encouraging people to use renewable energy to ensure a better life for citizens, protect the environment, and localize the mention of sustainability Hence, we use a more accurate term, "city." Smart sustainable instead of smart city due to the necessity of smart city sustainability. The paper discusses different sustainability systems, as well as smart city standards, making a comparison between them, studying the strengths and weaknesses of each system, and coming up with the best standards to achieve a smart sustainable city.

Keywords
Sustainability of smart cities, Information and communications technology, Internet of things, Smart city, A real smart city application

1. Introduction

During the last three decades, the development of information and communications technology (ICT) and its applications as one of the most important technologies of the era that has become linked to various aspects of life, many ideas have emerged that express the content of cities that is primarily linked to and influenced by information and communications technology. Each idea includes one of the trends supported by the use of ICT, and some of them express the function or goal of those cities related to ICT in one way or another.

In the middle of the twenty-first century, the term smart cities spread as an idea linking intelligence and sustainability, and this term became linked to sustainability, information, and communications technology at the same time. The term Smart City includes in its meaning other terms such as: Intelligent Smart City; digital cities; Eco city. Whereas, sustainable city is a global term that possesses a greater importance in the field of urban policies to make the condition of cities more efficient and sustainable, and this concept has become widespread in recent years. (Papa, 2013, April)

Thus, by linking the different concepts of smart cities to the terms that have been treated as synonyms for smart cities. In order to achieve the idea of smart cities, there must be assessment systems to measure the efficiency of these cities. This article aims to spot light on these systems to measure the efficiency of smart cities, despite the lack of a unified concept for them or a coordinated measurement procedure that achieves the desired goal. Therefore, there are unclear evaluation criteria in the existing assessment systems. The research problem can be summarized as the existence of deficiencies in some standards of

smart city systems and sustainable city systems, which resulted in the unavailability of a consensus assessment system that assess the efficiency of smart sustainable cities. Therefore, the goal of the research is to develop a system to measure the efficiency of smart sustainable cities and adopt it through analyzing the evaluation points of several different systems.

2.Background

2.1 A sustainable city

Sustainable city is defined as a low or zero carbon emission city, thus contributing to reducing the production of carbon dioxide and other organic compounds that lead to increased severity of climate change.[§] This requires introducing structural transformations towards reducing the use of fossil fuels to a minimum and increasing reliance on new and renewable energy resources. Solar energy, wind energy, geological energy, wave energy, etc. Such structural transformations not only require eco-industrial systems and integrated systems for managing solid, liquid and gaseous waste and their complete recycling, but they also require cultural transformations - mainly - in patterns of consumption, entertainment, transportation, etc. For example, sustainable cities are characterized by a relatively compact fabric, to reduce travel distances between housing, work, and services, and to reduce energy use in transportation, which requires land use planning in a way that enhances these perceptions. Accordingly, a sustainable city is a contemporary city that is planned, built, and managed to satisfy the daily living needs of its residents. Infrastructure, civil facilities, health, educational, commercial, social, and transportation services. This is achieved through new approaches and methods for its integrated development and urban planning, which embody the environmental, economic, social and urban principles and frameworks in an integrated system, governed by symbiotic relationships, and in a growth method different from the traditional growth process of the city, in terms of its development planning, design, construction, marketing, management, and resistance to deterioration Environmental" (Ferraro, 2013, March)

2.1.1 Standards for Sustainable Cities

In terms of urban planning, this includes: creating a healthy urban environment and crafting a unique local urban identity; Providing open spaces for city residents; Determine reasonable building densities; Diversifying land uses; Providing reliable transportation. In the field of architecture, the use of local building materials, emphasizing the unique local character of a city, and protecting historical and valuable structures are all part of the process of building smart, technology-based structures for the comfort and well-being of their residents. users in a way that suits their requirements. (Khansari, 2013)

In terms of the economy, the city relies on generating its own revenues, bringing in capital and investments, and providing good-paying jobs for its citizens. On the social side, this includes maintaining a reasonable population density, offering a wide range of age-appropriate educational opportunities, and promoting social justice for all city dwellers through equitable access to resources, services, and employment opportunities. In addition, preserving the city's social and cultural identity while enhancing the sense of community belonging among its citizens is crucial to providing opportunities for women and avoiding increasing rates of illiteracy, ignorance, and crime.

With regard to the environment, this means protecting local natural resources through rational use, increasing their efficiency, taking into account their resilience and avoiding their depletion for the benefit of future generations, and taking into account compatibility with the needs of the local ecosystem. (Holland, 2008)

Reduce the amount of pollution produced, recycle garbage, and operate buildings and services using renewable energy. Increasing the city's independence and the pillars of good governance in state administration in a way that supports the values of social justice, accountability, openness, public participation, and preventing corruption. (Nam, 2012)

2.2. Sustainable systems

The authors chose four classification systems based on their importance. They reflect diverse regional contexts and present the most important strengths and weaknesses and the method of evaluating each

system to see an integrated picture of the systems and reach an integrated, unified system for sustainability it will showing on table no 1,2.

Table 1. Comparison of LEED, BREEAM, CASBEE, and Estidama

	LEED	BREEAM	CASBEE	Estidama
Developer	Leadership in Energy and Environmental Design. U.S	Building Research Establishment Environmental Assessment Method U.K	Comprehensive Assessment System for Built Environment Efficiency Japan	Estidama is a building design methodology for constructing and operating buildings and communities more sustainably. Abu dhabi
Year	1998	1990	2001	2008
Deidentification	The leading energy and environmental design (LEED) green rating system was created by the U.S. Green Building Council. It is the most internationally recognized sustainable building certification. Thus, ensuring your business adheres to the LEED certification The requirements mean dynamic, clean and cost-effective urban communities. (U.S.G.B.C)	As the world's first built environment sustainability rating system, it has greatly influenced the UK's strong focus on sustainability at all stages of design, societal uses, construction and uses. BREEAM is currently an international standard implemented locally by a network of operators, evaluators and global business experts. BREEAM helps customers by usage and application	This comprehensive assessment of building quality covers everything from interior comfort and consideration of the landscape to evaluating environmental considerations, such as adopting energy-efficient materials and technology that reduce environmental loads.	It is a program that will make Abu Dhabi an example of sustainable urban growth. Its goals include achieving a balance between the basic elements of sustainability - namely (the environmental element, the cultural element, the economic element and the social element) - and building more sustainable cities, towns and international companies.
Categories	Materials, Resources, Quality, Regional Priority, Sustainable Site, Water Efficiency, Energy, Atmosphere, Indoor, Environment, Innovation, Design Process, and Credits	Transport, Energy, Waste, Management, Land Use and Ecology, Pollution, Innovation, Health and Wellbeing, Land Use and Ecology, Materials	Materials. Energy, Resources, Environmental, Quality-of-Service, Quality, Indoor and Outdoor Environment	Natural Systems, Process, Materials, Innovating Practice, Development, Precious Water, Liveable Buildings, Energy
Logo	(Humbert, 2007)	(Global, 25 May,2013)	(Environmental, 31st August, 2008)	(Municipality, April 2010)
Rating	Platinum, Gold, Silver And Certified.	Outstanding, Excellent, Very Good, Good and Pass	Superior (S), Very Good (A), Good(B+) , Slightly Poor(B-) and Poor (c)	5 Pearl, 4 Pearl, 3 Pearl, 2 Pearl, 1 Pearl

Table 2. Measures of frequency standards for variables in sustainable systems

Sustainable Components / Sustainable Rating systems			Leed	Bream	Casbee	Estidama
1	Governance	Consultation plan		●		
		Consultation and engagement	●			
		Community management	●	●		●
		Design review	●	●		
		Environmental Management plan	●		●	
		Innovation	●	●		●
		Sustainability Awareness	●		●	
		Accredited Professional	●			
			87.5%	50%	25%	25%
2	Economy	Economic impact	●	●		●
		Local Food production	●			
		Digital Economy				●
		Regional Materials			●	●
			50%	25%	0%	75%
3	Transport and connectivity	Transport assessment		●		
		Bicycle facilities	●			●
		Network Public transport facilities		●	●	
		cycling network	●			
			50%	50%	25%	25%
4	Social and cultural	Community Development		●		●
			0%	100%	0%	100%
5	Environmental	Ecology strategy		●		
		Low impact materials		●		
		Energy strategy		●		
		Renewable Energy Production	●		●	●
		Natural Systems			●	●
		Rainwater Management	●			
		Solar orientation	●			●
		Rainwater Management	●			
			50%	37.5%	25%	37.5%
	TOALL	100	**37.5**	**27.5**	**15**	**25**

3 Smart city

" A creative metropolis that blends elements of intellect and utilizing technology to enhance services and infrastructure while integrating stakeholder engagement into governance along with " Greater reliance on technologies, such as remote sensing and communications and information technologies, to improve the efficiency of energy networks, transportation, and other systems, making the city more coordinated, networked, and smart in its actions and initiatives. logistics services" are two definitions that characterize a smart city in full. Communication between services and actors can be improved with the help of technology. Through sustainable urban expansion, improved social, administrative, economic, environmental, logistical, and competitive outcome, and the provision of a sustainable living environment for its residents, this aims to ensure the requirements of the present generation are satisfied. (Bouskela, 2016) (.Sumarsono.Surahyo)

3.1 Key groups to describe smart cities

The smart city relies on key areas to be more convenient for life, more functional, more competitive, more modern, and more encouraging of innovation, excellence, and knowledge management, including smart management, environment, citizenship, mobility, and life, showing on table 3.

Table 3. describe smart cities

Smart mobility	**Smart economy**	**Smart life**
Easy access and safe transportation using advanced technologies for improved and more advanced transportation networks. Which reduces traffic congestion through the use of traffic networks with smart technologies to transport people, goods and cars. And use transportation methods flexibly and easily, such as sharing cars with each other or switching between driving and cycling. (Preis, 2012)	Global and regional competitiveness Entrepreneurship and innovation productivity levels are high Making broadband networks available to all citizens and businesses to support Commercial opportunities Freedom to choose the location, and the possibility of benefiting residents in rural areas. Electronic business operations, electronic banking services, electronic shopping.	A high standard of living in many areas of society, including public safety, housing, health care, and education Monitoring and following up on work remotely, evaluating it, and obtaining opinion polls to achieve the best possible performance and best user satisfaction.(editors, 15 February 2019.) (American Planning Association Editors, 2015)
Smart management	**Human intelligence**	**Smart environment**
Ease of decision-making regarding social and public services and complete transparency To enhance community service access to service between government departments with ease, quality and democracy(Albino, 2015)	Social and human capital of citizens Qualified, creative and educated. The ability to benefit from smart services based on information technology and communications Provide a To achieve accurate educational performance that has flexibility, excitement, and improved performance (Bouskela M. C.)	Controlling the extent of pollution while exploiting environmentally friendly technology and sustainable and environmental use of energy. Non-reliance on energy use through technical progress while encouraging and stimulating the reuse of materials and energy.

The term "smart city" refers to a kind of urban area that integrates six key performance areas: economy, mobility, environment, and competitiveness. It also uses new technologies to make these areas more competitive, modern, friendly to life, and supportive of knowledge management and innovation. Administration, Quality of Life and Citizenship (Cities, 2014)

3.2. the smart and the sustainable city

Table 4: Comparison between the sustainable city and the smart city

City type	City characteristics	Definition
Smart city	Infrastructure and information technology the information Electronic and mechanical technology the knowledge society and the digital city Possibility of electronic control and decision making (Polson, 15 March.2013)	A concept that links the knowledge society and the digital city. It is known as the city that includes all types of infrastructure and information-structure, information technology and the latest technologies in the field of communications, electronic and mechanical technology. It is characterized by good performance in the field of innovation, where innovation and solving complex problems represent the main features of intelligence. (Union-ITU, 2014)

Sustainable city	Paying attention to both economic, social and environmental dimensions Achieving economic growth without depleting resources Recycling as a general principle for the city Promoting and supporting the achievement of social justice, democracy and participation A green, environmentally friendly city that balances local resources and ecosystems (Group)	They are cities that achieve economic growth through an economic base that does not exhaust natural resources through the rational use of energy or pollute it, with Adopt the principle of recycling and energy recovery These are cities that achieve social justice for their residents and promote the concepts of democracy, participation in decision-making, society's self-reliance in meeting the basic needs of its members, and ensuring minimum standards. It is an acceptable quality of life for all members of society. It is a green, environmentally friendly city that achieves a balance between resources and local ecosystems by increasing the efficiency of resource use and achieving a minimum of polluting outputs.

Although the term "smart cities" is linked in people's minds to information and communications technology, the literature dealing with sustainability often concludes that "smart cities" are considered one of the advanced paths to achieving sustainability from the development of sustainability thought and green cities, which confirms the close relationship between the two axes of research. This makes the term "smart sustainable cities" the comprehensive term for both axes.
Evaluating smart city performance also helps to ground policy interventions in solid evidence by guiding decision makers, at the national and local levels, in setting realistic goals, understanding the position of cities towards their goals, and tracking progress and adjusting policy interventions to increase efficiency and effectiveness. Ultimately, it enhances Smart City measures accountability and helps citizens monitor how governments are fulfilling their obligations as sown in Table 4 (ESCWA., 2019)

4.3. Smart systems

The authors chose four classification systems based on their importance. It reflects diverse regional contexts and presents the most important strengths and weaknesses and the method for evaluating each system to see an integrated picture of the systems and reach a unified, intelligent integrated system, as will appear in Table No. 5,6.

Table 5. Comparison of TWD, IMD, and BSI

	TUW	**IMD**	**BSI**
Developer	The Economist Intelligence Unit Limited, Vienna UT, (Giffinger, October 2007)	The IMD World Competitiveness Centre, Singapore	The British Standards Institution UK (bsi., 2013)
Year	2007	2019	2015

Categories	• **Smart mobility** • **Smart economy** • **Smart environment** • **Smart governance** • **Smart living** • **Smart people** • **Social and Human Capital** It is calculated by taking the average by summing the values and dividing them by their number, instead of summing all the indicators. (Sarma, October 2016)	Five major areas are used to evaluate each pillar: • **Governance** • **Activities,** • **Safety,** • **Mobility,** • **Activities,** • **Opportunities,** • **Health.** A "rating scale" (ranging from AAA to D) is awarded to each HDI group of cities according to how that city's views compare to those of all the other cities in that group.	Datasets needed to support city projects • **Health = 2%** • **Energy = 6%** • **Transport and Mobility = 12%** • **Technology = 13%** • **Infrastructure = 13%** • **Innovation = 3%** • **Social / community = 18%** • **Geo-spatial = 5%** • **Natural Environment = 2%** • **Water = 2%** • **Built Environment = 5%** • **Economic = 9%** • **Logistics = 2%** • **Communications = 8%**
Deidentification	These comparative studies assess and rank cities based on many economic, social, and geographic factors to identify the best (and worst) locations for particular types of activity. A top ranking in a well-known city ranking enhances a city's international image, which makes it a valuable tool for marketing strategies. As a result, cities frequently use city rankings to raise their profile and strengthen their position in the competition amongst cities.	"Systematically verify the facts" on the ground, and continue to prioritize the opinions of citizens and local actors. This index will remain a "work in progress" as new data, issues and opinions continue to gather around it and the questions it raises. Its coverage will also increase over time, significantly exceeding the 102 cities included in this first edition. (Lanvin, 2019)	Smart city infrastructure sectors, such as communications, IT and electronics, enable and support this interaction. A common theme in smart city prototyping is the use of sensors to collect data from the city which can, through platforms, be integrated, stored, analyzed and displayed. This provides decision support to city actors who can then act and make changes, whose impact can in turn be measured (Department for Business, October 2013) (Consultants, 2013)

Advantages and disadvantages of evaluation This evaluation is characterized by its focus on details, which gives applicable results, but it can reinforce existing stereotypical models. As for the methodological aspects of the evaluation, it is not transparent in the field of data collection and processing as shown in Table 5: (BEHZADFAR, 2017.)
Accordingly, it can be concluded that IDM,BSI occupy first place in the Components of sustainability standards, And second place in TUW.

Table 6. Measures of frequency standards for variables in smart systems TUW, IDM and BSI

	variables		TUW	IDM	BSI
1	Smart Government	Contributing to the innovation industry	●		
		Consultation and engagement	●	●	●
		Community management	●	●	●
			100%	67%	67%
2	Smart Transport	Local mobility	●	●	
		Car-sharing Apps		●	●
		Vehicle recognition			●
		Safe and sustainable transportation systems	●	●	●
			50%	75%	75%
3	Smart environment	Energy ratings			●
		pollution	●	●	
		environment protection	●	●	●
		Recycling services		●	●

			50%	75%	75%
4	Smart life	CCTV cameras			●
		Online reporting of city maintenance		●	
		Free public Wi-Fi	●	●	●
		Traffic monitoring			●
		Educational events	●	●	
		Arranging medical appointments online		●	●
		Tourism (tourist attraction)	●	●	●
			42.9%	71.5%	71.5%
5	Smart individuals	Minorities feel welcome	●	●	
		Contributing to long-term education	●	●	●
		Ethnic and social pluralism	●		●
		Flexibility	●		●
		creativity	●	●	
		Most children have access to a good school		●	●
		Contributing to public life	●	●	
			85.8%	71.5%	57.2%
6	Smart economy	Innovative spirit	●	●	
		Businesses are creating new jobs		●	●
		Economic image and branding	●	●	●
		Productivity	●		
		Labor market flexibility		●	●
		International Relations	●		●
			50%	50%	67%
	TOTALL	100	**31.8**	**34.3**	**33.9**

4.4. Proposed Smart City Assessment Criteria

Since smart cities may help achieve sustainability and ultimately become smart and sustainable cities based on their respective indicators, there is a close and significant connection between smart cities and sustainable cities. Presentation on Table No. 7 In order to empower planners and decision makers and make room for evaluating each city in order to meet the requirements of a smart sustainable city, the goal is to build a unified system for evaluating smart cities and sustainable cities by linking indicators together.

Table 7. Proposed assessment sustainable & smart city framework (by the researchers)

	Sustainable city (Criteria) LEED, BREEAM, CASBEE, and Estidama	smart city (Criteria) TWD, IMD, and BSI
Economy	Economic impact	Innovative spirit
	Local Food production	Businesses are creating new jobs
	Digital Economy	Economic image and branding
	Regional Materials	Productivity
	Economic impact	Labor market flexibility
		International Relations
Government	Consultation plan	Contributing to the innovation industry
	Consultation and engagement	Consultation and engagement
	Community management	Community management
	Design review	
	Environmental Management plan	
	Innovation	
	Sustainability Awareness	
	Accredited Professional	
Transport	Transport assessment	Local mobility
	Bicycle facilities	Car-sharing Apps
	Network Public transport facilities	Vehicle recognition
	cycling network	Safe and sustainable transportation systems

Social and cultural	Community Development	Minorities feel welcome
		Contributing to long-term education
		Ethnic and social pluralism
		Flexibility
		creativity
		Most children have access to a good school
		Contributing to public life
Environmental	Ecology strategy	Energy ratings
	Low impact materials	pollution
	Renewable Energy Production	environment protection
	Natural Systems	Recycling services
	Rainwater Management	
	Solar orientation	
	Rainwater Management	
Smart individuals		Minorities feel welcome
		Contributing to long-term education
		Ethnic and social pluralism
		Flexibility
		creativity
		Most children have access to a good school
		Contributing to public life

5. Conclusion

The sustainable smart city focuses primarily on the human essence and relies on information and communications technology infrastructure and continuous urban development and takes into account environmental and economic sustainability.
Smart cities are closely linked to sustainability, as efficiency in energy and water consumption represent pressing issues in their design and construction
This study demonstrates the breadth of the concept of smart and sustainable cities, and the breadth of their measurement systems in various fields.
Which puts decision makers in front of many perspectives through which they can adopt the idea according to their respective ideologies.
According to the needs of citizens according to time and place, and not submitting to the idea that it is a unified model that can be applied In all cases, it is a broad, flexible model that is subject to change.

6.References

(n.d.)., B. (Retrieved 20 January, 2014). *BREEAM.* http://www.breeam.org/.

Albino, V. D. (2015). Smart Cities: Definitions, Dimensions, Performance and Initiatives. *Journal of Urban Technology*, Vol. 22.

American Planning Association Editors. (2015). Smart Cities and sustainability Initiative. *American Planning Association*, p. 8-9.

Batty, M. e. (2012). Smart cities of the future. *The European Physical Journal*.

BEHZADFAR, M. (2017.). International Challenges of Smart Cities. *Armanshahr Architecture & Urban Development*.

Bouskela, M. C. (n.d.). *M., op.cit*, p. 32-33, 35-36.

Bouskela, M. C. (2016). *The Road toward Smart Cities: Migrating from Traditional City Management to the Smart City.* Inter-American Development Bank.

bsi. (2013). City data survey report. *for BSI in support of understanding data requirements and standards for smart city initiatives*.

Cities, I.-T. F. (2014). Smart Sustainable Cities : An Analysis of Definitions. *International Telecommunication Union.*

Consultants, K. v. (2013). BSI.Mapping Smart City Standards. *Arup. Global innovators: International case studies on smart cities*.

Department for Business, I. a. (October 2013). BIS Research paper. *Arup. Global innovators: International case studies on smart cities*, 135.

editors, S. W. (15 February 2019.). *Smart City: What is a Smart City.* Stadt Wien. (https://bit.ly/2EML6rD).

Environmental, C. A. (31st August, 2008). *CASBEE-Technical Manual.* Japan : Environment and Energy Conservation (IBEC).

ESCWA. (2019). Open government for greater public sector transparency and accountability. *Capacity development material on open data.* Beirut.

Ferraro, S. (2013, March). *Smart Cities, Analysis of a Strategic Plan.* A Master Thesis in Management Engineering. Dublin, Unpublished.

Giffinger, R. F. (October 2007). Smart Cities: Ranking of European Medium-sized Cities. *The Centre of Regional Science (SRF), Vienna University of Technology*.

Global, B. (25 May,2013). *BREEAM in numbers Retrieved.* http://www.breeam.org/page.jsp?id=559.

Group, I.-T. F. (n.d.). Smart Sustainable Cities: An Analysis of Definitions. International. In T. Union, *ITU-T Focus Group on Smart Sustainable Cities.* (p. 201). Telecommunication Union.

Holland, R. G. (2008). Will the Real Smart City Please Stand Up? City.

Humbert, S. H. (2007). Leadership in Energy and Environmental Design(LEED) A critical evaluation by LCA and recommendations for improvement. *Journal Life Cycle Management*, 1, 46-57.

Karadag, T. (2013, Februray). A Master Thesis Submitted to the Graduate School . *City Planning Department, Middle East Technical University.*

Karadag, T. (2013, Februray). *An Evaluation of the Smart City Approach.* Turkey: Unpublished.: A Master Thesis Submitted to the Graduate School of Natural and Applied Sciences, City Planning Department, Middle East Technical University.

Khansari, N. M. (2013). Impacting Sustainable Behaviour and Planning in Smart City. *International Journal of Sustainable Land Use and Urban*, 46-61.

Lanvin, A. B. (2019). IMD smart city. *WORLD COMPETITIVENESS CENTER*.

mneam. (2014). *hhjhj.* vcvc: cvccvc.

Municipality, A. D. (April 2010). *The Pearl Rating System for Estidama.* Abu Dhabi : UPC Development Review and Urban Design.

Nam, T. &. (2012). Understanding Smart Cities: An Integrative Framework. *Hawaii International Conference on System Sciences* (pp. pp. 2289-2297). Hawaii: IEEE Computer Society.

Papa, R. G. (2013, April). Towards an Urban Planners Perspective on Smart City. *TeMA Journal of Land Use Mobility and Environment*, Vol.6 - n.1, pp. 5-17.

Polson, J. (15 March.2013). water losses in India cut in half by smart meters. *Bloomberg news,*.

Preis, A. I. (2012). *Case Study: A Smart Water Grid in Singapore.* Massachusetts Institute of Technology.

Sarma, A. (October 2016). , "smart city and urban sustainability. *Conference on Tackling Urban Environmental Concerns in Upcoming Smart Cities of our Country, Institution of Engineers (India)*.

Union-ITU, I. T. (2014). *Smart sustainable cities: An analysis of.* Geneva: ITU: Focus group technical report.

Zhou, N. &. (March 2013). An International Review of Eco-City Theory, Indicators, and Case Studies. *Berkeley: China Energy Group, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory*.