

Concord Evaluation Group

# Future City Evaluation: 2015-16 Report

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# Background

DiscoverE hired Concord Evaluation Group (CEG) to conduct an independent evaluation of the Future City program (<http://futurecity.org>). Future City has been operating since 1992. According to DiscoverE, the Future City program is “a national, project-based learning experience where students in 6th, 7th, and 8th grade imagine, design, and build cities of the future. Students work as a team with an educator and engineer mentor to plan cities using SimCity™ software; research and write solutions to an engineering problem; build tabletop scale models with recycled materials; and present their ideas before judges at Regional Competitions in January. Regional winners represent their region at the National Finals in Washington, DC in February.”



**Winners of the 2016 National Competition from the Academy for Science and Foreign Language in Alabama**

Future City’s cross-curricular educational program gives students an opportunity to do the things that engineers do: identify problems; brainstorm ideas; design solutions; test, retest, and build; and share their results (i.e., the engineering design process). With this at its center, Future City is designed to provide an engaging way to build students’ 21st century skills. Students participating in Future City are expected to:

- Apply math and science concepts to real-world issues;
- Develop writing, public speaking, problem solving, and time management skills;
- Research and propose solutions to engineering challenges;
- Discover different types of engineering and explore career options;

- Learn how their communities work, and become better citizens;
- Develop strong teamwork skills.

In 2014, DiscoverE received a grant from the Project Management Institute to integrate the principles of project management into the Future City process. DiscoverE completely redesigned the Future City competition handbook to incorporate project management processes and concepts. The handbook was pilot tested during the 2014-15 school year, subsequently revised, and then field tested during the 2015-16 school year.

CEG conducted an evaluation of the field test. This report summarizes the field test findings and makes recommendations for enhancing the program.

# Evaluation Design

## Study Design

The evaluation consisted of two separate, but related, studies. First, we conducted a **national study** in which we administered surveys to all students, educators, parents, mentors, judges, and Regional Coordinators who participated in Future City during the 2015-16 school year.

Second, we conducted an **intensive study** in which we followed six teams from early fall of 2015 to spring of 2016.

## Methodology

### National Study

The national study included the one-time administration of surveys to all Future City participants. Student and parent surveys were administered on paper at the regional competitions, while educator, mentor, judge, and Regional Coordinator surveys were administered online. Surveys may be found in the Appendices and include:

- Student survey (Appendix A)
- Educator survey (Appendix B)
- Parent survey (Appendix C)
- Mentor survey (Appendix D)
- Judges survey (Appendix E)
- Regional Coordinator survey (Appendix F)

### Intensive Study

The intensive study included six teams across the country. We administered a student pre-test survey in the fall of 2015, followed by a student post-test survey after each team's competitions were held in 2016. Copies of the surveys may be found in Appendix G.

We also conducted student focus groups via Skype in early 2016. The interview protocol may be found in Appendix H.

Finally, we conducted educator interviews by telephone in 2016. The educator interview protocol may be found in Appendix I.

## Organization of Report

The report is organized as follows:

- **Study participants** – This chapter describes the study participants in both the national and the intensive studies.
- **High-level summary of findings** – This chapter provides a list of the high-level findings.
- **High-level summary of suggestions for improvement** – This chapter provides an overview of the main recommendations.
- **Detailed findings** – This chapter provides a detailed description of all the results that support the high-level findings and recommendations reported above.



# Study Participants

## Students

### National Sample

As shown in Table J-1, 2,059 students responded to the survey, representing 30 different states and regions throughout the United States. The regions with the greatest representation were Idaho (n = 184), Pennsylvania (Philadelphia) (n = 158), New York City (n = 113), and North Carolina (n = 111). The only regions *not* represented were: Florida (Tampa Bay), Georgia, Louisiana, New York (Western), and Ohio.

As summarized in Table J-2, a roughly even proportion of male (47%) and female (49%) students participated, with the vast majority participating in Future City for the first time (75%). Nearly half of students in the national sample were related to an engineer (45%).

Most students in the national sample were 13 years old (39%), with the next most common ages being 12 (27%) and 14 (18%). Nearly half of students in the national sample were in 8th grade (46%), followed by 7th grade (30%), and 6th grade (22%).

Slightly more than half of students in the national sample identified as White (57%), with the next most commonly reported ethnicities being Hispanic (14%) and Asian American (13%).

### Intensive Sample

As shown in Table J-1, the intensive study included 73 students representing six states: Alabama, Kansas, Iowa, Michigan, New Jersey, and New York City. As summarized in Table J-2, similar to the national sample, a mostly even number of male (45%) and female (48%) students participated, with most students participating for the first time (73%). Thirty-four percent of students in the intensive sample were related to an engineer.

As summarized in Table J-2, most students in the intensive sample were 13 years old (34%), with the next most common ages being 12 (32%) and 11 (23%). The children in the intensive sample were most commonly in 8th grade (37%), and represented the remaining middle school grades roughly evenly, with 26% in 6th grade and 30% in 7th grade.

Three quarters of students in the intensive sample identified as White (74%), with the next most commonly reported ethnicities being Hispanic (11%) and Asian American (10%).

## Educators

### National Sample

As shown in Table K-1, 369 educators responded to the survey, representing 35 different states and regions throughout the United States. The greatest proportion of educators were from New Jersey (n = 23), Arizona (n = 21), and Idaho (n = 20). The only regions *not* represented were: California (Southern), and Florida (North East). The reader may recall that student and parent surveys were administered in paper formats at the competitions, while educator surveys were administered online via email. This accounts for the differences between those regions represented by educators and those represented by students and parents.

As shown in Table K-2, the vast majority of educators were classroom teachers (94%), yet out-of-school-time teachers (4%) and homeschool parents (2%) also responded to the survey.

Of the classroom teacher participants, the majority were science teachers (42%) and/or teachers of gifted and talented students (32%). The next most common types of classroom teachers were math teachers and technology teachers, each representing 19% of respondents. As reported in Table K-3, respondents had participated as Future City educators an average of 4.8 times, with a range of one time to 19 times.

As summarized in Table K-6, the opportunity to participate in a Future City team was offered most commonly as part of a class (50%), but was also offered as a club (38%), or both during and after school (12%). Due to the fact that teams most commonly met as part of a class, the majority of teams met mostly during school hours (50%). However, some teams did meet mostly after school (36%) or equally during and after school (14%).

Roughly half of all Future City teams had the support of a mentor for the whole program (55%); 16% of teams had a mentor for only part of the program; while 29% of teams did not have a mentor at all.

## Intensive Sample

Six educators participated in the intensive sample. We originally recruited ten educators, but four dropped out due to lack of time. Five of the educators were classroom teachers and one was a Girl Scout leader. Half of the sites led Future City as a class and half led it as an afterschool club. Only one site had the support of an engineer mentor, but only for a portion of the semester.

## Parents

As shown in Table L-1, 664 parents responded to the survey, representing 24 different states and regions throughout the United States. The regions with the greatest representation were: North Carolina (n = 68), New York City (n = 59), and Alabama (n = 54). The only regions *not* represented were: California (Southern), Florida (Tampa Bay), Georgia, Illinois (Chicago), Indiana, Louisiana, New England, New York (Albany), New York (Western), Ohio, Texas (North and Houston), and Washington.

As summarized in Table L-2, the vast majority of parents had one child participating in Future City (90%). The children represented each of the middle school grades fairly evenly, with 35% in 6th grade, 31% in 7th grade, and 35% in 8th grade.

Parents most commonly reported contributing seven hours of their time to the Future City program this year, with a range of zero hours all the way up to 800 hours. Parents contributed to the Future City program in a variety of ways, with the most prevalent being:

- Attending the competition (86%),
- Offering support or encouragement (76%),
- Providing materials or supplies (60%), and
- Provided transportation for team members (not just their child) (37%).

## Mentors

As shown in Table M-1, 103 mentors responded to the survey, representing 29 different states and regions throughout the United States. The regions with the most representation were Wisconsin (n = 10), Philadelphia (n = 9), and Minnesota (n = 8). The only regions *not* represented were: California (Southern), Florida (North East), Indiana, Louisiana, Mid-Atlantic, Nebraska, New Mexico, Oklahoma, and Washington.

As summarized in Table M-2, 82 (80%) of mentors were engineers. Of those mentors who were engineers, 48% were civil engineers, as depicted in Table M-3. The next most common types of engineers were electrical and mechanical, each representing 17% of the sample.

As summarized in Table M-16, mentors reported that they belonged to a wide range of diverse engineering associations. The most common were ASCE (21%), ASME (n = 9%), IEEE (n = 9%), and NSPE (n = 7%).

As summarized in Table M-5, participants most frequently chose to become a Future City mentor because they:

- Enjoyed the experience, it was rewarding (63%);
- Were asked by a teacher, colleague, friend, etc. (62%); and
- To encourage student interest in STEM (61%).

In addition to serving as a mentor, 31% of the mentor participants reported additional involvement in Future City, including serving as a judge (53%), organizing committee member (21%), or competition volunteer (6%), as reported in Table M-6.

As shown in Table M-8, respondents had served as a Future City mentor an average of 6.3 times, with a range of one time to 17 times. Mentors have worked with students in many capacities for an average of 8.2 years, with a range of one to 20 years.

## Judges

As summarized in Table N-1, 491 judges across 36 regions, including the national competition, responded to the survey. The regions with the greatest representation were Wisconsin (n = 40), Washington (n = 37), and Pittsburgh (n = 35). The only regions *not* represented were: Florida (North East) and Louisiana.

As shown in Table N-2, 332 (68%) were engineers. As summarized in Table N-3, among the judges who were engineers, 46% were civil engineers. The next most common types of engineers were electrical (16%), mechanical (13%), and environmental (9%).

As summarized in Table N-12, judges reported that they belonged to a wide range of diverse engineering associations. The most common were ASCE (18%), NSPE (7%), IEEE (6%), and SWE (6%).

Only eight judges reported that they themselves participated in Future City as a student (five reported that the experience had a moderate or significant effect on them professionally).

As shown in Table N-5, most were motivated to become judges because they:

- Enjoyed the experience, it was rewarding (67%);
- Desire to volunteer/mentor (64%); and
- To encourage student interest in STEM (53%).

As Table N-6 shows, judges also reported having served in other capacities for Future City, especially as competition volunteers (36%), mentors (23%), and organizing committee members (18%).

As summarized in Table N-8, most reported that they have served as judges an average of 5.4 years (the range was two to 20 years). Judges have worked with students for an average of 7.4 years, with a range of two to 20 years.

## **Regional Coordinators**

As shown in Table O-1, 38 Regional Coordinators responded to the survey, representing 16 different states and regions throughout the United States. The only regions *not* represented were: California (Northern and Southern), Florida (North East, South, and Tampa Bay), Georgia, Great Plains (Kansas), Illinois (Chicago), Kentucky, Louisiana, Michigan, Mid-Atlantic, Nevada (Southern), and New England.

As summarized in Table O-2, Regional Coordinators also contributed to the Future City program by serving as mentors (18%), judges (13%), or in other capacities (26%). Most Regional Coordinators' positions were volunteer positions (82%) as opposed to paid positions (18%).

# High-Level Summary of Findings

Overall, the evaluation data provide strong evidence that Future City continues to be a powerful program that persists in providing an engaging platform for building students' 21st century skills. As our report demonstrates, Future City has achieved significant success with respect to the following objectives.

*Future City aims to help students...*

- Apply math and science concepts to real-world issues;
- Develop writing, public speaking, problem solving, and time management skills;
- Research and propose solutions to engineering challenges;
- Discover different types of engineering and explore career options;
- Learn how their communities work, and become better citizens;
- Develop strong teamwork skills.

Our report also shows that Future City has achieved considerable success when it comes to supporting educators and helping them become significantly more comfortable teaching the engineering design process and the project management cycle.

## Program Impact

**Most students reported that they enjoyed Future City, especially the model building, fun, self-discovery, and teamwork aspects of the program.**

90%	The proportion of students who reported that they enjoyed model building.
86%	The proportion of students who reported that they enjoyed working in teams.
73%	The proportion of students who would participate in Future City again, if they could.

**Students, parents, educators, and mentors reported that Future City had a strong, positive impact on students' 21<sup>st</sup> century skills, especially teamwork.**

For example, students reported...

89%	I see the value in working with a team to solve problems.
88%	I am comfortable working in a team to create something with little direction from a teacher.
86%	I am comfortable working in a self-directed manner.
86%	I have developed good problem-solving skills.
85%	I understand how cities work.
83%	I am good at working in teams.
83%	I understand how to use engineering to solve real-world problems.
83%	I know how to apply math and science to real-world problems.
79%	I improved my research skills.
74%	I improved my public speaking skills.
74%	I have developed good time management skills.
68%	I believe that I can be an engineer someday.
67%	I improved my writing skills.

Students also reported that Future City...

89%	...helped me appreciate how many different types of engineering go into a city.
86%	...has given me an outlet for my creativity and imagination.
85%	...helped me see that math and science are important to my future.
80%	...has helped me learn the value of project planning.
75%	...has boosted my confidence in myself.
73%	...has made me more aware of civics issues like politics and taxes.
69%	...made me interested in doing other engineering clubs or activities.
68%	...has given me a place where I fit in.
57%	...has helped me in my other classes.

Parents, educators, and mentors reported that they saw improvements in the following skills...

	Using engineering to solve real-world problems	Applying math and science to real-world problems	Teamwork	Writing and research skills	Public speaking skills	Time management skills	Problem solving skills
Parents	89%	86%	94%	88%	85%	81%	92%
Educators	86%	76%	94%	85%	89%	79%	90%
Mentors	85%	65%	94%	86%	92%	77%	84%

In addition, Future City judges noted that working with teams is, perhaps, the most challenging part of Future City, but also the most rewarding aspect for students. Students also noted that there were times during the process when team members had differences of opinions and needed to work through those conflicts and that they emerged as **stronger teams** as a result of working through these issues together.

**Participants reported a positive impact of Future City on students' project management knowledge and skills.**

For example, students reported that because of Future City:

90%	I understand how to plan a project.
89%	I am familiar with the “do” stage of project management.
85%	I am familiar with the “plan” stage of project management.
77%	I am familiar with the “review” stage of project management.
76%	I am familiar with the “define” stage of project management.

**The impact of Future City on student knowledge of engineering and the engineering design process appeared to be dependent on whether Future City was offered as a class or as an afterschool club and whether teams had the consistent support of an engineer mentor.**

When we compared the impact on students from teams with a strong mentor (students rated their mentors) to students from teams with weak mentors or no mentor at all, we found that **students with strong mentors reported statistically significantly greater impacts than students with weak/no mentors.**



<b>Impact of Future City on engineering related knowledge and skills</b>	
Students <b>with</b> a strong, consistent mentor	Students <b>without</b> a strong, consistent mentor
4.4 out of 5.0	3.6 out of 5.0

We also analyzed the national educator sample to look for differences in perceived impacts on students for Future City teams that were offered as clubs, classes, or both as classes and clubs due to claims by some teams that Future City is harder for afterschool teams to compete in when compared with teams that are formed in classes. We found evidence that teams that operated only as afterschool clubs demonstrated statistically significantly fewer positive impacts than teams that operated as both classes and clubs. In each case, students in teams that were offered as both a class and a club (these teams likely spent the most time working together as teams) demonstrated significantly greater impacts than students whose teams met only as afterschool clubs.

<b>Students' teamwork skills</b>	
Classes and Clubs	Afterschool Clubs
4.8 out of 5.0	4.4 out of 5.0
<b>Students' writing and research skills</b>	
Classes and Clubs	Afterschool Clubs
4.5 out of 5.0	4.1 out of 5.0
<b>Students' public speaking skills</b>	
Classes and Clubs	Afterschool Clubs
4.7 out of 5.0	4.3 out of 5.0
<b>Students' time management skills</b>	
Classes and Clubs	Afterschool Clubs
4.5 out of 5.0	3.9 out of 5.0
<b>Students' problem solving skills</b>	
Classes and Clubs	Afterschool Clubs
4.7 out of 5.0	4.3 out of 5.0

**Future City met or exceeded the expectations of most parents (87%), judges (84%), mentors (77%), and educators (76%).**

<b>94%</b>	The proportion of parents who would recommend Future City to others.
<b>81%</b>	The proportion of parents who reported that Future City helped their child(ren) believe that they could be engineers someday.

<b>89%</b>	The proportion of mentors who agreed that Future City represents the field of engineering.
<b>88%</b>	The proportion of mentors who would recommend Future City to others.

<b>84%</b>	The proportion of educators who would recommend Future City to others.
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**Future City helped educators feel significantly more comfortable teaching the engineering design process and project management.**

Among educators, 35% were very comfortable teaching the engineering design process before Future City and 48% were very comfortable after. This difference was statistically significant.

In addition, 19% were very comfortable teaching the project management cycle before Future City and 36% were very comfortable after. This difference was also statistically significant.

<b>Comfort levels teaching the engineering design process</b>	
Before	After
<b>2.9 out of 4.0</b>	<b>3.3 out of 4.0</b>
<b>Comfort levels teaching the project management cycle</b>	
Before	After
<b>2.6 out of 4.0</b>	<b>3.2 out of 4.0</b>

## Workload

Many educators and mentors reported that the workload was appropriate for them and their students, but teams that operated after school reported having a greater workload burden than teams that operated during school hours.

Nearly half (48%) of educators and 25% of mentors reported that their workload was greater this year than in previous years; 46% of educators and 28% of mentors reported that their workload was the same.

	The amount of work required was appropriate for <b>me</b> .	The amount of work required was appropriate for <b>my students</b> .
Educators	62%	68%
Mentors	77%	76%

Students' least favorite aspects of Future City were the stress from deadlines and the workload required.

## Handbook

Many educators (68%) and mentors (66%) and 50% of Regional Coordinators reported that the new Handbook was easy to follow.

More than three-quarters of educators and mentors reported that the Handbook was helpful; 99% of educators and 90% of mentors used all or part of the Handbook this year.

	The new Handbook was <b>easy to follow</b> .	The new Handbook was <b>helpful to us</b> .
Educators	68%	83%
Mentors	66%	75%
Regional Coordinators	47%	N/A

When asked how to improve the Handbook, educators as well as some students reported that the Handbook might benefit from being streamlined and shortened.

## Website

The website was used most frequently by educators and more than half of educators and mentors reported that the website was easy to navigate. Most website users reported that it was helpful.

86% of educators and 44% of mentors reported using the Future City website several times; 12% of educators and 47% of mentors reported using it only once or twice; 2% of educators and 10% of mentors never used the website.

	The website is <b>easy to navigate.</b>	The website was <b>helpful.</b>
Educators	61%	85%
Mentors	61%	72%
Regional Coordinators	76%	76%

## Mentors

All participants recognized the critical importance of having the support of an engineer mentor, but many teams did not have the full-time support of one this year.

55% of educators reported having the support of an engineer mentor for the whole program; 16% had a mentor for part of the program; and 29% did not have access to a mentor at all.

Several mentors commented that they were never asked to support a school this year, or that there were no school teams located close to them, despite their willingness to mentor a team.

<b>63%</b>	The proportion of students with a mentor who reported that their mentor (the engineer) helped me to see myself as an engineer someday.
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## SimCity (Virtual City)

As reported in previous evaluations of Future City, we continued to observe that many educators reported experiencing disruptive technical issues with SimCity and/or PowerPoint on a wide scale.

Dozens of educators reported that they experienced serious technological problems with SimCity. Despite these problems, some students did enjoy using it and that it helped them learn about infrastructure.

62%	The proportion of students who reported that they enjoyed using SimCity.
54%	The proportion of students who reported that SimCity helped them learn about infrastructure.

There was evidence that SimCity was a valuable teaching tool.

Students reported that SimCity helped them...

84%	...learn what it takes to create and sustain a city.
82%	...understand the consequences of the decisions my team and I made as we designed our SimCity.
76%	...learn how cities work.
76%	...imagine and design my Future City.

Educators and mentors also reported that SimCity was helpful as a teaching tool.

	Helped my students learn about how cities work.	Helped my students apply their knowledge of how cities work to their future city.	My students tested different city designs in SimCity before designing our future city.
Educators	76%	68%	56%
Mentors	72%	74%	55%

In their open-ended responses, most educators described problems with the new SimCity deliverable and called for eliminating SimCity as a deliverable--keeping it only as a teaching tool.

42%	The proportion of educators who reported that SimCity should be a research tool and not a required competition deliverable.
27%	The proportion of mentors who reported that SimCity should be a research tool and not a required competition deliverable.

Half the Regional Coordinators agreed or strongly agreed that “The Virtual City deliverable should stay the same (slideshow PDF),” while 22% reported that the deliverable should revert back to the prior version (SimCity game file). Only 11% of Regional Coordinators agreed or strongly agreed that the Virtual City deliverable should be optional instead of a required deliverable.

## City Description

**Students demonstrated moderate interest in the City Description deliverable.**

72%	The proportion of students who reported that that they enjoyed <b>designing</b> waste management solutions.
52%	The proportion of students who reported that that they enjoyed <b>researching</b> waste management solutions.
46%	The proportion of students who reported that that they enjoyed <b>writing</b> the City Description.

**Educators and mentors reported that the City Description helped their students as they built their models and shaped their presentations.**

We asked educators to report how easy or challenging it was to make connections between the City Description, SimCity, and the Model: 39% reported it was challenging, 34% were neutral, and 27% reported that it was easy.

	The 1,500 word limit for the new City Description worked for my students.	Students referred to their City Description as they built their model and shaped their presentation.
Educators	81%	81%
Mentors	74%	70%

**Most educators (81%) were satisfied with the change in the City Description this year to a single deliverable.**

### Project Plan

**Students were more enthusiastic about managing projects using their own methods, rather than using the Project Plan.**

- 58% of the students in the national sample reported that they enjoyed working on a Project Plan.
- 67% of students reported that they enjoyed managing a project.

Educators and students in the intensive sample described how they managed their projects. Most did not use the worksheets provided by Future City, but instead used whiteboards, calendars, texting, and discussions to plan their projects. Regardless of the methods teams reported using, in the national study, most students reported that the Project Plan had a positive impact on their teams.

76%	Goal setting was helpful at the beginning of the process.
74%	Reflecting on the project was useful.
70%	The Project Plan helped us plan and manage the Future City project.
68%	Creating a schedule helped us stay on track.
68%	Conducting check-in sessions helped my team.

In addition, students in the national sample reported that because of Future City...

89%	...I am familiar with the “do” stage of project management.
85%	...I am familiar with the “plan” stage of project management.
77%	...I am familiar with the “review” stage of project management.
76%	...I am familiar with the “define” stage of project management.

### Educators and mentors provided moderate reviews of the Project Plan.

- 43% of educators and 58% of mentors agreed or strongly agreed that “The Project Plan helped us plan and manage the Future City project.”
- 63% of educators and 81% of mentors agreed or strongly agreed that “Goal setting was helpful at the beginning of the process.”
- 53% of educators and 69% of mentors agreed or strongly agreed that “Creating a schedule helped us stay on track.”
- 48% of educators and 66% of mentors agreed or strongly agreed that “Conducting check-in sessions helped my students.”
- 64% of educators and 74% of mentors agreed or strongly agreed that “Reflecting on the project was a useful exercise.”

### City Model

#### Model building was the most popular Future City activity among students.

When we asked students in the national sample what they liked most about Future City, the most popular response was model building, reported 1,432 times.

90%	The proportion of students who reported that they enjoyed building the city model.
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## Presentation

**Student feedback about preparing and presenting their models at the competitions was generally positive.**

When we asked students in the national sample what they liked most about Future City, the 4th most frequent response was the presentation, reported 147 times.

66%	The proportion of students who reported that they enjoyed <b>delivering</b> their presentation.
64%	The proportion of students who reported that they enjoyed <b>preparing</b> their presentation.

## Regional and National Competition Logistics

**The regional competitions were exciting for most participants, but many had specific suggestions about ways to improve the logistics of competition day.**

## Rules, Judging, and Equity

**Participants reported several challenges with respect to rules, equity, and judging.**

The following issues related to rules, judging, and equity were reported by participants:

### Rules

- The one-team-per-school rule for finals was discouraging for some teams who placed in the Top 5 in their regions, but could not attend because another team from their school also placed in the Top 5.
- The rules allow teams to reuse pieces or parts of their models year after year, which is viewed as unfair to losing teams as they observe winning teams using the same materials over and over again and continuing to win.
- Some participants were astounded that cheating was not expressly prohibited by Future City (and that “cheat codes” are provided for SimCity).

## **Judging**

- Educators and mentors reported that there wasn't enough feedback from the judges or examples of past projects available.
- Judges also complained that they felt "unprepared," did not have an understanding of what was considered "age appropriate," and that they felt like they were "doing a disservice to the students" by not having proper training.

## **Equity**

- Afterschool teams reported that they felt they were at a disadvantage in the competition when compared to teams that did Future City as a class (also discussed in Workload section above).
- Some teams' models included expensive components that were not valued in seemingly fair ways.
- Participants reported that inequalities need to be addressed and that Future City needs to be advertised to a wider range of school types, including schools in traditionally underserved communities.

# High-Level Summary of Suggestions for Improvement

## Workload

1. Provide workload estimates to participants at the outset, if possible. This information would be especially useful during recruitment.
2. Given that students' least favorite aspects of Future City were the stress from deadlines and the intense workload, consider ways to reduce the amount of work required. This would help in several ways:
  - a. Teams that operated as clubs (38% of all teams) reported feeling disadvantaged because they could not devote as much time to Future City as their counterparts who ran Future City as a class.
  - b. Many respondents reported that students could not possibly complete all the requirements without the help of adults, which in turn meant that some teams were viewed as cheating and relying too heavily on adults. Other teams that did not have ready access to parents who could help out felt like they were at a disadvantage. In particular, schools in poor, urban areas mentioned this.
  - c. Consider releasing the essay topic in May so that teams can start planning ahead.
  - d. Consider separating the regional competitions into two competitions: (1) one for classes, and (2) one for clubs, or at least judging the team types separately and awarding them separately.

## Handbook

3. While some educators were interested in teaching the engineering design process and liked the structure of the Handbook because it followed the engineering design process and project management process, other educators were less interested in teaching the design process *per se* and would rather the Handbook simply contain one chapter containing all materials related to the City Description, one related to the Model, etc. This was especially true of teams that operated as after-school clubs.

Many teams found it very difficult to use the Handbook because there wasn't one single place to find the requirements, and they often had the sense that they were missing pieces because they were "scattered"

throughout the Handbook. Rather than suggesting that Future City revise the Handbook to satisfy one or the other approach, we suggest the following changes to make it easier for participants to find information, regardless of which approach they are taking:

- a. Include an Index;
- b. Include a single list of requirements (components) and direct users to where in the Handbook they can learn more about each part;
- c. Since Future City already lists the required components in the chapter Learn the Specs, but participants had trouble locating it, we recommend that this resource be moved up so that it's easier to find;
- d. Since participants seemed unaware that Future City provided exemplars of all deliverables on its website, we suggest that Future City try to identify ways to help participants find this information; and
- e. Consider ways to shorten the Handbook.

Participants were unaware that Future City provided a Word version of the Project Plan on its website, so we suggest that Future City try to identify ways to help participants find this information and provide instructions on how to download it into their Google classrooms, if needed.

4. Other suggestions from educators and mentors included:
  - a. Adding suggestions for ways that students can conduct and coordinate their research more effectively;
  - b. Include a sample Timeline from a successful teacher;
  - c. Include sample questions the students may be asked by judges during the competition;
  - d. Suggest more ideas or examples of ways that students can fundraise the money for making the model of the city;
  - e. Under "Role of the Mentor", suggest that teachers ask their mentors to score each deliverable according to the rubric well before the due dates;
  - f. Under "Building the Model": 1) have a "Disassemble Day", where small castoff electronics, appliances, and toys are taken apart and interesting parts saved. 2) Ask mentors or other engineers for interesting materials for the model. 3) Teacher or mentor can collect small items in an "inspiration jar" to share with students, made out of jumbo clear plastic snack jar. 4) Encourage students to make buildings on model out of items related to the purpose.

- For example, a phone keypad may be part of a communications center, or a faucet piece may become a water treatment facility;
- g. Include team-building tips.

### **Program Update**

Future City reviewed the suggested improvements and implemented many of the ideas in the 2016-2017 Handbook. For example, Future City added: an index; a prominent and robust chapter listing all competition requirements, corresponding resources, and detailed directions on how to find them on the website; an expanded Role of the Mentor PDF; a new student handout section; and a new Preparing to Lead chapter for educators.

### **Website**

5. There was a lack of understanding on the part of some participants about what is available in the Handbook and what is also available online. Future City may want to consider additional ways to make participants aware of all the resources.
6. Consider doing some user testing to ensure that information is easy to find and download.
7. Eliminate the need to enter an email address every time someone accesses the website.
8. Ensure that the regional websites are kept up-to-date and do not contradict the National website.

### **Program Update**

As a result of the suggested improvements, Future City now only requires participants who download a document to enter their information every 90 days.

### **Mentors**

9. This report provides evidence that mentors are crucial to Future City's impact on students. Roughly half of all teams (45%) did not have a full-time mentor this year. Moreover, several mentors commented that they were never assigned to a school this year, or that there were no schools located close to them, despite their willingness to work with teams. We recommend that Future City consider the following:

- a. Assign mentors in a timely manner.
- b. Ensure that all willing mentors are assigned to schools.
- c. Develop a national pool of available mentors and connect teams remotely via Skype or phone, at the very least.
- d. Reach out to universities and student engineering societies to recruit student engineers as mentors.
- e. For veteran educators who have years of experience with Future City, consider developing a national pool of mentors who hold regular webcasts where any Future City teams can connect and ask specific questions when they need to, but may not need full-time support.

## SimCity

10. We strongly recommend that Future City eliminate SimCity as a deliverable and offer it only as a research tool. Many schools continue to struggle with technology problems related to SimCity, and many respondents were troubled by how including SimCity as a requirement is inherently unfair to schools without the resources to access it. Future City should also consider:
  - a. Using alternative programs like Cities: Skylines or Minecraft.
  - b. Creating a document that answers FAQs for teams that are new to SimCity.
  
11. Participants were divided about whether the new Virtual City deliverable was useful. All agreed that it was *very* time consuming, that PowerPoint was an obstacle for some teams, and that the requirements for judging it were unclear. We recommend that if SimCity remains as a deliverable:
  - a. The Virtual City deliverable should be included on a list of requirements (see #2 above).
  - b. The requirements for points should be made clearer. Even judges complained about the lack of clarity and too much subjectivity in the scoring.
  - c. Considering using Google Slides or a tool that is web-based to remove the cost or technology barriers to using PowerPoint.

## Program Update

For 2016-2017, Future City reduced requirements for the Virtual City deliverable and updated the rubric to reduce subjectivity. Future City also created more

versions of the slideshow template, including Powerpoint, Google Slides, and MS Word to allow participants to use the program that works best for them.

## City Description

12. While the feedback on the new City Description deliverable was mixed, many participants found it useful, so we recommend keeping it as a single deliverable.
13. Educators, students, and mentors suggested that Future City review the City Description rubric and the Handbook to ensure that the instructions for the City Description are clear, streamlined, and well-balanced between research and city narrative.
14. Judges also suggested that Future City add a comments section to the City Description judging form so they can indicate why they deducted points.

## Program Update

Future City renamed the City Description deliverable to City Essay and updated the rubric to balance the point structure between the description of the city and the annual citywide theme and solution.

## Project Plan

15. Most teams in the intensive sample did not use the Project Plan worksheets, even though all teams did engage in some form of planning. Teams used a variety of methods for planning and reflecting on their projects and they found the process of doing so to be helpful. To encourage teams to use the worksheets, we recommend:
  - a. Consider awarding more points for the Plan, considering the time commitment required to complete it.
  - b. Creating an electronic version (see 3 above).
  - c. Creating a rubric for the Project Plan (see 2c above) OR explaining very clearly why a rubric is not offered.
  - d. Ensuring that the Project Plan is included in a list of requirements (see 2c).
  - e. Consider allowing teams to use alternative formats for their planning deliverable, such as video or photo journals.

## **Program Update**

For 2016-2017, Future City edited the Project Plan to clarify the instructions, made the link to the online word version more prominent, and reduced the number of questions in the Project Check-in and Project Reflection worksheets.

## **City Model**

16. With respect to the rules for model building, consider doing away with the rule that allows schools to tear down and rebuild prior years' models. Consider instituting a new rule that requires all teams to start from "scratch."
17. Consider providing "Tips for Quality Construction" for model building.
18. Make it clear that the City Model does *not* have to be based on the Virtual City, but that it *should* be based on the City Description.

## **Program Update**

For 2016-2017, Future City revised the rule addressing prior years' models; clarified the relationship between the Virtual City, City Essay and City Model; and created a new Model Building Tips student handout.

## **Presentation**

19. Provide teams with a list of questions or topics that judges may ask during the competition so they can be prepared.
20. Encourage teachers and mentors to give students adequate time to practice their presentations before an "audience" well in advance of the competition. Emphasize the importance of speaking loudly since competition venues are typically loud and judges often struggle to hear the presentations.

## **Regional and National Competition Logistics**

21. All regions should schedule a "rain date" (backup date) for their competitions or have a backup plan in case of weather or other factors that could cause the competition to be cancelled on the original date, and all plans should be communicated to parents, educators, and mentors well in advance of the competition date.



22. Future City should consider offering more awards or some form of recognition for *all* students on winning teams, not just the presenters, even if it's just certificates.
23. Some of the competition venues could have been better organized, with a clearer schedule and directions/maps. This was especially important to new teams.
24. Parents and mentors were also reportedly upset with the way the venues were organized and the way some of them were treated by regional representatives.
25. Consider ways to add more variety in terms of the competition day schedule or activities that may help people stay engaged throughout the long competition days.
26. Communicate with parents, mentors and educators well in advance of the competition about the day's schedule and rules about which sessions parents can attend and which ones they cannot.
27. Consider providing a time during the day when parents can visit the models and talk with students about their projects.
28. Consider ways to improve the registration process for the national competition.
29. Consider holding the national competition in other areas around the country, rather than always in Washington, DC.

## **Rules, Judging, and Equity**

30. Participants expressed a strong desire for Future City to find ways to identify cheating and cases in which parents are doing the work instead of the students. Reducing the workload required may help to alleviate the degree to which parents intervene.
31. Participants suggested eliminating the rule that allows teams to reuse parts and pieces year after year and to keep a closer eye on which materials are being used and their actual value.
32. Participants recommended that more than one team per school should be allowed to participate in the finals.

33. Participants recommended ensuring that judges and sponsors are not affiliated with any schools as mentors, as this presents a conflict of interest.
34. Participants recommended that Future City look for ways to make the competition fair to teams that do their work only after school (versus as part of a class). This report provides evidence that the way teams are structured has a significant impact on their experience.
35. Participants recommended that Future City find ways to advertise the program to a wider audience and, at the same time, make the competition more accessible to lower-income schools and other underserved students.
36. Create more tools for judges, including:
  - a. Clarify and simplify existing rules and guidelines so judges may be as objective as possible.
  - b. Create a training course that clearly explains all the points below. Even better would be a calibration exercise in which judges have to judge an old project to ensure that all judges are ratings projects in a consistent, fair, and reliable manner.
  - c. Offer clear guidelines about appropriate and inappropriate questions to ask.
  - d. Create a penalties form for the judging teams to use in reviewing for and assessing penalties.
  - e. Create a summary form to show all the scoring and deductions on a single page. An electronic form that can be shared with teams would be ideal.
  - f. Normalize judges' scores to ensure fairness (e.g., subtract judge-set mean score; divide by standard deviation).
37. Enable judges to provide feedback on scoring sheets so teams can understand why they received the scores they did (Some do this, others do not but would like to.)
38. Allow judges to have more time to do their work. Many judges reported being rushed.
39. To address questions about socioeconomic inequality, we suggest that Future City reach out specifically to schools in lower SES communities to learn about their specific obstacles and to find ways to make the competition more accessible to them.

## **Program Update**

For 2016-2017, Future City is creating a new Best Practices Manual for Regional Coordinators that addresses how to organize a competition and ideas for how to include and recognize all participants. Future City also reviewed and updated the competition's rules, clarified when and how SimCity 'cheat codes' can be used, and updated the Virtual City rubric to reflect their use. It is revamping the judge's manual and creating a national training webinar for judges. It also updated the Competition Expense Form to more clearly outline how monetary values should be assigned to materials. Future City also revised the rules to clarify that a mentor or educator participant is not allowed to also serve as a judge.

## **Other**

Other suggestions offered by Regional Coordinators included:

40. Regions would like help from the National office with sponsors and funding.
41. Regions would like the National office to stop changing the materials and to seek input from Regional Coordinators sooner.
42. Regions would like the National office to help them recruit.
43. Regions provided suggestions for improving the CMS.
44. Regions would like the National office to provide information and respond to requests in a timely fashion.
45. Some regions would like to have greater interaction with the National office.
46. Regions suggested creating a system for teacher support.
47. Regions had other logistical suggestions that are described in the report.

# Detailed Findings Related to the Future City Program and its Components

## Organization of this Section

This section presents detailed findings from the evaluation study. These findings provide the rationale for the suggestions presented in the previous section. This section is organized by Future City components/activities as follows:

- Program Impact on Participants
- Workload
- Handbook
- Website
- Mentors
- SimCity
- City Description
- Project Plan
- City Model
- Presentation
- Regional and National Competition Logistics
- Rules, Judging, and Equity

## Program Impact on Participants

### Impact on Students

**Most students reported that they enjoyed Future City, especially the model building, fun, self-discovery, and teamwork aspects of the program.**

Using an open-ended question, we asked students in the national sample what they liked most about Future City. The most common responses were:

- Model creating and building (n = 1,432)
- Teamwork (n = 227)
- SimCity (n = 181)
- The presentation (n = 147)
- Planning and designing (n = 121)
- The competition and the judges (n = 88)
- The City Description/essay (n = 69)
- Engineering, making STEM connections (n = 46)
- Making connections to real life (n = 47)
- Accomplishing a goal (n = 42)
- Critical thinking (n = 41)
- Creativity (n = 40)
- Seeing the other cities (n = 37)
- Researching (n = 36)
- Learning (n = 34)
- Problem-solving and brainstorming (n = 26)
- Everything about it (n = 26)
- Meeting new people (n = 25)

For example, students in the national sample reported that they enjoyed:

- *Building my relationship with my group members and working as a team to create a great project.*
- *Coming up with new ideas with my teammates; seeing their faces light up when something worked was priceless.*
- *We got to work in groups and share all the ideas as one team.*
- *Learning about possible future practices like building materials, things we might use when we grow up.*
- *I enjoyed building the model of the city because we get to use... recycled materials and it's fun using these materials in a creative way to build our buildings.*

- *I liked when we were doing SimCity because we got to design a city any way we wanted and made it so that everything would work together.*
- *I loved having our ideas just come together and just having what we wanted in our city to just click.*
- *I was a big fan of the problem solving stage where we had to really think about it. Because to me that's the whole point of this. The designing of the city. We have to create the city before we can do anything else. And that was my favorite part because we got to be creative and think of whatever we wanted.*
- *I liked creating different ideas on new technology and actually building the model and getting to create that.*

Educators reported:

- *The competition is the best part because they get to tell their story.*
- *To me, the big benefit of this project is that there's this huge project with lots of different parts and they have to work through it. And when I describe this to the school board or whoever is giving us money for the year to do so, I always say, "If you look at what these kids have done over this semester, these are all the things that we want these kids to be able to do when they graduate from high school."*

We asked students in the national study how they would describe their experience with Future City this year. The most common responses that were positive included:

- It was fun, amazing, wonderful, etc. (n = 1,121).
- I learned something, it was a process of self-discovery (n = 348).
- It was interesting, eye-opening, motivating (n = 132).
- It was good to work with a team (n = 188).
- It was complex and challenging (n = 98).
- It was helpful, useful, beneficial (n = 67).
- I got to do work that was hands-on or creative (n = 61).
- It was rewarding (n = 43).
- It was novel or different (n = 21).
- It was memorable (n = 18).
- It was better than last year (n = 15).

**Students, parents, educators, and mentors reported that Future City had a strong, positive impact on students' 21<sup>st</sup> century skills, especially teamwork.**

As summarized in Table J-12, the majority of students in the national sample agreed or strongly agreed that *because of Future City...*

- I see the value in working with a team to solve problems. (89%)
- I am comfortable working in a team to create something with little direction from a teacher. (88%)
- I am comfortable working in a self-directed manner. (86%)
- I have developed good problem-solving skills. (86%)
- I understand how cities work. (85%)
- I am good at working in teams. (83%)
- I understand how to use engineering to solve real-world problems. (83%)
- I know how to apply math and science to real-world problems. (83%)
- I improved my research skills. (79%)
- I improved my public speaking skills. (74%)
- I have developed good time management skills. (74%)
- I believe that I can be an engineer someday. (68%)
- I improved my writing skills. (67%)

In addition, as summarized in Table J-16, most students in the national sample agreed or strongly agreed that Future City had an impact on the following knowledge and confidence factors...

- ...helped me appreciate how many different types of engineering go into a city. (89%)
- ...has given me an outlet for my creativity and imagination. (86%)
- ...helped me see that math and science are important to my future. (85%)
- ...has helped me learn the value of project planning. (80%)
- ...has boosted my confidence in myself. (75%)
- ...has made me more aware of civics issues like politics and taxes. (73%)
- ...made me interested in doing other engineering clubs or activities. (69%)
- ...has given me a place where I fit in. (68%)
- ...has helped me in my other classes. (57%)

The classes reported most frequently included:

- Science (n = 671)
- Math (n= 592)
- ELA (n= 184)
- Social studies (n = 92)

As summarized in Table J-14, among the students in the intensive sample, 80% agreed or strongly agreed that Future City helped them see that math and science are important to their future and 22% agreed or strongly agreed that Future City made them interested in doing other engineering clubs or activities.

Seventy-three percent of students reported that they would participate in Future City again, if they could.

Educators in the intensive sample reported:

- *It was a great experience, even with the little bit of the twist at the end. The girls were very engaged, very engaged.*
- *They're already telling me how they miss Future City and how rewarding it was and how they had a great time. They're always wearing their t-shirts to school. They're incredibly proud of what they accomplished.*
- *Yeah it was incredibly rewarding, very time consuming but incredibly rewarding, very good experience for the kids. The actual competition was just very organized. It was really easy to find where we needed to set up and how things were going to play out. All of the people that were judging and participated in the process were just exceptional individuals. So my hats off to that fact.*
- *Yeah...It's still a solid project and a good tool to use to teach kids lots of different things.*
- *They're always met because it's a learning process and we get to exposed to a lot of new things. So, yes, I think so. It's always good resources out there.*
- *They love interacting. We went out to a place and met with a bunch of engineers at the Brooklyn Navy Yard here in New York City that's being built up. And talking to them about the process and they love that stuff and I really try to make it interesting for them.*
- *I thought everything was great. I think the girls sounded like it was going to be a ho-hum for them in the beginning and they really got into it.*

More than three-quarters of educators, mentors, and parents in the national sample (Tables K-10, L-6, and M-11) agreed or strongly agreed that Future City helped students...

- ...learn how to use engineering to solve real-world problems.
- ...learn how to apply math and science to real-world problems.<sup>1</sup>
- ...improve their ability to work with a team.
- ...improve their writing and research skills.

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<sup>1</sup> The only exception to the three-quarters result was that 65% of mentors agreed or strongly agreed with this statement.



- ...improve their public speaking skills.
- ...develop good time management skills.
- ...develop good problem-solving skills.

As shown in Table L-7, 81% of parents reported that Future City helped their child(ren) believe that they could be engineers someday.

As shown in Table M-14, 89% of mentors agreed or strongly agreed that Future City represents the field of engineering.

Using an open-ended question, educators in the national sample reported the positive impacts they observed on students. The most common responses were:

- Teamwork (n = 106)
- STEM knowledge or interest (n = 94)
- General enthusiasm (n = 56)
- Project/time management (n = 46)
- Problem solving (n = 44)
- School/life connections (n = 34)
- Generally positive (n = 33)
- Confidence (n = 32)
- Research/writing skills (n = 26)
- Public speaking skills (n = 25)
- Creative thinking (n = 23)
- Hands-on skills (n = 20)

For example, some educators reported:

- *Future City is a wonderful project based learning experience which has so many real-world applications...these kids will carry on these lessons learned for a lifetime.*
- *The learning-to-work-as-a-team aspect of the project was a huge benefit to our students. How do teams work when everyone has a good idea? Or when 2/3s of the team prefers one solution and the other 1/3 isn't budging? Our team learned the value of majority rule in breaking an impasse and the importance of negotiation and logical thinking. They also learned about expressing their own ideas and critiquing others' ideas in positive, helpful ways. Especially for middle school students, this part of the program is extremely valuable.*
- *This is the first time that many of my students have seen a connection between a class at school and the real world.*
- *I have several students whose confidence was low, this really gave them a positive experience and I could see the difference. I think it also helped*

*them see that each student can offer different skill sets and strengths to the team and that to accomplish all they did, it took a team effort.*

- They are being challenged at a high level to work as a group, tackle something that is bigger than themselves, and accomplish tasks that are more real world, more intrinsically fulfilling than sports.*
- The program introduced the students to a different method of collaboration and problem-solving.*
- Future City has a significant impact on the students who participate. It gives them a community of students where they can build strong relationships. They learn to communicate and work together. They are forced to confront a very difficult and complex problem (many of the for the first time in their life) and figure out a way to solve that problem on their own. They learn to speak in front of people and defend their ideas in front of well educated adults. Most importantly it gives them an opportunity to feel successful and build confidence at a time when they are trying to figure out who they are. There are so many ways my students are impacted that it is hard to describe.*
- For a group of students who seemed to be more followers, my students learned to find leadership within themselves.*
- The Future City has provided an authentic learning opportunity for my students. They have learned how a project is completed and all the components involved in project management. They have also had a platform for a real world application of everything they've learned in school.*
- My students are a special group of kids who have not fared well in the public and other private schools. Being a part of and especially winning a place in the regional competition was a first for their lives. Only two students in the class had ever experienced a competitive event. The win gave individuals in this class a sense of personal success that most had never experienced before. These students found a greater sense of "can do" and "anything is possible" from this experience. Thank you FCC!*

Parents reported:

- Future City taught team work to a group of three leaders. They learned compromise without giving up their ideas. They also learned how to build their thoughts into a visual model. Sometimes writing and building don't go hand in hand.*
- Future City gave him the opportunity to learn how to articulate and express himself. It also helped him learn to work in a team for a common goal.*
- Future City has helped my daughter better understand the cooperative nature the field of engineering must be.*

- *He has learned how to do proper research, work with a team of others to brainstorm and coordinate ideas.*
- *Helped him be part of a team with the responsibility associated with helping the group meet their goal of creating a unique project by combining multiple ideas from several people for a common goal.*
- *Helped my daughter look for creative solutions to problems. Increased my daughter's awareness of problems that cities face and helped her realize the importance of becoming educated in order to contribute to a solution.*
- *My son learned so many valuable lessons and gained so much knowledge from Future City: presentation skills, the science behind waste management, water renewal, city planning. He learned about economics and project planning, as well. The impact will be life-long as he moves towards his own future.*

Eighty-six percent of students reported that they enjoyed working in a team (Table J-10).

We asked judges to share their observations about students' teamwork. The most common observations were:

- Students demonstrated strong teamwork (n = 239).
- Some students demonstrated strong teamwork while others demonstrated a lack of teamwork (n = 46).
- Teams demonstrated weak teamwork (n = 20).
- Students commented on the importance of teamwork (n = 14).
- Students displayed a positive response to stress (n = 4).
- Students were well-organized (n = 6).

Judges commented on the degree to which they saw students demonstrate strong teamwork skills. Several judges noted that working with teams is, perhaps, the most challenging part of Future City, but also the most rewarding aspect. Some observed, for example:

- *Teamwork seems to be one of the areas the students really learn something. By and large, they all expressed how much they had to work at and learn about teamwork.*
- *This is perhaps the area where they are learning the most. It was hilarious to hear them talk about resolving their differences (sounding like grownups) and then see them start the eye-rolling when one of their teammates said or did something they didn't agree with.*
- *A lot of teams said the hardest part for them was working as a team and figuring out how to work together. This is a very good skill to learn at their age, and in the end I thought they all worked very well together as a team during the presentation.*

- *Many teams say that learning teamwork is the hardest part of the competition, but most of them seem to have worked it out.*
- *In the project plans they did seem to realize that working together was the best way to achieve their team goals.*

Despite the challenges of working with teams, most judges reported that they observed strong teamwork among many of the teams they judged:

- *All of the teams seemed to feed off of each other and when one person would get caught stuck one of their teammates would jump in and help them out.*
- *All teams seemed to share the load and could speak intelligently about the areas in which they participated which seemed to me to be an improvement over years past.*
- *I think I saw better teamwork this year than in past years. With the larger groups it was hard to tell who participated a great deal and who did not. However, most groups split up responsibilities to tackle this project. Some assigned “leaders” for certain tasks, which I thought was very helpful for them (they liked that strategy). I also saw teams with multiple grades on the same team which was nice.*
- *By their responses, it seems like the majority of teams that did better participated in collaborative sessions to discuss ideas of how to achieve their goals.*

Some judges noted differences in teamwork, depending on the size of the teams:

- *Depended on how the team was organized. Smaller teams of interested students usually worked very well together as a team and the entire team was supporting the presenters. If the team was really an entire class that worked on it, the product was often good but they did not work as well as a team and often those that also worked on the competition but did not have to present were not present to support their peers.*
- *It is clear that in order to present a city on the day of the competition all of the teams must work together. While all of the teams did a fabulous job I was disappointed that some teams designated one or two individuals to speak while 3-4 students stood in the background. I would have loved to have heard from if not all, the majority of the students at the table. While I understand the massive undertaking that the Future City competition is for both the students and the teachers, schools that bring a large number of students with them should designate a role for each student. Schools with large groups of students standing around is a bit distracting.*

Several students noted that there were times during the process when team members had differences of opinions and needed to work through those conflicts

and that they emerged as stronger teams as a result of working through these issues together:

- *We all had different thoughts, but once we got in a rhythm, I loved how we were able to put our heads together to come up with innovative solutions to complex problems.*
- *My favorite part of Future City was [that we were] four people going from kind of strangers to having to work together which was sometimes hard, to having a lot of fun making a future city model.*
- *We didn't always get along, but I like to be on a team that values my ideas, and treats everyone equally.*
- *My favorite part of Future City was learning better teamwork and being challenged to work in a time frame with others.*
- *My favorite part was learning to work as a team with people I didn't really get along with.*

In an open-ended format, we asked mentors what impact Future City had on their students. Again, teamwork was one of the top responses. The most common observations were that Future City impacted students':

- STEM interest and knowledge (n = 36).
- Teamwork (n = 28).
- Project management skills and knowledge (n = 21).
- Problem solving skills (n = 13).
- Enthusiasm (n = 9).
- Public speaking skills (n = 5).
- Critical or creative thinking (n = 3).
- Research and writing skills (n = 3).
- Hands-on skills (n = 3).
- Confidence (n = 2).

Mentors reported:

- *As the program is entering its 10th year at my participating school, it's rewarding to see how the kids gravitate towards Future City as they grow. Some participate as an extracurricular activity, and others are seeking to learn more than what's being taught in school. It's a win-win all around.*
- *Experience of going through the project and depending on other team members gives a great learning experience for real life. They learn not only about STEM but also deal with real life professional situations of conflict, planning and learning to detach from personal feelings and focus on the project success.*

- *Exposed them to real-life applications of engineering, like basic everyday municipal needs, gave them an opportunity to meet and learn from engineers about different jobs in engineering, helped them figure out how to work on a long-term project with a team and talk through disagreements.*
- *Future City gave the kids a wonderful exposure to a real authentic project-based engineering experience, very different from anything they have ever experienced in school.*
- *I could see a real growth in the students during the semester in being able to work together for a common purpose. They learned how to identify a problem, come up with solutions, test them, and then adjust as required. As with any middle school students, time management was a real issue, but in the end, they realized how to get things done.*
- *I have seen kids breaking out of their shell and engaging with their teammates, mentors and parents. They gained confidence and a more pronounced interest in science. From the experience this year, my daughter is thinking she might want to become an architect. She has always had the interest in the creative side and now the engineering interest is there as well. It is a great program.*
- *Now that my current school has participated for seven years, it is great to see the seniors and juniors involved in mentoring and coaching the 7th and 8th grade teams and relaying their lessons learned. There is a buzz and spirit in the Future City program that excites the school and the successful competition results from previous teams encourage them for the new year. I have had a handful of students go on to major in engineering and it makes me proud to think this may have been the spark.*
- *The students learned about how to organize themselves as a team. Which students had interests and aptitude for which tasks was something they worked through. This experience may have been the first time working in a team over a long period of time (other than sports) where time management, writing skills, as well as research skills were an important part of the experience.*
- *Their biggest take away was teamwork!*
- *Through the years, I have seen those that participated in the program do extremely well in high school and then college. I am having my 1st group graduating from college 90% are graduating with an engineering degree. They all have come and told me how this program taught them about something they love. The impact of this program is phenomenal.*

Finally, we asked judges to share their observations about students' public speaking skills. The most common observations were:

- Students' skills were strong, well-rehearsed (n = 74).

- Some students were strong, while others were not (n = 45).
- Students were very mature, better than average students (n = 33).
- Students were nervous and inexperienced (n = 14).
- Students' skills were not strong at all (n = 7).
- Students tried hard (n = 4).

**Participants reported a positive impact of Future City on students' project management knowledge and skills.**

As summarized in Tables J-10 and J-21, more than three-quarters of students in the national sample agreed or strongly agreed that *because of Future City...*

- I understand how to plan a project. (90%)
- I am familiar with the “do” stage of project management. (89%)
- I am familiar with the “plan” stage of project management. (85%)
- I am familiar with the “review” stage of project management. (77%)
- I am familiar with the “define” stage of project management. (76%)

With a pre-post survey administered to students in the intensive sites, we measured student knowledge of the stages of the project management cycle. As shown in Table J-13, there was no significant change in scores from pre-test to post-test. This is likely due to the fact that none of the intensive site teams followed the Project Planning process as prescribed, although they did engage in planning in different ways.

As reported by their educators (project planning) in the intensive sample:

- *I think they have truly gotten the whole idea of when you make a project plan it's understanding the end. They understand the idea of it...I think she understands the importance of priorities and keeping to the plan.*
- *Is it the handbook or just by doing it? You plan it. Like we built our city model. We mocked it out on cardboard. We had the whole thing planned out before we actually built the city model. Right? And so we had and I think the girls had been talking about it. They realized wait a minute. We can't have our roads this way so they did follow the system of define, plan, do, refine or whatever the flow of that is.*

Students in the national sample reported:

- *Future City got me to open my eyes to the magic of engineering.*
- *The fact that this project can help me later in life, is INCREDIBLE. All because of this project, I think I would like to become an Architectural Engineer, when I am older.*

- *I enjoyed the hands-on part of starting to build it. I got to see it come together even if I wasn't able to be in town to finish it with my team. I also liked the Simcity part of it because, well, Simcity's just a fun game. :D All in all, this was a very fun, creative, inspiring, and thought-provoking activity and I cannot wait for next year to solve another world problem and make a difference.*
- *My favorite part of Future Cities was the fact that it was such a learning experience. Not only did I learn about lots of new problems and how to tackle them, I also learned many new teamwork skills that I will carry on to high school.*
- *My favorite part of Future City was learning all the things that go into a city. I also loved the fact of how all the different engineering roles came into play when you wanted to design something.*
- *Working as a team and being able to contribute ideas and ask questions in a judge-free environment.*
- *Although the process in future cities is difficult, with problems such as disagreement, differing ideas, and higher expectation of satisfactory it was altogether enjoyable. Of course it was a difficult process, a few hours each Friday making everything as decently average to grandeur as possible. I know many others have an hour a week to complete this however since I am a child without any past experience in the competition it made me focused more on trying to better make a better city. Of course since my expectation are slightly higher I did try to make things better.*
- *Despite all the hard work and sleepless nights, it was a good experience to have when referring to collaboration, communication, and designing skills.*
- *Future cities was a fun, yet challenging experience. It helped me work on my creativity and problem-solving skills. It was a very good experience.*
- *Future cities was such a fun intellectual experience for me, always another problem to solve which was great because it gave a sense of the real world.*
- *Future City was a great experience that I was happy to participate in. I got to learn about future problems that could surface in the future, and I feel confident in pursuing an occupation in the engineering field.*
- *Future City was a great experience. I definitely tested my skills as a leader and that was sometimes stressful. There was so much that went into this project. We really had to channel both our creative side, and our logical thinking side. Overall, I had a great time and feel as if I'm a more well-rounded student because of it.*
- *I really liked my experience with the Future City Competition. This was my first year participating and I would like to take part in it again next year. Although there were times where I was very stressed out and frustrated, I think that it was completely worth once we went to the regional competition.*



- *I would describe it as a great learning experience. This project has helped us learn the value of team work, and how hard it is in the real world. This has widened our vision of our community.*
- *It was a fun process, with some setbacks and challenges, but in the end it was all worth the effort.*
- *It was hard at times, but it was fun. My team kept me up and moving. I made new friends. When I was upset, nervous, or falling apart, they helped me. We make a good team. I also enjoyed learning about how cities work. I was never really partial to math. But Future City was fun. I'll miss it.*

**The impact of Future City on student knowledge of engineering and the engineering design process appeared to be dependent on whether Future City was offered as a class or as an afterschool club and whether teams had the consistent support of an engineer mentor.**

Judges observed that students' engineering knowledge seemed to be directly related to whether teams had the support of an engineer mentor:

- *A couple of teams had some understanding, probably from an effective mentor. Some teams seemed to think that engineers were the maintenance crew, for instance, checking for leaks of a domed underwater city.*
- *As an essay judge, I see year after year of essays in which the required discussion of engineering disciplines is minimal or missing altogether. It should be an easy element to include and do well, so I think they are probably not hearing this emphasis from their teachers and mentors.*
- *As usual this varied a great deal. While I do not know who the mentors of the teams are I suspect that the areas where they focus in their essays is largely driven by their mentor. Some essays reflected detailed discussions of engineering disciplines required to support their ideas while others were completely silent on engineering disciplines.*
- *Based on the write ups, their knowledge of engineering was anecdotal at best. It seemed as though they had no support from professionals in the field to help them in their knowledge base before coming up with solutions that were many times outlandish.*
- *Mentors need to provide guidance for the students how STEM disciplines are applied to present day city infrastructure design, deployment and maintenance and how those disciplines may be applied for the students' Future City design.*
- *Having an engineer as the team mentor was helpful and evident in the students' presentations with their use and understanding of the role or need of an engineer.*

- *I judged project plans and they discussed the presence of and the lack of an engineer as an advisor. It seems the students rely heavily on outside engineers. I think if they have an engineering advisor they may learn a lot about engineering but if they don't this could be lacking.*

We explored judges' hypothesis with data from the national sample. Due to a lack of variation in the intensive sample (none of the teams in the intensive sample had a consistent mentor), we could only use the national sample data. We found evidence that mentors *did* make a significant difference. When we compared the impact on students from teams with a strong mentor (students rated their mentors) to students from teams with weak mentors or no mentor at all, we found that students with strong mentors reported significantly greater impacts than students with weak/no mentors. Students with strong mentors reported an average impact of 4.4 out of 5.0, while students with weak/no mentors reported an average impact of 3.6.<sup>2</sup>

We also analyzed the national educator sample to look for differences in perceived impacts on students for Future City teams that were offered as clubs, classes, or both as classes and clubs due to claims by some teams that Future City is harder for afterschool teams to compete in when compared with teams that are formed in classes (see section on Rules, Judging, and Equity). We found evidence that teams that operated only as afterschool clubs demonstrated statistically significantly fewer positive impacts than teams that operated as both classes and clubs. The following impacts showed significant differences between the groups:

- ...improve their ability to work with a team (club = 4.4, class = 4.6, class and club = 4.8).<sup>3</sup>
- ...improve their writing and research skills (club = 4.1, class = 4.2, class and club = 4.5).<sup>4</sup>
- ...improve their public speaking skills (club = 4.3, class = 4.5, class and club = 4.7).<sup>5</sup>
- ...develop good time management skills (club = 3.9, class = 4.2, class and club = 4.5).<sup>6</sup>
- ...develop good problem-solving skills (club = 4.3, class = 4.3, class and club = 4.7).<sup>7</sup>

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<sup>2</sup>  $t_{(1244,59)} = 27.43, p < .0001.$

<sup>3</sup>  $F_{(2, 362)} = 6.01, p < .001.$

<sup>4</sup>  $F_{(2, 360)} = 2.82, p < .003.$

<sup>5</sup>  $F_{(2, 360)} = 3.23, p < .002.$

<sup>6</sup>  $F_{(2, 362)} = 8.16, p < .000.$

<sup>7</sup>  $F_{(2, 362)} = 4.89, p < .004.$

In each case, students in teams that were offered as both a class and a club (these teams likely spent the most time working together as teams) demonstrated significantly greater impacts than students whose teams met only as afterschool clubs.

We further explored the impact on students with a pre-post survey administered to students in the intensive sites. We measured student knowledge of the engineering design process as well as their self-perceptions of their knowledge and skills before and after Future City. Table J-13 summarizes the results. There was no significant change in engineering design process knowledge scores from pre-test to post-test. Again, these findings may be due to the fact the none of the intensive sites had the support of a strong mentor (in 5 out of 6 cases, there was no engineer mentor at all). Because there were no sites with a full-time mentor, there was no variability in the sample, and as a result, we were unable to determine the impact of Future City on students' engineering knowledge or their engineering design process skills.

**Students' least favorite aspects of Future City were the stress from deadlines and the required workload.**

Finally, we asked students what they liked the least about Future City. The most common responses from students in the national sample included:

- It was stressful, frustrating, nerve wracking (n = 113).
- It was too much work, too much time (n = 76).
- It was alright or just fair (n = 45).
- We had team issues, problems (n = 42).
- We had problems with deadlines (n = 30).
- It was boring or tedious (n = 23).
- It was confusing and disorganized (n = 15).
- It was worse than last year (n = 10).

Regarding stress, some students reported:

- *I think Future City was overall a beneficial experience overall to learn how a city functions and teamwork skills, but it was at times a tad stressful and overwhelming.*
- *I think that it was stressful and that I was not exactly ready and that I was a bit unprepared for what was happening. Overall I think that it was a great academic experience, but the way that deadlines and deliverables were stressed over everything else didn't help at all and only led to more confusion. Deadlines should be mentioned, but not prioritized over everything else. I am glad that we got invited to the competition and I had fun.*

- *It was fun to build the city, though, I did not enjoy all of the planning and writing components contributed to this project. It was an extremely stressful project that brought down my grade in science. It involved too many unnecessary elements.*
- *It was fun, but hard and everything was due right away.*
- *It was okay, but I wish I had better time management skills and my teammates were able to meet more often.*

## Impact on Educators and Other Adults

### **Future City met or exceeded the expectations of most parents, judges, mentors, and educators.**

Ninety-four percent of parents, 88% of mentors, and 84% of educators reported that they would recommend Future City to others.

Ninety-one percent of parents (Table L-8), 87% of judges (Table N-11), 77% of mentors (Table M-15), and 76% of educators (Table K-14) reported that Future City met or exceeded their expectations.

### **Future City helped educators feel significantly more comfortable teaching the engineering design process and project management.**

As summarized in Tables K-15 and K-16, among educators in the national sample:

- 35% were very comfortable teaching the engineering design process before Future City and 48% were very comfortable after. This difference was statistically significant.<sup>8</sup>
- 11% of educators were uncomfortable teaching the engineering design process before Future City, but only 3% were uncomfortable after. This difference was statistically significant.<sup>9</sup>

The average educator comfort level (across regions) increased significantly from an average of 2.9 (out of 4.0) before Future City to an average of 3.3 after Future City.

- 19% were very comfortable teaching the project management cycle before Future City and 36% were very comfortable after. This difference was statistically significant.<sup>10</sup>

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<sup>8</sup> Chi-square (df = 9) = 336.03, p < .0001.

<sup>9</sup> Ibid.

- 13% of educators were uncomfortable teaching the project management cycle before Future City, but only 3% were uncomfortable after. This difference was statistically significant.<sup>11</sup>

The average educator comfort level (across regions) increased significantly from an average of 2.6 (out of 4.0) before Future City to an average of 3.2 after Future City.

As reported in Table K-16, the average educator reported significantly more familiarity with the four stages of project management after participating in Future City (3.3 out of 4.0) than before (2.8).

Overall, educators in the intensive sample reported an increased ability to successfully teach the engineering design process, and that it's integration was vital to the Future City project:

- *I think it helped because it was laid out with that in mind, with the project plan. I think that is what helped the most, the way that the project plan was more important than the handbook itself.*
- *I think I understand a little bit better because we can reflect a little bit on it after putting that project plan together how we could have structured it and executed it a little bit better during the competition.*

Mentors reported:

- *Teachers also benefited from this experience, getting to put their own work in perspective by talking with engineers and competing against other schools, working to embed STEM concepts throughout curriculum.*

## Suggestions for Improvement

Educators provided 445 critical comments or suggestions for improvement (20 educators reported that they would not change anything). The most common criticisms and suggestions included:

- The program could be better organized overall (n = 73). [Discussed below, under Handbook]
- There was too much work (n = 63). [Discussed below, under Workload]
- The competition venues could be improved (n = 57). [Discussed below, under Regional Competitions]

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<sup>10</sup> Chi-square (df = 9) = 43.64, p < .0001.

<sup>11</sup> Ibid.

- The Future City program is confusing and could be clearer (n = 54). [Discussed below, under Handbook]
- Need tech support for SimCity and the website (n = 50). [Discussed below, under SimCity and Website]
- Inequality related to socioeconomic status need to be addressed (n = 40). [Discussed below, under Rules, Judging, and Equity]
- There wasn't enough feedback from the judges or examples of past projects available (n = 30). [Discussed below, under Presentation]
- The competition judges need to ask better questions and Future City needs better judges (n = 27). [Discussed below, under Rules, Judging, and Equity]
- Some schools need mentors or better mentors (n = 15). [Discussed below, under Mentors]

Mentors also provided critical comments or suggestions for improvement (6 mentors reported that they would not change anything). The most common criticisms and suggestions included:

- Find ways to deal with the issue of inequality (n = 16). [Discussed below, under Rules, Judging, and Equity]
- Make it clearer to potential mentors what the actual time commitment expectations are (n = 9). [Discussed below, under Mentors]
- Scheduling or logistical problems (n = 8).
- Improve the Project Plan rubric (n = 7). [Discussed below, under Project Plan]
- Find a way to deal with unfair judges (n = 6). [Discussed below, under Rules, Judging, and Equity]

Regional Coordinators reported that they did not enjoy:

- Logistical problems on competition day (weather, speaker systems) (n = 7)
- Dealing with judges or teachers who do not follow instructions (n = 5)
- Not having enough time to accomplish goals (like getting time with students, working long hours) (n = 4)
- The CMS system (n = 4)
- Dealing with angry parents and students (n = 3)
- Recruiting judges and teachers (n = 3)
- Getting media coverage
- Lack of responsiveness and unrealistic expectations from national office
- Multiple changes to SimCity
- Not having a back-up or someone to take over their role

Regional Coordinators reported that the national office could make their job easier by doing the following:

#### Help with sponsors and funding

- *Lay the groundwork for national sponsors that also want to fund at the local level - significant sponsorship over \$1000 per year.*
- *Provide information about topics quicker to allow for the fundraising process to begin earlier in the year.*
- *Identify supporters on a national level so that all regions receive fundraising support.*

#### Stop changing the program and seek input from Regional Coordinators

- *Stop changing the various parts of the competition and try to maintain as much consistency from year to year.*
- *Seek out opinions of all coordinators on more things that really matter.*
- *It is not a good idea to change the documentation each year for the sake of changing. By the time the regional committee and school teams get acquainted with a document, it is changed. I am sure all such changes cost money, which could probably be used for other innovations.*

#### Help with recruiting

- *More advertising through various engineering groups like ASCE, IEEE, SAME, etc. to recruit mentors.*
- *Help with ideas on recruiting committee members.*
- *We did not get our NCEES and ASABE judges this year. It would be nicer to have the National Office introduce us to more regional contacts that care about our regional events.*

#### Make changes to the CMS

- *Eliminate the requirement to manage score keeping in the CMS for event day.*
- *Improve the CMS system so it can be used as an email system that really works. We were promised this 18 months ago.*
- *Establish a link to the CMS that provides access to everything regarding a team and make it downloadable: Teacher name, school name, school location, all the student names involved on the team, the mentor name, etc.*
- *Better training on CMS for committee members.*

### Timing

- *Nationals needs to get their work done on time. Handbooks come out too late; judges' manuals come out too late. It is hard for committees to know when to schedule meetings because those items matter to us. Nationals should schedule their deliverables and work with regional coordinators to schedule regional committee meetings around those deliverables.*
- *Move the finals date so there is more time after the holidays for the teams and the steering committee to prepare for the event.*
- *Help with how to break up tasks and jobs into reasonable time commitments so volunteers are not overwhelmed, including checklists for typical positions and committee roles.*
- *Schedule all deliverables to national well in advance.*
- *Submit the Handbook to the coordinators for review ASAP so comments can be incorporated before publishing.*

### Interaction

- *During the regional competition weekend, have a national staff available to support the region, if needed.*
- *Need more interaction with the national committee.*
- *Need continued interaction among volunteers and committee members.*
- *I'm interested in how others make the final judging more interactive for the audience? There is a lot of downtime during set up; tallying scores; questions; etc. and would like to engage the audience a bit more...*
- *Greater physical presence from the National Office on competition days (an official national judge).*

### Teacher Supports

- *I wonder whether there can be a buddy program for teachers. The first year of organizing is the hardest for a MS teacher. Pairing up an experienced teacher with a new teacher would be powerful in bringing more teachers and sustaining the teacher who will be interested in this competition.*

### Logistics

- *Create an easier way to quickly see which judges are assigned to specific school. It would also be helpful if there was a way to download/export a file that listed all of the judges and their respective assignments.*
- *Send folders with FCC stickers already on them.*



- *We had a conference call with the co-heads of Environmental Engineering at Johns Hopkins and the girls did a conference call with them. One of the fellows has two girls. And he said, "I've never heard about this project. This is so exciting. I can't wait for my kids to do it." So I think it's something that more people will hear about it but a lot of people don't even know about it.*
- *Please get it out to teachers early in the summer months. I have limited time to plan extra activities once school starts. Most teachers I know (myself included) use the summer to leisurely absorb ideas for the next year. It would be helpful to know the topic and get the requirements at the end of the school year (late May or early June). I would have liked to plan some extra field trips but was pressed for time once school started.*
- *Have a better source of contacts for students, mentors and educators. This will help first timers.*
- *I would like more correspondence with the regional director. The Future City website was not updated for Georgia.*
- *Improve communication between the regional program and the national program. The regional site was not updated until well into the competition time. Also, not all of the regional information reached all of the teams at the same time resulting in some teams having more time to complete activities than other teams. And finally, I did not know the deadlines for the deliverables until late into the process. If I know the deadlines ahead of time I can have many teams competing for the three school slots. This year I had huge teams competing to the point of it being slightly unmanageable.*

## Workload

### General Feedback

**Many educators and mentors reported that the workload was appropriate for them and their students, but teams that operated after school reported having a greater workload burden than teams that operated during school hours.**

Nearly half (48%) of educators and 25% of mentors reported that their workload was greater this year than in previous years; 46% of educators and 28% of mentors reported that their workload was the same.

Of the 119 educators who reported that their workload was greater this year, 75% attributed the difference to the new SimCity deliverable, 72% to the Project Plan, 27% to the new Handbook structure, and 29% to the number of students.

Of the 25 mentors who reported that the workload was greater this year, seven attributed it to the new SimCity deliverable, seven to the number of students, and six to the new Project Plan.

As summarized in Tables K-13 and M-14, we asked educators and mentors to rate the degree to which the amount of work was appropriate for them and their students:

- 68% of educators and 76% of mentors agreed or strongly agreed that “The amount of work Future City required was appropriate for my students.”
- 62% of educators and 77% of mentors agreed or strongly agreed that “The amount of work Future City required was appropriate for me.”

Educators in the intensive sites reported that the workload was manageable and on par with what was expected, albeit a bit more this year compared with last year due to program changes. All educators in the intensive sites reported that Future City was rewarding, despite being a lot of work this year. Some reported:

- *There were days we were here until 8 o'clock at night, a couple of days a week. It seemed like every time something was due we would be here three, four nights. We ate a lot of pizza. Right before the day of the competition we were here Saturday, Friday night and into Saturday. It was an immense amount of work.*

- *It's definitely the most time consuming project that I've ever done with kids. I don't go home and have dreams about anything else that I teach, but I do have Future City dreams. So, it's huge.*
- *I think it's just right.*
- *I don't think I realized how much work was involved when we started, especially having a small team. But, I would definitely do it again because the kids had a great [experience].*

Some educators were creative in managing their workload, such as including parent volunteers, high school students that had previously done Future City, and paraprofessionals.

One mentor reported:

- *I must say that doing the Future City competition outside of school time was a challenge but the kids and I embraced it and did very well. People say that you can spend 100 hours on this. I put in at least 150 and the kids did more.*

## Suggestions for Improvement

When asked how Future City could be improved, 63 educators in the national sample reported that the amount of work required should be reduced. For example, some reported:

- *For kids ages 10-13 there is too much required. My co-teacher and I put in over 130 hours each and our mentor did roughly 50 hours. The students meet for 3 hours a week from Sept until Jan when the competition was.*
- *For middle school students to tackle a project of this size and magnitude without the full time assistance is daunting. I do this as an after school club and without the help of another parent and support would never be able to complete the project.*

Future City should consider providing workload estimates to participants at the outset, if possible. This information would be especially useful during recruitment.

Educators suggested that Future City should look for ways to reduce the workload, especially for after-school teams who cannot spend as much time during the week working on Future City as teams that offer Future City as a class (38% offered it as a club this year), for example:

- *[Because we run it as a club]...we're already three, four weeks into the school year before we were even able to talk about what we were doing here and then because we only get one day a week to work on this, it's very limiting.*
- *There were good resources to use and if I had this as part of a class, it would be very beneficial. I had this as a club, so we didn't have time to cover all of the information.*
- *We run Future City as a club. At 2:30pm once and on occasion, twice per week, it was impossible for us to complete the activities and research portions of the handbook. Time was a huge issue for a club structure. This year's topic required a healthy amount of research and learning about current recycling practice. We started by following the process using the handbook but realized we could never finish on time if we continued. Issue a class version along with a club version of the handbook.*

Others suggested that Future City should consider releasing the topic during the previous academic year. For example:

- *If they let it out in June you'd have kids working on it over the summer and it would be great because then come September, even if we're not starting our clubs until October, you'd have teams that would be above and beyond ready. I'd say at least a third to half of these kids here would take the time to read stuff over the summer because it's interesting and it's fun to find cool stuff related to it. It's nice to sometimes get a tease of it but it would be great if we could actually get a full disclosure of the topic and start looking up things, because if the essay were done ahead of time it changes how you develop the physical model.*
- *[Future City could] probably give them more time [before the competition]. They got it done but it was really in a rush. A little more time would have helped.*

Similarly, mentors reported, for example:

- *Our school offered Future City as an after school club, generally meeting for 1.5 hours once per week Sept - Jan. They did put in extra hours over the December break and closer to the state competition in Jan. We did not have nearly enough time to do every activity in the book with this schedule. I tend to think that the handbook makes the competition seem harder and more complex than it really is.*

Students in the intensive sample reported:

- *This year we did have a lot more activities to do. But the time limit made it a little bit hard.*
- *We sometimes fell behind [our calendar] and so we couldn't get it done by that time.*
- *Future City took up a lot of my free time. Two or three days a week for about two hours ... or three hours.*

## Handbook

### General Feedback

**Many educators and mentors and half of Regional Coordinators reported that the new Handbook was easy to follow, but educators and students reported that the Handbook was, at times, confusing, complicated, and not well-organized.**

- 99% of educators and 90% of mentors used all or part of the Handbook this year. Educator use of the Handbook in the intensive sites mirrors that of the national sample of educators.
- 68% of educators (Table K-13), 66% of mentors (Table M-14), and 47% of Regional Coordinators (Table O-4) agreed or strongly agreed that “The new Handbook is easy to follow.”

**More than three-quarters of educators and mentors reported that the Handbook was helpful.**

- 83% of educators (Table K-13), and 75% of mentors (Table M-14) agreed or strongly agreed that “The Handbook was helpful to us.”
- 49% of Regional Coordinators reported that they liked the new Handbook structure.
- Educators in the intensive sites reported that the Handbook was “big/intimidating, everything was a bit scattered/poorly organized, it made finding things hard, and they felt like they [the teachers] missed things.”
- 73 educators in the national sample reported that the program could be better organized overall and 54 reported that Future City is confusing and could be clearer.

Educators in the intensive sample reported:

- *I thought it was very helpful. I thought it was open enough where it didn't have a prescription on what you should be doing. And it gives you enough leeway to go in different directions.*
- *To me it seemed like there was a lot more content in the new handbook. I think the handbook has a lot of information in it and I think it is very helpful.*
- *The rubrics are really well developed.*

Students in the intensive sample reported:

- *We had three copies. One went to each group that was specifically working on one part of the project. [They were] useful [and] very thorough.*
- *They were helpful to me. They sort of helped me figure out what all to put into the city. So, yeah, it was pretty good the way it was.*
- *The pages were pretty helpful. Some of the things I needed to have help on understanding what it was asking but it was really nice to have those because then you knew what was required for each thing that you were supposed to do.*
- *It was useful.*
- *It helped a lot so we knew what we had to do and how to do it.*
- *The rubrics helped a lot.*
- *I think it pretty much explained everything that we need to know.*

Regarding whether educators in the intensive sample closely followed the handbook, most did:

- *We really followed the rubrics. So when we were writing our essay we were sure to make sure that we answered everything so we could get five points. What would the judges be looking for? So that was one thing that we followed very closely.*
- *[We] followed it pretty much 100%.*
- *I at the beginning followed it pretty closely and then I wasn't using it as much and then at the end was going back to it. So it was kind of a combination of the two.*

A few educators did not:

- *So I felt like I kind of have things figured out. So at that point I didn't really use the handbook or the lessons. I didn't use that kind of stuff because I pretty much knew what I was doing. I didn't follow the handbook but I did use lots of pieces of it.*
- *I just cannot see really going through, using the whole thing. It's big.*
- *They [the students] probably never saw it. I would print off pages from it but they never actually saw the handbook. I would give them the rubrics or we'd go over the requirements for a project but then they didn't have copies of it.*
- *We used the handbook for deliverable explanation and the rubrics but I didn't have a handbook for each one of them and we didn't go through it as a document together.*

## Suggestions for Improvement

The majority of the comments received from educators about the Handbook were criticisms or suggestions (n = 253). Educators made 40 positive comments about the Handbook or simply reported that they did not want to see the Handbook changed. The most common complaints and suggestions received from educators were that:

- It needs to be better organized (n = 75).
- The structure was confusing and that it was hard to find information (n = 69).
- It needs to include a requirements list (n = 34).
- It needs to be shortened (n = 22).
- It needs to include more resources (n = 19).

Educators in the intensive sites echoed these suggestions.

Mentors offered the following suggestions for improving the Handbook:

- It needs to be re-organized (n = 12).
- It needs an index (n = 4).
- There is too much/too long (n = 6).
- It should focus more on encouraging student creativity (n = 3).

For example, some reported that it would be useful to include an index and to re-organize the Handbook by deliverable, rather than by the engineering design process:

- *Splitting the project plan deliverables into four different parts of the book was a little confusing.*
- *The new deliverables were not explained well and the available template were formatted poorly. Our teams had a lot of problems with the template files looking differently on different computers with information disappearing. It was also unclear how much latitude there was to vary from the template. The directions should be a separate file from the information to be added. Knowing what I know now I would have the students start from scratch and not use the provided templates, but that is just more work.*
- *An index would be helpful. For me, it didn't seem logically organized. Maybe it was because I was looking for more organization along the lines of the deliverables vs the planning process.*
- *It seemed like information that was needed was put in some locations but not in others. It took me forever to find the size of the poster boards or the*



*requirements for the 4x6 card. It would be nice if the detailed information was all in one place.*

Educators in the national sample mirrored mentors' suggestions about simplifying and reorganizing, reporting, for example:

- *Simplify the rubrics, too long and too wordy to help students with planning.*
- *Sometimes I found the same information in different places. For example, information about the presentation requirements appeared several times throughout the handbook. Some of the wording is different, so it's important that the participants use the index in order to read all of the information. Perhaps a change in organization of the handbook would help this.*
- *All information was NOT included in the handbook. The new aspects of the project should ALL be outlined specifically in the handbook. The online resources should also be in the handbook. Example: The PowerPoint should have been outlined in the handbook. We had to redo this part of our project 3 times due to the lack of information.*
- *Entirely too much documentation. How many pages was that "handbook"? 100? I am not opposed to reading, but let's cut to the chase a little quicker.*
- *Having the project plan spread out was really confusing.*
- *I appreciated the extra info on the Project Planning and the Design Process. However, I did find it difficult to find the basic requirements for each of the deliverables, as they were always "buried" in the explanations. It might be good to have a specific section with just the checklist for each aspect of the project - for example, double-checking the dimensions of the model, etc. My students also found some of the concepts of the project planning difficult - one section had what looked to be forms to fill out, and another part stated to create their own - they weren't sure which direction to go.*
- *I would prefer all information contained in the handbook rather than some on the website and some in the handbook. In addition, I would prefer that all content be arranged by project component such as "city narrative" rather than by what fits into the project management plan. The organization is not necessarily how I must teach this course in a school setting. I felt very stressed that I was overlooking things.*
- *It should be interactive so you can select the section/keyword you need and be brought right to it.*
- *The handbook seemed to be created to follow the "timeline" of the engineering design process. However, I would prefer having each of the deliverables exclusively in their own section for easier reference.*

- *The handbook was full of knowledge but it was extremely hard to navigate through it if I was just looking for a piece of information. It was almost too long, and I felt that it could have been organized better or made shorter. Additionally, as a first time teacher participating in Future City, I did not feel adequately prepared for the competition. I learned more from being at the competition (what to expect, things to teach/focus on, what my students should be doing, and what I should have asked of my students) than I did from reading the handbook.*
- *The sections of the handbook were difficult to follow. I kept wanting to just see all the information about each deliverable at once. I don't need a whole lesson plan format. I didn't even really realize that that was the way it was set up until the end. If you continue to use this format please make an easy reference guide for those of us who aren't going to read every page.*
- *Junior High Students do not need 6 page rubrics and 5 different Rubrics. Reduce them.*

Other suggestions from educators and mentors included:

- *It might be helpful to have some suggestions for ways that students can conduct and coordinate their research more effectively.*
- *We need more information about SimCity regarding how it will be scored. My students got about half the points but they followed the sample PowerPoint quite well. I didn't see where it stated that some goals are more difficult than others and would receive higher scores. This needs to be developed more and spelled out in the Handbook.*
- *I would have liked to see a Timeline from a successful teacher. I was also unclear how much to emphasize each aspect of the project.*
- *I would include sample questions the students may be asked by judges during the competition. This would allow them to see that they are developing an entire city, not just the component that addresses the theme issue.*
- *Give more ways or ideas that students can use for fundraising the money for making the model of the city.*
- *Under "Role of the Mentor", I would suggest that teachers ask their mentor to score each deliverable according to the rubric well before the due dates. In this way, I have provided valuable feedback to the team and made them think more about each phase of the project.*
- *Also, under "Building the Model", I have a few tips: 1) have a "Disassemble Day", where small castoff electronics, appliances and toys are taken apart and interesting parts saved. This is a fun day for our team and starts many discussions about how things work. Often it provides materials for the moving parts. 2) Ask their mentor or other engineer for interesting materials for the model. 3) Teacher or mentor can collect small*

items in an "inspiration jar" to share with students, made out of jumbo clear plastic snack jar from Sam's or Costco. 4) Encourage students to make buildings on model out of items related to the purpose. For example, a phone keypad may be part of a communications center, or a faucet piece may become a water treatment facility. This will help them remember what is important in the city.

Some Regional Coordinators agreed with educators and mentors that the Handbook needed to be re-organized. They reported:

- *It needs to be better organized.*
- *Teachers complain to me the handbook is too complicated.*
- *It needs to be less scattered.*
- *The plan-define-do-review process should be explained for every deliverable. That's how people think about work - on a task level. The way it is laid out just isn't realistic and it's very hard to miss information. Also, I believe that this method even confused those who wrote the handbook. For example, some of the key specifications for the slideshow, listed on page 43, don't even make it into the slideshow rubric, specifically the size of the population at each step.*
- *While I understand at some level the reasoning behind the new structure, it was difficult to find specific information. I preferred when you could go to one section and read all about a particular deliverable and feel comfortable all the info was in that section. In the new format, info on, say the City Narrative, was in multiple locations so I couldn't tell if I had all the information.*
- *I understand the handbook being put in the project management "stream" or order but I don't think it was intuitive for many teachers or necessarily how they planned to use it in their program. When they wanted to find something, often it was in multiple places that caused some confusion or missing details. I would be in favor of the usual topical approach but with a chapter on the project management section and how to incorporate it in that manner that was flexible in how to use it. I appreciate being asked about this.*
- *Everything that is needed to upload should be in the handbook...the templates, etc. Flipping from the website and the handbook is confusing. Keep all of the essay material together, all the model materials...etc. include the rubrics with the sections, not at the end of the book. I know the Engineering Design process is important, but as it is laced throughout the book, it gets too confusing.*
- *I recommend calling more attention to pages 24-33 somehow. These pages give a great overview of what is required for each deliverable. I would put this section at the beginning of the "Define" section and and*

*bold "The Future City Challenge and Deliverables" heading on page 1 in the table of contents.*

## Website

### General Feedback

**The website was used most frequently by educators and more than half of educators and mentors reported that the website was easy to navigate. Most website users reported that it was helpful.**

- 86% of educators and 44% of mentors reported using the Future City website several times; 12% of educators and 47% of mentors reported using it only once or twice; 2% of educators and 10% of mentors never used the website.
- 61% of educators (Table K-13), 61% of mentors (Table M-14), and 76% of Regional Coordinators (Table O-4) agreed or strongly agreed that “The website is easy to navigate.”
- 85% of educators, 72% of mentors, and 76% of Regional Coordinators agreed or strongly agreed that the website was helpful.
- 51% of educators and 68% of mentors agreed or strongly agreed that “The “Leading Your Team” section of the website was helpful.”

Educators in the intensive sample reported:

- *I listened to their launch of the project, their webcast. I went in on that and I think two of them. One I listened live and then the other one I did a replay of.*
- *We used the website a little bit. On the first few meetings we watched some of the videos that were on there. We watched a couple of the presentations that were recorded on the Future City website.*
- *I didn't use it too much. I mean we used it a little bit. I think the kids referred back to it quite a bit when they looked at examples for like the models and things like that. Mainly we used the handbook and some of the examples. I went to the orientation, Future City orientation when we started the competition and that was pretty helpful.*
- *I like the website. I like how it's laid out. I think it's easy to find.*
- *It's a lot better than it used to be. And there's a ton of information. And typically if I didn't know something I could find it there.*
- *I know my para watched several of the videos on things so she kind of had a better grasp.*
- *I watched lots of videos and it was very helpful.*

## Suggestions for Improvement

Many educators reported that it was “tedious” and “time-consuming” to have to enter their contact information every time they wanted to download something from the website. For example:

- *Accessing certain parts of the website is tedious. For instance, having to re-enter your information every time you want to look at the manual.*
- *One thing that got tedious about the website was every time that you want to open up any of the resources it asks for an email every time you go back to the website and that got annoying.*

Regional Coordinators agreed:

- *Do not require an email each time you download a file.*
- *Need a better interface on the website for downloading resource materials.*

Some educators reported that their regional websites were not kept up-to-date:

- *It would be helpful if the website had dates and locations of the regional competitions.*

Mentors and Regional Coordinators agreed:

- *[Regions should] maintain an updated website as the only updated information was available to mentors and was difficult having to forward all schedules to parents.*
- *Need better website coordination and design especially for the Regional Competitions.*
- *I'd like it to be easier to update our region's Future City website portion. I always have to dig out the manual to do it and it's not very simple. I wish there was an easier and simpler page that we could have connected to the National page.*

Some educators reported that the website was outdated or difficult to navigate:

- *The website was overwhelming. There is helpful info there but for someone new to the program way too much and too hard to navigate.*
- *At times, I found my way to pages that were clearly outdated.*
- *Instead of just filtering I should be able to search for a specific term. Also, if you click on something you find, then click the back button, it doesn't*

*save your filter, so you have to filter again. Made it really hard to browse through past projects.*

- *Our only comment is that the information must be accurate in all locations a student should be able to access it. Our students downloaded outdated rubrics from the website and were using them for their deliverables. Since we only get two hard copies, this should not be possible. All previous rubrics should be archived off the site when the new rubrics are released.*
- *The online system was not easy to navigate. If the Handbook and supporting documents were arranged as one continuous document with a hyperlinked table of contents, I would more quickly be able to locate the info I need.*
- *We tried to look at the scores for some of the different things too and the scores don't appear to be in there.*
- *I don't think the website is great, for teachers or kids. Finding things on the website was a little clunky. For example, I don't think that there was an easy way to pull up the rubric by itself for each component.*
- *When my students went in and they wanted to see the SIMCity rubric, just the three pages, or the Virtual City, I think that they had to go into the handbook of the 87 pages.*

One Regional Coordinator offered the following additional suggestion for improving the website:

- *Get a new logo. I know that we went through this a few years ago, but the logo is not particularly strong and sure does not seem to indicate the "Future" or "Engineering". It looks like a silhouette of a third grade art school project. Even "Future City" written in the old 1980's computer font would at least be perceived as futuristic. The logo is meant to inspire engineering. Our current logo does not do that. Seriously, we need to revisit this.*

## Mentors

### General Feedback

**All participants recognized the critical importance of having the support of an engineer mentor, but many teams did not have the support of one this year.**

- 55% of educators reported having the support of an engineer mentor for the whole program; 16% had a mentor for part of the program; and 29% did not have access to a mentor at all.
- Several mentors commented that they were never asked to support a school this year, or that there were no school teams located close to them, despite their willingness to mentor a team.
- Of the students who did have a mentor, 63% agreed or strongly agreed that “My Future City mentor (the engineer) helped me to see myself as an engineer someday (Table J-16).”

Many intensive site educators cited challenges in finding and sustaining a strong mentor for the Future City project:

- *We really didn't have a strong mentor from the beginning. They had set us up with a couple of people. Those people kind of backed out on us pretty quickly. We jumped right into the competition and never really had an opportunity to connect with a mentor. We're fortunate enough that we have a paraprofessional who works with our program and she used to work in an engineering, she was actually an engineer so she kind of stepped in and helped us out when we were in need. You really have to have that strong relationship with somebody before you start the project. If I was not a technology teacher I don't think that we could have done very well at all without having a strong mentor.*
- *In our county, there are no engineering firms. The kids don't know what engineering is, and we haven't been able to get a mentor. It's hard for me to not have a mentor here.*
- *I went from having a really awesome mentor to having nothing. I can verify that that is important. They really add a lot to what the kids learn and to helping the teacher. We're not engineers you know...*
- *I've done this for four years now and never once have I had an engineering mentor. I sure would like to have one.*

Ironically, mentors also reported that they were not assigned to a team this year:



- *I was never contacted or assigned to a group. It was disappointing to not even hear if there was a group I could be assigned to.*
- *At least let volunteers know why they aren't being used. I'm guessing that no one in my state (North Dakota) participated this year. But I really don't know - I never heard anything about anything.*

Parents reported:

- *My child felt like he did not get any support because other children had engineers and my child's group did not have any help from the school whatsoever.*
- *The lack of engineers or engineers to ratio of students/groups was extremely unfair. The lack of direction was unfair among the students.*

Judges also discussed the importance of mentors for helping to develop students' understanding of engineering and the engineering design process. This topic is reported in the chapter on impacts.

## Suggestions for Improvement

When asked how Future City could be improved, 15 educators reported that many schools need mentors or better mentors.

Nine mentors from the national sample reported that Future City should make it clearer to potential mentors what the actual time commitment expectations are.

Future City should find ways to better coordinate matching teams with mentors. Mentors reported:

- *Get me to participate. No one ever contacted me from Orange school systems to participate.*
- *More mentor training sessions, please.*

Intensive site educators offered the following ideas for sourcing quality mentors:

- *Maybe teams could work with mentors remotely via Skype calls: "It would definitely be best if it was the same person, but they could still get benefit from it even if it wasn't, I think."*
- *Maybe Future City could sponsor mentor webcast events: "If you have a webcast mentor event for some groups that have maybe done it in the past one year and their questions are going to be maybe more specific, a*

*different type of question. And you kind of have like a troubleshooting...that would be helpful.”*

- *Help school find mentors via universities and SWEs: “The closer in age you can get the mentor to them I think the more, the less intimidated [the students] are.”*

## SimCity (Virtual City)

### General Feedback

**As reported in previous evaluations of Future City, we continued to observe that many educators reported experiencing disruptive technical issues with SimCity and/or PowerPoint on a wide scale.**

Educators in the national sample reported that they needed tech support for SimCity and the website. For example, they reported:

- *The inability to utilize the SimCity was very disappointing to everyone. Without the computer simulation, student interest waned. SimCity will not run on the district server and the district will not permit the internet connection with EA.*
- *Our school computers cannot load the SimCity game so I have to rely on students who can bring in their own computers. We also always have trouble downloading the program. This step always takes us a lot of time, which eats into the amount of time the students have to learn and use the program.*
- *Please work on the SimCity tech issues, especially for small, rural schools like mine.*
- *SimCity is a royal pain to install and run thanks to Origin. I know this is not within your control, but it was a huge factor in us falling behind.*
- *The technology continues to be difficult to upload for our school, even with our best tech people helping us.*
- *SimCity needs to be eliminated because schools that are technology challenged are at a huge disadvantage.*
- *Our school always has trouble getting the SimCity game to work.*
- *SIM City was extremely difficult to access and manage.*
- *I liked the addition of the PowerPoint for the SimCity model. But, I believe that this portion keeps A LOT of schools from participating. As a school district, adjusting your technology to be able to complete this portion of the project is a serious issue.*
- *Apparently, Future City is not familiar with how technology in schools works. NOTHING gets installed, or updated, without a tech person from district coming to do the install or approve the update. Thus, FC was useless to us. I would think I had everything set up, have lab time scheduled and then; surprise! An update. I couldn't plan for the updates because I didn't know when they were happening; and I couldn't schedule lab time without knowing I'd be able to follow through on my lesson plan. This was by far; the most frustrating thing I've ever tried to do with my students. I ended up scratching the entire project; which really stunk*

*because we had spent a week doing research prior to beginning that section.*

Regional Coordinators observed:

- *[We] Need to overcome the SimCity hump since just installing the program is as far as some schools get with firewalls, etc.*
- *Some of these technology-based changes mean lower-income schools (the ones we really should be reaching out to) can't participate.*

Sixty-two percent of students in the national sample reported that they enjoyed using SimCity (Table J-10). At least three-quarters of the students in the intensive sites agreed or strongly agreed that SimCity helped them (Table J-22)...

- ...learn how cities work. (76%)
- ...understand the consequences of the decisions my team and I made as we designed our SimCity. (82%)
- ...learn what it takes to create and sustain a city. (84%)
- ...imagine and design my Future City. (76%)

Roughly half (54%) of students agreed or strongly agreed that SimCity helped them learn about infrastructure. When we asked students in the national sample what they liked most about Future City, the third most common response was SimCity, reported 181 times.

Students in the intensive sample reported that they enjoyed the opportunities to be challenged and problem solve as they figured out how to address those challenges:

- *I feel like this team had their city maxed out. In fact, it was as good as it could have been, in other words.*
- *We were having some trouble with our hyperloop, which is a major transportation system within our city, and we were having a little trouble on how to connect it with each part of the city. And we came up with a very detailed tube system which ended up working really well for deliveries and transporting people and transporting waste.*
- *We were relying a lot on the machinery in our city, and we were trying to think about what would happen if this broke down. And that was very hard for us but we still managed to get through that too, so we're really excited.*
- *It was really fun to design a city in SimCity because you have to look at the comments that the residents make, and you always satisfy their needs. And it's sometimes difficult to give them what they want and make the city function well because there are all these utilities like power, water,*

*and sometimes things didn't work out. But it was really fun designing the city and making everything work all together.*

- *So when we were working on SimCity there were a lot of tough decisions. There was that quest in jobs that we could do, but some of them had some bad effects afterwards. Even if we gained enough money to buy something that could really improve our city, the effects of the opportunity we'd have to take would also affect our city in a negative way. So we had to think about, is this really worth it? And some of them were really obvious, like, "Oh no, we're totally not going to do this." And some we had to sit down, get our whole group together and talk about what we felt we should do.*
- *I kind of liked being able to solve problems that residents had. For example, one time we didn't have a hospital and people started dying for no reason, and we lost population, which made everything worse for our city. So I kind of like solving problems and deciding over choices for the solutions.*
- *I felt that SimCity was really valuable because it kind of told us what our city needs to have. The way we need to design it and the certain things that our residents will need to survive.*
- *The rubric sheet. One of the games ... like SimCity, after we got all of our thoughts together and [wrote] a lot of the notes, we took those big sheets of white paper – they were kind of poster paper almost but not quite as big – and we answered all the questions so that we would have this to look back on and something we could add to or change or whatever, and have our thoughts organized.*
- *It was pretty good. Our city did pretty well but we had a couple of city design things that didn't go so well so we had to, we had some problems with that. Like our industrial may be too close but overall we achieved our goals of education and waste management.*
- *It was hard because when you first start out you're not thinking about how each little detail you do will affect the future of the actual city because you don't have everything planned out in your mind. But I think we did pretty well.*
- *It helped us see like what would work and what wouldn't ... what would actually work in real life.*
- *I love SimCity but that's because I love playing video games.*
- *I think it's good to actually give someone a different ... that can't visualize words in their mind to see the SimCity and how to plan it.*
- *It was sort of nice and it was fun, but it didn't really help us out very much.*

Students in the intensive sample felt that having SimCity was a helpful component of the program:

- *It's not technically necessary. Well it might be a little bit necessary for the model but basically if you don't do SimCity you probably won't have an idea of how a city works unless you like talk to the mayor or something.*
- *SimCity gives you a city sense. Kind of like you know you have to put like the factories away from the houses and zoning and transportation smart and you have to have adequate power and all that.*
- *For the people that it's their first year and they didn't play SimCity they would have no idea like what the city needs.*
- *[If SimCity were eliminated], it may have changed our model's design just a bit because we wouldn't have the experience about industrial needs to be away from your residential and commercial if you want to have good success. It helped us learn what programs we needed to like add into our city and stuff for it be evenly balanced. So it was pretty effective.*

**There was evidence that SimCity was a valuable teaching tool.**

Seventy-six percent of educators (Table K-13) and 72% of mentors (Table M-14) agreed or strongly agreed that “SimCity helped my students learn about how cities work.”

Sixty-eight percent of educators and 74% of mentors agreed or strongly agreed that “SimCity helped my students apply their knowledge of how cities work to their future city.”

Fifty-six percent of educators and 55% of mentors agreed or strongly agreed that “My students tested different city designs in SimCity before designing our future city.”

- *I think knowing, for example, the city walkthrough is a bit more work but in the end makes it a lot lighter for everyone. And in fact if used properly is an amazing tool for the kids in particular, let alone that the judges don't have to sift through these electronic models.*
- *I thought the SimCity is useful because it gave them a framework on how to start answering questions within the essay.*
- *One thing that I felt worked well was the way that the students had to actually think about what they did with the SimCity and how it applies to the other areas where in the past there wasn't that element that tied them together as much. So that worked well.*
- *I like the changes they made with the Virtual City. I think they can learn more from it this way. It's more meaningful...*

## Suggestions for Improvement

As summarized in Table K-13, 42% of educators agreed or strongly agreed that “SimCity should be a research tool and not a required competition deliverable.” Only 27% of mentors agreed or strongly agreed with this statement, while 30% of mentors remained neutral.

Half the Regional Coordinators agreed or strongly agreed that “The Virtual City deliverable should stay the same (slideshow PDF),” while 22% reported that the deliverable should revert back to the prior version (SimCity game file). Only 11% of Regional Coordinators agreed or strongly agreed that the Virtual City deliverable should be optional instead of a required deliverable.

In their open-ended responses, most educators described problems with the new SimCity deliverable and called for eliminating SimCity as a deliverable--keeping it only as a teaching tool:

- *The SimCity component is nice, but should not be a required deliverable because of the inherently, and overly, technical nature of meeting the deliverable. Meeting the technical requirements for points was a distraction from the overall objective. My students' valuable time is better spent playing the simulation and learning from it than in jumping through hoops to demonstrate their learning. I do not believe the PowerPoint requirement for this year really demonstrated what my kids actually learned from doing the SimCity simulation.*
- *The most immediate way to improve Future City is to remove the Sim Model as points value. Every school has different computer capabilities, and every year, my team struggles to do get points on the Sim City because our resources are low. You expected screenshots this year, but our old computer struggled to do that, and we lost points because of our lack of financial resources in getting up to speed with the technology. In addition, the rubrics this year for the Sim Model seemed subjective, which in terms of rubrics is not acceptable. Also, you allow cheating which is the worst thing you could do. Without the Sim Model, I think Future City is a great way to teach students time management skills, project management skills, leadership skills, and group management skills.*
- *SimCity, though a valuable educational tool, continues to be a challenge. I have different computers available to me from year to year. There are firewalls. It has to run on fairly new equipment. The SimCity PowerPoint with screenshots and all the data that needed to be collected was burdensome, because the report had to be redone every time a new SimCity city was created (most teams create a few SimCities that fail before they have a good one.) A number of students did not like the fact that their SimCity didn't have to be successful - it sort of went against the*

grain. The SimCity PowerPoint held back at least two of my teams from completing all the components of the city. One of my teams worked on a mac, and therefore didn't have images to insert in the PowerPoint. It was really, really frustrating!

- We didn't like the new virtual city requirements. The ability to manage a city well was completely lost in the new system. Being able to use cheat codes and not having to even have a thriving city made the virtual city portion a waste of time.
- I feel that SimCity offers very little to the students in terms of education with the city design. As a standalone project it could be great, but students felt that it was a lot of time and no pay off on the final project.
- The new SimCity deliverable is too subjective for judging to be fair. The old way was better and more engaging for the students. Don't get rid of SimCity altogether. It is a very useful tool for students to learn about planning a city before doing the paper and model.
- For students who are just trying to get their cities built without too many fires and robberies all that extra information you asked for was too much. The SimCity deliverable was a nightmare.
- My students and I struggled with the PowerPoint component of SimCity. The students were so worried about plugging in screen shots and finding information, that they didn't get a chance to learn as much as I have seen in years past.
- I still don't see much connection to the game except kids like to play and it's probably a sponsor for the company. I have a difficult time allowing my students to play for weeks. I wish it wasn't a requirement.
- The rubrics seemed more subjective, especially the SimCity rubric. Noting in the rules that cheating is discouraged but not prohibited was disappointing to say the least! That tells me that you cannot catch a team that cheats. I refuse to let my team cheat, and that seems to have cost us a lot of points on the Sim. Do NOT ever allow cheating. What are you teaching our youth?
- The SimCity PowerPoint should be eliminated. The students did not like it at all. They felt like they spent more time worrying about their PowerPoint than the actual city itself. Many times they created an amazing city, but couldn't use it because they forgot to take screenshots or record benchmarks.
- Both the Project Plan and SimCity deliverables should be tools to use, not required parts of the project.
- For my more rural students with no computer in their home, this project was especially challenging.
- I would take out the SIM City portion completely. For our team of girls who never plays video games....the learning curve was just too much.
- SimCity is not a necessary deliverable in my opinion.



- *The competition deliverables are too complicated. SimCity should be used as a research tool but not a deliverable. It doesn't directly relate to the city that the students design. Instead, the students should create a ppt about their own city, which is what I did with my class to connect their research and their future city plan. Not anything to do with the competition, but since SimCity runs software, we had an issue with accessibility, since our school uses Chromebooks. I ended up having the students use my personal laptop to finish the virtual city.*
- *Do not use the SIM as scored part of the competition.*
- *The SimCity component is nice, but should not be a required deliverable because of the inherently, and overly, technical nature of meeting the deliverable. Meeting the technical requirements for points was a distraction from the overall objective. My students' valuable time is better spent playing the simulation and learning from it than in jumping through hoops to demonstrate their learning. I do not believe the PowerPoint requirement for this year really demonstrated what my kids actually learned from doing the SimCity simulation.*
- *The SimCity bit is extraneous.*

Mentors suggested:

- *Eliminate SimCity as a deliverable. It ends up being a game that only a few can play.*
- *I would encourage you to either make SimCity a resource, so that educators and mentors can manage how much time is spent on it, or if you continue to have it be part of the competition, have it toward the end, not the beginning. I do understand that it helps students understand what goes into running a city, but I think that educators and mentors can give them the basics so they can focus on research, writing, and model construction, not playing the game right off the bat. I think having it at the end, and asking students to play the game the way they set up their model would be an interesting experience that they could learn from.*
- *SimCity should be required but these kids don't need to be developing the model for over 40 hours.*
- *SimCity helps the kids get familiar with some basic concepts, but it really doesn't seem to transfer much forward into the other aspects of the contest.*

## City Description

### General Feedback

#### **Students demonstrated moderate interest in the City Description deliverable.**

- 52% of students reported that they enjoyed *researching* waste management solutions (Table J-10).
- 72% of students reported that they enjoyed *designing* the waste management solutions (Table J-10).
- 46% of students reported that they enjoyed writing the City Description (Table J-10).

Students reported:

- *My favorite part of Future City was getting the City Description back and seeing that we got 100%!!!! It took a lot of time to complete the description and I was really proud of the outcome.*
- *Writing the city description was quite fun, seeing as how it allowed my group to flourish in a fun and creative environment, unlike the restrictions of the other portions.*
- *My experience was very fun and I enjoyed writing the essay very much. I can see myself as an engineer.*

#### **Educators and mentors reported that the City Description helped their students as they built their models and shaped their presentations.**

Educators and mentors reported positive experiences with the City Description:

- 81% of educators (Table K-13) and 74% of mentors (Table M-14) agreed or strongly agreed that “The 1,500 word limit for the new City Description worked for my students.”
- 81% of educators and 70% of mentors agreed or strongly agreed that “Students referred to their City Description as they built their model and shaped their presentation.”

We asked educators to report how easy or challenging it was to make connections between the City Description, SimCity, and the Model: 39% reported it was challenging, 34% were neutral, and 27% reported that it was easy.

**Most educators were satisfied with the change in the City Description this year to a single deliverable.**

All but one intensive site educator reported that the new City Description was a useful change.

One educator from the intensive sample reported:

- *Combining the two writing pieces together into one makes sense, and letting it be a little bit longer. Because we would often spend quite a bit of time cutting, cutting, cutting. So it was helpful for it to be a little bit longer. In fact I think my first couple of years it could only be 800 words, or something crazy, and that was really hard.*

Students in the intensive sample reported:

- *The essay and narrative used to be separate and now it's just one city description. It was easier because I didn't have to write two essays at the same time. I could put it all into just one essay. It's easier.*
- *The most [reflection] that we did was when we were writing our essay, when we were going back and looking over it and saying, "Wait. Is this right? Do we want to be doing this? Is this good?"*

One Regional Coordinator reported:

- *Putting the two writing pieces together was a great idea. Many teachers applauded this in our region. It streamlined the teacher's work while sticking to a necessary component.*

## **Suggestions for Improvement**

Educators, students, and mentors suggested that Future City review the City Description rubric and the Handbook to ensure that the instructions for the City Description are clear, streamlined, and well-balanced between research and city narrative.

Educators in the national sample reported:

- *I really liked the new format this year. One area that was unclear was the balance of how much city narrative vs. how much research paper should go into the City Description. It seemed like the rubric was very heavy on the research side and light on the description side. It was hard to balance the two.*

- *The most confusing part was the City Description. I did not like that the Research and City Description were combined. Were we to describe the organization and beauty of our city (a sales pitch) or were we only to address waste disposal? The directions in the book said one thing and the evaluation rubric said another.*
- *The old narrative allowed the students more freedom to dream about the "future" of their city. Because the new rubric had so little emphasis on future city aspects (in comparison to prior years), they did not spend enough time exploring all the other areas of their city and focused mostly only on the solution. It was fine to have the narrative and essay deliverables combined, but I would suggest more rubric points for the narrative portion.*

Educators in the intensive sample reported:

- *One thing that I felt didn't work well was the essay because it was so long and some areas felt repetitive with the way it was, the outline was in the handbook. And so students got frustrated because it was so long and they felt like they were saying the same things over and over again. And so that with middle-schoolers doesn't work well. I actually liked it better when they had the two essays before.*

Students in the intensive sample reported:

- *We couldn't really figure out what all of the things [were] ... so it was very hard to do. The outline helped a lot but it was really hard for all of us, because we needed to work all together to do that one city description. And we were all over the place trying to do SimCity and that. So that's my least favorite part.*
- *There was a lot of writing. I get that we have to put a lot of information because we need to know our city but there was a lot of writing. I feel like we were repeating some stuff that we wrote in the essay into the presentation.*

Mentors suggested:

- *There are so many items in the rubric for the essay that the students had a difficult time keeping within the 1,500 word essay. Either decrease the rubric requirements or increase the essay length.*

Judges also suggested that Future City add a comments section to the City Description judging form so they can indicate why they deducted points.

# Project Plan

## General Feedback

**Students were more enthusiastic about managing projects using their own methods, rather than using the Project Plan.**

- 58% of the students in the national sample reported that they enjoyed working on a Project Plan (Table J-10).
- 67% of students reported that they enjoyed managing a project (Table J-10).

Educators in the intensive sites described how their teams approached project planning. Most teams did *not* use the worksheets:

- *We didn't write it down on the [worksheets]...We had big sheets that we would tack up and write on, but we did not use the handbook sheets. [I have a picture of these for the final report]*
- *It ended up being an 8th grade girl who took over the responsibility for those check-in sheets and the forms and everything. This person might ask the other kids what to do but generally there was one kid on each team who sort of took responsibility for that.*
- *We came up with our own schedule and calendar using Google. We setup a (Google) classroom and that's how we adapted... It worked well. That was a good way for all the kids to see what was going on every single day and they'd log into that even if they weren't at school.*
- *So initially we started with those forms. As we continued we kind of used the calendar and we kind of used notebooks and towards the end of the project when we realized that we should put this together into the project plan. We realized there was some additional forms to the project plan so we had to go back and kind of enter that information in. It was kind of like we started with the initial forms and deviated a little bit and then we went back and added it into the forms provided.*
- *I try to give them the worksheets to break it down into smaller pieces. This is really just five different projects. But they don't really see it that way and so that's hard.*
- *We used the worksheets. We kind of used texts too but it wasn't our main thing. And towards the beginning I had a notebook and we all had notebooks in which we took notes.*

Students in the intensive sites also described their project planning processes:

- *We did a whiteboard. We watched videos and we saved everything ... Those were kind of only notes, finding videos for us to go back on and listen to if we had any questions. And then we took photos of the whiteboards, so when we erased it and had new ideas we'd have the photos. Also, when we tried explaining something we'd always draw on the whiteboard, trying to get our point through. It helped instead of just having to talk about it we could use what we wanted it to look like so that people could add in what they thought would be better in the design of it.*
- *We also had these big white sheets of paper and we wrote down every single component of our city so that when we're like, "Oh, wait. What are we having here?" We'd always go back to the paper and be like, "Oh, we're having the bypass," or, "We're having the hydroponics. Oh, this is how the hydroponics work." And then if somebody missed a meeting they'd be like, "Wait. What are we doing with the paper again?" And we'd have it on the piece of paper and we'd let them read through it and if they had any questions we'd answer them.*
- *There were a lot of the check-ins. Honestly, I mean they were helpful in a way for organizing but we knew we had essay, SimCity, model and we didn't really go into further detail on those [worksheet] pages because we just knew exactly what we were going to do.*
- *We talked about it a lot. We talked about the deadlines and we needed to get stuff done. And then we had a calendar.*
- *Before class we'd bring our stuff in here and [teacher] would be like okay guys this is what we have to do and we'd be like oh yeah and then we'd just kind of all have our input on what was going to happen, what needed to happen today and what needed to happen during the week and when things were due.*
- *I would say like it helped us reference our schedule and see how on track we were.*
- *I think they were a good idea. I didn't like them mainly because I'm lazy and I didn't really want to do them.*
- *We wrote down a lot of stuff and we always took notes on everything, but we didn't follow the actual worksheets that they gave us.*

As summarized in Table J-18, at least two-thirds of the national sample of students agreed or strongly agreed with the following:

- The Project Plan helped us plan and manage the Future City project. (70%)
- Goal setting was helpful at the beginning of the process. (76%)
- Creating a schedule helped us stay on track. (68%)
- Conducting check-in sessions helped my team. (68%)
- Reflecting on the project was useful. (74%)

As summarized in Table J-21, at least three-quarters of students in the national sample reported that because of Future City...

- ...I am familiar with the “define” stage of project management. (76%)
- ...I am familiar with the “plan” stage of project management. (85%)
- ...I am familiar with the “do” stage of project management. (89%)
- ...I am familiar with the “review” stage of project management. (77%)

As summarized in Table J-19, at least two-thirds of the students in the intensive sites agreed or strongly agreed that the Project Plan helped them...

- ...figure out what I needed to do. (74%)
- ...stay on track. (71%)
- ...communicate with my team. (71%)
- ...get my project done. (69%)

### **Educators and mentors provided moderate reviews of the Project Plan.**

Educators (Table K-13) and mentors (Table M-14) were mixed about their feedback on the Project Plan:

- 43% of educators and 58% of mentors agreed or strongly agreed that “The Project Plan helped us plan and manage the Future City project.”
- 63% of educators and 81% of mentors agreed or strongly agreed that “Goal setting was helpful at the beginning of the process.”
- 53% of educators and 69% of mentors agreed or strongly agreed that “Creating a schedule helped us stay on track.”
- 48% of educators and 66% of mentors agreed or strongly agreed that “Conducting check-in sessions helped my students.”
- 64% of educators and 74% of mentors agreed or strongly agreed that “Reflecting on the project was a useful exercise.”

### **Suggestions for Improvement**

Educators appeared to be confused that there was no rubric for the Project Plan, since all other deliverables have rubrics. We suggest either creating a rubric for the Project Plan or making it clearer to educators and mentors why there isn't one.

Educators in the intensive sites offered the following observations and suggestions:

- *Put the project planning worksheets online to be completed/stored; move everything online: docs, calendars, etc.*
- *I don't think there was a rubric for the project plan...It was only ten points and I think it was the first year for the project plan so that was one of the things, you know the rubrics really help you to identify the big concepts and ideas and things that really should be a part of that. And not having a rubric to look at and just trying to understand the process made it even more difficult.*
- *I think that maybe it could be broken down into a corresponding, small piece of the project plan corresponding with the first deliverable or the city description. So kind of breaks it down into smaller steps for someone who hasn't done that before.*
- *I didn't feel like I taught them project management through that. I did it through other things.*
- *It's such a big project that I don't think the kids at this age have the mental capacity to do planning.*
- *They're a little bit difficult to do, for the kids who have never done the contest before.*
- *We didn't realize how part of the criteria the judging and what the points were for it.*

Educators in the national sample reported:

- *While I can appreciate what was attempted by adding the Project Plan and revamping the Virtual City components, I think both were poorly designed and did not at all enhance the experience. It was VERY difficult to explain to my students what the PowerPoint requirements were. Additionally, all 4 of my teams received a 10/10 on the Project Plan component and we filled it out the day it was due. Either we knew how to game the rubric (not likely given our continued poor performances on the models!), or even the judges acknowledged the uselessness of the document.*
- *It is a great program, however some of the project planning is a bit extensive for this age of students. They lost interest quickly every time we worked on project planning. It is a good element, maybe needs simplification.*
- *The project planning tool was not useful for my students- it was difficult to fit into our work sessions, and the kids complained it just felt like more work. Could you consider having this component as a photo/media journaling piece? I think the students would get a lot out of this if they*



*could create a journal with pictures and/or scans of plans/rough drafts, just dated and tracked along the way.*

Seven mentors in the national sample also suggested that Future City needs to improve the Project Plan. Mentors reported:

- *The new PM task was difficult to follow as to what was required. It is so much work to get the kids to write the essay, play SimCity, make the model and practice the presentation and then to have them do the PM task was a little much. As a PM, I understand the need for this but it really adds a lot of work when the students are doing this as an extracurricular activity and not as a class in school. Maybe provide the guidance but don't make it another deliverable.*
- *The project plan was very helpful but added a significant amount of busy work to the project since the kids had to make it presentable. Good tool but don't make it mandatory.*

## City Model

### General Feedback

#### **Model building was the most popular Future City activity among students.**

- 90% of students reported that they enjoyed building the city model (Table J-10).
- When we asked students in the national sample what they liked most about Future City, the most popular response was model building, reported 1,432 times.

Students in the national sample reported:

- *Building the model was really fun because it was learning stuff while having a great time.*
- *Building the physical model was my favorite part because it helped me with space and time management.*
- *Failing and then fixing the problem was my favorite part.*

Students in the intensive sample reported:

- *It wasn't hard because all our ideas, after going through all those stages of always going back and looking over every single detail of our city, when we came to the building of it we didn't come up with any problems that were too big to solve.*
- *I thought that we were prepared because we did the essay and SimCity before, and we already knew what we were talking about and what we were working on. And we used our notes that we wrote down and the whiteboard, which helped us make this model.*
- *If our hyperloop anchor broke down, how do we transport people around? We came up with a new way, another means of transportation using airplanes, if the hyperloop ever broke down.*
- *In the end we don't really end up doing any of those things. We just end up coming up with a solution that combines all of them, and that was really the fun part.*

## Suggestions for Improvement

Educators in the national sample reported:

- *The Description and Model due dates should be switched, or coincide with one another. It was difficult for 6th graders to fully explain a solution in words before they had done a lot of work towards physically planning it.*
- *Tips on quality construction would help as well.*
- *As a rookie to this program I did not realize that the SimCity design was just a launching pad. The way we had to create the PowerPoint, I thought we were supposed to stick to one city plan and then create our model off of that.*
- *Also, I feel it would be more valuable to upload the project plan before and after the completion of the city model and take out the slideshow as a deliverable. I feel that would allow the students to explore the simulations further without feeling they need to choose one to move forward with.*

Educators in the intensive sample reported:

- *There were some things that we didn't know about, like what we could use and couldn't use on our actual model because once we got to the competition some of the models had some stuff that they also had last year. We didn't know we could reuse things that, like 3D printed material and things like that we didn't know we could reuse that stuff.*
- *They made the model worth less this year, quite a bit less. And for us that's huge. Because our models are never the top models of the contest. And that's partly because I refuse to let it be model building class...The model to me is the least academic deliverable.*
- *Looking at the models, there's the range of them. From really, really poor to, "Did actual engineers make this?" The fact that the range is that big I think, says something about the way it's set up is not ideal.*

Students in the intensive sample reported:

- *[If we could do this over again] we'd probably start working on the model a little bit earlier.*
- *This year making the model wasn't as fun [as last year] because we used paper-mâché and stuff [last year] and it was messy and stuff.*

## Presentation

### General Feedback

**Student feedback about preparing and presenting their models at the competitions was generally positive.**

- 64% of students reported that they enjoyed *preparing* their presentation (Table J-10).
- 66% of students reported that they enjoyed *delivering* their presentation (Table J-10).
- When we asked students in the national sample what they liked most about Future City, the 4th most frequent response was the presentation, reported 147 times.

For example, students in the national sample reported:

- *My favorite part of Future City was presenting to the judges. I liked how I now have more experience in orally presenting and I could take information from previous judges, learn how I can improve and do better the next presentation.*
- *The questions were thought provoking, interesting, and the judges were really nice and made the experience enjoyable.*
- *I liked that we got more experience talking in front of people, because that is a valuable skill to have.*
- *I loved presenting to the judges at the competition and each time I did it, I got better at explaining our process each time.*
- *My favorite part of Future City was the actual day of the competition. The entire process was very fun, but I especially enjoyed talking to the judges and presenting our city. It was wonderful to finally be able to share the city we had been working on for so long.*
- *My favorite part of Future City was the interaction with the other students and the judges. I like to present to each judge because for the most part they each taught my group and I something new.*
- *My favorite part of the Future City Competition is the presenting to the judges and the award ceremony. Although the judges seemed a little intimidating at first, the experience was worth it and I would totally do it again.*
- *My favorite part was the competition. It was entertaining to see the soon-to-become engineers. Also, I enjoyed presenting to many judges. It made me more confident in speeches.*

- *I learned a lot from the engineers as they were asking me questions.*

We asked judges about the students' public speaking skills. They reported:

- *Above and beyond what I was expecting, and where I was at their age.*
- *[I was] absolutely blown away and impressed with their professionalism.*
- *Although they were nervous, I was very impressed with their speaking abilities.*
- *Clearly, there is a wide range of skills, but even the less polished teams seem to be trying very hard to use good public speaking/presentation tools.*
- *For 6-8th graders, I couldn't have been more impressed. Their confidence was remarkable.*
- *I feel this is another important exposure for these students and potential engineers. They all had put in a lot of work on their public speaking. Our future engineers need to have the ability to communicate very complex concepts to the general public confidently.*
- *I was very impressed with the speaking skills of the students, especially since they are not even in high school yet! Most were well prepared, polished, and did not seem to be phased by the audience of "expert" judges. They were able to answer questions with confidence, for the most part. Their speaking skills exceeded my expectations.*
- *I'm always impressed by the teams that are prepared and so well-rehearsed. Some of these kids present better than many of my engineering firm colleagues!*

Some judges observed that the older students seemed to have better public speaking skills than the younger ones generally:

- *The older students dominated the talking portions while the younger students generally seemed more timid unless we directly asked them questions. Without knowing how many years each of them has been involved it is hard to say that there is a direct link to their public speaking skills and Future City, but it would stand to reason that having done it multiple years helps them practice and feel more comfortable speaking in front of the large crowds.*
- *There is also definitely a gap in public speaking skills from group to group. Some students have obviously practiced a lot and others you can tell it's not their first year. Other groups struggled to have a coherent presentation at the right length.*

## Suggestions for Improvement

Students in the intensive sample complained about or suggested the following:

- *[At the competition], there were a lot of off the wall questions ... from judges.*
- *When we go to present to the judges, sometimes the judges ask you questions that aren't in the handbook and that really confused me.*
- *What would be really good is if you put a page in that has an example of questions that the judges could ask at the competition.*
- *Overall I felt unprepared for the actual competition. I enjoyed the actual day but I think that if questions were going to be asked about things specifically other than waste management that I should have known long in advance.*

Educators in the intensive sample reported:

- *I would say that it would be mandatory that everyone has to speak at [the presentation]. You can't designate one speaker or two speakers or three speakers of a five person team. That each person, I think that would be very valuable. Because that really pushes everyone.*

Some judges emphasized that students should have an opportunity to practice their presentations before the competition day, and many judges commented on the need for students to speak louder during their presentations:

- *Public speaking quality was perhaps the greatest separator between weak and strong performing teams. Students should place emphasis on polishing their presentation, using the physical models as a presentation tool, not the product.*
- *Some were great. Some average. Some could use more help with eye contact, confidence, approachable attitude.*
- *The biggest issue here is volume. Most of the kids are not loud speakers, so we had to huddle in closer to the display just to hear them. Sometimes, when reference was made to the visual aids on one side of the table, the judges furthest away couldn't hear a thing they were saying over the noise of the crowd.*
- *Perhaps it would be useful to have example presentations from previous years available somewhere for kids to watch to get an idea of what an outstanding presentation looks like (sorry if this is a thing already, never actually checked to see if these are already available).*

- *The room was a disadvantage for their presentations as there was too much noise. Although we requested that they speak loudly because of the noise level in the room, most did not do so.*
- *Additionally, the kids could be coached on speaking louder in the sometimes very loud room.*
- *I felt that the 2 teams from China may have been unfairly judged due to the communication/translation challenges that arose. Maybe this was different in the presentation but I felt it was possible to discount their hard work simply because it could not be received clearly. Just suggest ensuring an even playing field here.*

# Regional and National Competition Logistics

## General Feedback

The regional competitions were exciting for most participants, but many had specific suggestions about ways to improve the logistics of competition day.

Students in the national sample reported:

- *I loved meeting new people, and looking at other people's models. I loved hanging out with people at my school, and getting to know people who I don't normally work with.*
- *I LOVED the award ceremony because the group I was in had won an award. It was really nice because we had worked very hard on this for a long time and it was nice to see the work we did pay off.*

## Suggestions for Improvement

Educators in the national sample suggested that Future City should consider offering more awards or some form of recognition for all students:

- *At the national level, there needs to be more specialty awards. It would be nice to have more schools have the opportunity to receive something.*
- *I wish there was a way to recognize all of the design team members and not just the presenters. 2-4 students is not enough to complete this project from October to January in a club setting, so it is up to the teacher to buy more shirts, prizes, etc. Although I do very much appreciate all of the gifts and prizes. I would rather they all just receive a medal or tee shirt and that the entire team did.*
- *There are many awards and it would have been nice if the students had received some kind of recognition for the work they did.*
- *With over 50 teams I would suggest awards (even just paper certificates) for the top 10 teams? or 5? Lots of kids doing lots of work with no hope for recognition.*
- *I also think you should offer the schools the opportunity to purchase medals for the entire school team. I had 15 students who spent about 80 hours outside of school to put together our Team, yet Future City only rewards the three presenters. If I only had three people on the team that would be acceptable, but I had 15. That's 15 students who gave 100% effort to our Future City Team. They all deserve medals, not just the one who were in the front of the judges.*



- *I would rather have all the team members get 1 or 2 things like a tee shirt, instead of only the presenters. We always have to divide everything up and use our own money for the extra tee shirts. Many students contribute greatly, even though they don't present. Our teams average 6 students, or they would never be able to get the work done. We meet after school 3x/week and also 3 full Saturdays.*

Mentors agreed. For example:

- *Make prizes at the regional level more robust. This year my team received a box of pencils for winning a special award.*
- *We had a team of 9 kids. Why do we only get certificates for 4 of them? I don't like that "3 + alternate" are the only ones the contests recognized. I had to make up my own certificates to compensate. If you really want teams of 4, make that a rule. If you allow more on a team, please recognize all of them for their contributions. After so much effort, you should add more low-level awards: best building, best road, best grass, best backdrop, coolest moving part, best visual aid, etc... Doesn't seem like this would cost anything and would make a number of teams happy. When our team walked away with nothing after hundreds of hours of work, I was very worried this contest had actually discouraged these children from engineering.*

As one parent put it:

- *My child didn't receive a shirt because he didn't present. This is unacceptable. He put 100% of his heart and soul into it and didn't even get a T-shirt out of it. Not cool.*

Educators suggested that many of the competition venues could have been better organized, with a clearer schedule and directions/maps. This was especially important to new teams, for example:

- *Our regional competition is fairly disjointed and needs to apply some project management principles and some outside input into its production.*
- *On the day of, I think it would have been a better experience if there had been signs that directed everyone to where they needed to go. It was very confusing having never done it before. Many of the helpers had no idea how to answer many of our questions. To me, pulling in some of the education students of the university would be great as they would see an actual competition that they could potentially do with their students.*
- *A more formal check-in at the competition may be a good idea. We really had no clue what was going on. It all worked out but just would have been*

*nice as a first year team getting that welcome and getting questions answered.*

- *The only confusing part of the competition was when we got there. There was no check-in and since it was our first year, things were confusing as to what we needed to do. I think it would be helpful to let new teams know the expectations for the competition day, way before hand, like September. This would help plan out the time before the competition and less questions about how things work. Maybe have someone at the competition walking new teams through, explaining, and answering questions.*

One student in the national sample reported:

- *I feel like I would have enjoyed Future City more if I had notified about things, such as judging time, earlier.*

Mentors agreed For example:

- *Very disappointed with this year's regional competition. New venue with NO available parking, too many floors to move models around, mass confusion of process, team models spread across three floors (didn't get an opportunity to see other team's models), preliminary round and open/closing too far apart, closing program poorly executed, no announcement of top five teams, confusion presenting special awards, no explanation of special awards, no media or official photographer (but we had to do media releases), no explanation of alumni award or why she was nominated. It was very disappointed to have the students work so hard for a regional competition that was not conducted professionally.*
- *The regional contest was disorganized: will spectators be allowed or not? This kept flip-flopping up till the day of the contest. We had to travel 4 hours for this, and that disorganization really made our parents upset as they made and then cancelled travel plans.*

Parents also reported being upset with the way the venues were organized and the way some of them were treated by regional representatives:

- *Did not want to drive for 3 hrs to sit in a lunch room and not watch. Know what the project looks like already. Want to watch how she reacts to judging and presentation. Cannot do that if not in gym. Didn't expect to drive 6 hrs in one day to watch lunch clerks.*
- *Disappointed that we were not allowed to watch judging after driving for 3 hrs. to watch presentations.*
- *It took Future City organizers longer than what the teacher had told us it would to let him know which teams would advance to Regionals. We*

*didn't know until a week before the competition, so it was a little bit stressful to finish presentation to present to the judges. Didn't have enough time to practice presentation.*

- *Volunteer was rather short with my wife about where we were to go and attitude was not expected.*

One mentor suggested:

- *Change the region's director. The way he treated not only my team's inquiries, but all the other teams from our school and our teachers was unprofessional and unfair.*

Some educators suggested adding more variety in terms of the schedule or activities would help people stay engaged throughout the long competition days:

- *I also think increasing the excitement and enjoyment of the day could ease some of the disappointment of walking away with nothing. Really having an awesome opening ceremony, keynote speaker, and ending ceremony could help with that.*
- *The final questions in the auditorium with the top 5 teams were not very interesting, the process was slow, the transition was slow. This afternoon portion paled compared to 3 years ago and more.*
- *The changes in our regional competition had a negative impact on my non-presenting students. Because the gym gets noisy and hot every year (and it does), teachers, parents, and participants who were not presenters were asked to wait in another gym or the cafeteria. My students played video games most of the day. The only time they felt a part of the experience was during one of the breaks when they got to go around and view the different models. I hadn't wanted them to stay home, because I wanted them to feel a part of the competition. I recommend going back to the way it was, and have monitors in the bleachers to make sure we stay quiet, OR, asking someone to organize some STEM workshops in the classrooms so that the non-presenting kids can feel like their time was well spent.*
- *There is too much downtime at the competition. When not presenting, the competition should be an opportunity to interact and learn from each other.*

Mentors agreed. For example:

- *The finals and special award presentations could have been better. The audio in the facility was not adequate for the size of the group and technical difficulties made it difficult to hear the finals presentations. Holding all the special awards to the end of the program was somewhat*

*taxing on the students in attendance. We should come up with a way to keep the non-finals teams there throughout the finals program. Perhaps drawing a team at random at the end of the program to win a prize for no other reason, may keep most of the students there.*

- *My only real suggestion is that I felt bad for the parents that followed their participating children down to the competition. Other than sitting in our school's presentation, there seemed to be very little for them to do. I'd suggest coming up with a plan for parents and/or other people interested in the competition. Even if that plan shows the neighboring community, intended for the parents to leave and only be present for the critical parts... I think it would be helpful.*

Parents also agreed:

- *It could have been useful to have had activities for the children in between presenting, perhaps engineering team projects much like engineering week.*

The schedule and timing of different activities was a major challenge for some participants. For example, educators reported:

- *The event was very long for everyone. It seemed that the side classes as well as the lunch could have been shortened by 15 minutes to 45 minutes so that the day could have ended 1-2 hours earlier. 8am-6pm was way too long for everyone.*
- *The judging of models and asking questions began before students had a chance to settle in. Our team left at 5:00 am and our students did not have time to eat the breakfast that was provided before judges began making their way around. If possible could breakfast be served right at 7:30 next year? That way students have time before the judging at 8:30? This was my only concern. If the time remains the same next year, we will probably have to eat our own breakfast on our bus at 7.*
- *Not sure how the student choice award was given, because nothing was said on how the kids could vote. Our kids were so busy and one of the last presenters that they never got really a chance to walk around and see other student's projects, which is one of the things I was most hoping they would get to do.*
- *The schedule on event day left some of my families confused. First of all, it wasn't communicated ahead of time so that I could tell families what to expect. Then on the day of the competition, they did announcement of the 5 finalists around noon. Families who found out their children were not finalists left early. They did not know there were additional awards at the end, and did not wait through 5 presentations throughout the afternoon to*

*find out. I'm glad some of my teams were given awards, but it would be nice to announce all of this at once midday.*

- *I would like a hard deadline for presenter line-up, so that the names in the program are correct, or that all design team members could be listed in the program.*

Parents reported:

- *Program dragged out, especially in the afternoon. Announced they wanted to be done early but then kept asking mentors and teachers and students to come up and talk. Very contradictory message.*
- *Have a designated time parents and guests can walk around and interact with the other contestants and be able to talk and converse.*
- *The event space was too small. Too many presentations simultaneously, too close to each other.*

Many teams in the northeast were unable to attend their competitions due to weather. A significant number of educators, parents, and mentors strongly suggested that regions have a "rain date" or back-up plan well in advance of the competition so teams don't miss out simply due to weather:

- *The process of Future City was amazing for my students. They worked all semester to create all components. They put their heart and their soul into this project. They often took time out of their regular day and after school to complete each part. However, due to snow and the State of Emergency on the entire area, we could not physically get to the competition. Roads around our region were closed and often impassible. We were told that the competition would be cancelled if the venue was closed. The venue ended up closing later in the morning and the competition still went on. Only a fraction of the teams could participate due to weather. My disappointment is that the competition was not postponed given that the majority of teams could not make it. It was irresponsible and a poor decision. My students put an immense amount of work into this project to be penalized due to weather.*
- *Since the competition is in January, I feel weather is always a potential issue. It would be great to have a "back up" date in case of snow. Two years in a row we had snow - two years ago it did not cancel the competition, but my school's bus was canceled and this year, the competition was canceled and THANKFULLY rescheduled, but it almost wasn't. I know it may be a total pain to schedule a back up date, but I feel it would really help the stress level!!*
- *I think that in the coming years there should be an earlier date for the competition, with a backup date reserved for inclement weather. There were too many teams that didn't get the chance to participate this year*

*(over half!) because of school closings and bad roads. My school made it, in spite of 2 feet of snow in our home district, but only 4 of my 10 students were able to get out of their driveways to come. I think if there is a backup day planned, this could be avoided.*

Parents also weighed in on this topic:

- *Organization for Mid-Atlantic region was lacking. Any competition in January should always have a backup date in case of bad weather. Several teams were unable to attend due to the last minute change in date. If the backup date was chosen in advance, they may have been able to participate.*
- *Originally the competition was planned for 1/23 when a major snowstorm was expected. There was an email from the future city coordinator that the competition will not be rescheduled even in the event of major snowstorm. We booked hotel rooms in NYC in order to ensure our children's participation. The competition was rescheduled anyway and we were responsible for the hotel room deposit. The hotels waived the deposit, but it was not a pleasant experience to deal with.*

Mentors agreed. For example:

- *The only complaint I have was that with the snow the region received, the competition should have been postponed on 1/23. It was not. Our team, and I understand the majority of teams could not make it due to poor travel conditions. When only 16 of 41 Teams attend, there was poor decision making in keeping to the scheduled date. I am upset that the hard work the students put forth was lost when they could not attend the competition due to irresponsible leadership that made the decision to not postpone.*
- *The program itself is great. I was disappointed that there was not a snow contingency in place for a January competition date in the Northeast. The competition was postponed due to snow and the team participation revised as a result. I was extremely disappointed that only the presenters were permitted to attend the competition on the makeup date, as our school had a very large team. The other kids wanted to be there and were very upset that they could not attend.*

One participant cautioned against planning the competition for long weekends:

- *The only issue I have this year is that our regional competition was held during the Martin Luther King long weekend. 2/3 of my students did not go to the competition because there were family plans for the long weekend. In addition, I myself had family plans for this weekend and had*

*to shorten it in order to make it to the competition. It is my strong recommendation to stay away from long weekends when scheduling next year competition. If it is a week early, it is OK, we still have plenty of time.*

Some educators reported having problems registering. For example:

- *For Nationals, we had trouble registering for our rooms at the hotel and they put the teacher, coach and both student rooms on 4 different floors making it hard to supervise students. Linder Associates were not easy to work with this year. They were slow to return emails and slow to communicate as compared to past years. We requested the schedule for Presentations in order to plan our sightseeing and they would say they would get the info to us, but never did.*
- *The hardest part for us was getting all of the registration done in time for the national competition. That was a four day full time job for me, which made my other teaching duties take a back seat due to the time sensitivity. I agree very much that there needs to be a quick turn-around, but I felt the time frame was perilous, especially since our regional competition was on a Friday. Also, the "memo" with all of the information for national competition was very lengthy and I felt some of the information was sort of buried, plus there were some errors as to dates for some things that we discovered when dealing with the national registration folks. They were friendly and helpful, but I felt bad that I wasn't given accurate information.*

Food was a concern for several participants. For example:

- *The only negative that I must share is that I was exceedingly disappointed by the lunch provided for the students on competition day. In the two previous years I've attended, students were provided with a reasonable, full lunch on competition day. This year, they were provided 1/3 of a croissant sandwich, a drink, fruit, and a cookie. This was an unacceptably meager amount of food for growing middle school students and most of them called their parents to bring additional food for them. I was incredibly disappointed and hope that the meal offered on competition day will be significantly improved next year.*

Other suggestions included:

- *I also think that the National Competition should be in different cities throughout the U.S. so that more regions are able to bring their whole group to the competition by car, not just regions near DC.*

- *The National Competition booklet should be replaced with an app that includes the schedule with room assignments and information about speakers.*



# Rules, Judging, and Equity

## General Feedback

**Participants reported several challenges with respect to rules, equity, and judging.**

The following issues related to rules, judging, and equity were reported by participants:

### Rules

- The one-team-per-school rule for finals was discouraging for some teams who placed in the Top 5 in their regions, but could not attend because another team from their school also placed in the Top 5.
- The rules allow teams to reuse pieces or parts of their models year after year, which is viewed as unfair to losing teams as they observe winning teams using the same materials over and over again and continuing to win.
- Some participants are astounded that cheating is not expressly prohibited by Future City (and that “cheat codes” are provided for SimCity).

### Judging

- Educators and mentors reported that there wasn’t enough feedback from the judges or examples of past projects available.
- Judges also complained that they felt “unprepared,” did not have an understanding of what was considered “age appropriate,” and that they felt like they were “doing a disservice to the students” by not having proper training.

### Equity

- Afterschool teams reported that they felt they were at a disadvantage in the competition when compared to teams that did Future City as a class (also discussed in Workload section above).
- Some teams’ models included expensive components that were not valued in seemingly fair ways.
- Participants reported that inequalities need to be addressed and that Future City needs to be advertised to a wider range of school types, including schools in traditionally underserved communities.

For example, educators reported:

- *Was very unhappy with the scoring process and the way my region was handled. It was a great experience up until the competition and since that day it has been an extremely negative experience. At this point in time, I never want to compete in my region again. Feedback from my region was very poor. Asked for clarification on matters and did not receive any responses. My school will no longer recommend this competition unless changes are made and my concerns are answered, and as a school we have done this competition for 15 years. Very disappointing to students, parents and coaches.*
- *The biggest problem I found was the team who claimed their materials were recycled when they were what they had used on their models for over 8 years (the teacher told me this). I do not believe that is fair to new participants because of the high cost of 3D printing for first timers and the school who has been participating for years just tears off their 3D printed buildings and uses them year after year and not claiming the cost of them.*
- *SimCity might be a hook to lure boys into the contest; but I feel like it is actually keeping girls from signing up. I had a hard time finding girls that wanted to play SimCity.*
- *This program seems to be better suited for students who are willing to spend a lot of time outside of school and who have the resources to work outside of school. For my more rural students with no computer in their home; this project was especially challenging.*
- *Some of the cities were quite elaborate and seemed to receive quite a bit of help and direction from adults.*
- *Noting in the rules that cheating is discouraged but not prohibited was disappointing to say the least! That tells me that you cannot catch a team that cheats. I refuse to let my team cheat, and that seems to have cost us a lot of points on the Sim.*
- *Having been involved with Future City on and off over the past 7 years, I have seen different schools compete in our region. I think one of the biggest difficulties is the way each team CAN structure their participation in the process. We compete in a region with 22 schools who mostly do this on an after school club basis. However, there is one team that is a charter school for math and science who have this program incorporated into their curriculum. Given that they not only work during the school day on the project but can also then meet outside of school provides them with an amount of time to dedicate to the project that most other schools don't have. And with all of that extra time there is definitely time to review and revise that far exceeds what most school are able to allow time for. Not sure how the playing field could be leveled out, but they just won again for the 3rd consecutive year--not much of a true chance to compete for the other teams.*

- *Our team won first place at regionals but was unable to progress to nationals because of low participation in our region. It seems that some teams registered to participate, but did not complete the project, lowering the number of teams at regionals. This was our first year of competition and I understand that there is a back-story to the Louisiana competition which we weren't aware of (and still don't really comprehend), but it was unfortunate that our students weren't able to go on to the next level of competition because we live in an educationally-impoverished state with low participation in competitions like Future City.*
- *The judging of the regional competition is not fair, and two years in a row we have had to watch good teams (from our school and others) sit and watch a top 5 that includes weaker projects. It leaves our top students feeling very defeated and that all their hard work was a waste when they were excited about it prior to the day of the competition.*
- *The judging remains extremely INCONSISTENT. My students presented their essays in verbal format. The essays scored HIGH, but the presentations low. YET- the winning presentations/cities in our region neglected many areas on the rubrics, were not memorized, and did not include new and innovative ideas, but rather engineering feats that exist.*
- *The judging component at the competition seemed biased and unfair. All four of my school's teams were judged by the same exact judges, who openly mentioned being exhausted by the end of the day.*
- *The region does NOT always seem to follow the rules set forth in past years. This makes it challenging to those who follow the guidelines and rules and expect an equitable judging of the project parts.*
- *The majority of the questions my students were asked by the judges were about general city services, where do you get water, how do disabled people get around your city, what is your budget, etc. We spent the majority of our time research a waste management system and were quite prepared for those questions. If the emphasis is going to be on city services and quality of life, I think the rubric should reflect this and it should be specified in the Handbook. One of my groups made it to the finals this year and those judges barely asked a question about the waste management system. My students didn't prepare information on budget, etc. We also felt the judges were quite ethnocentric. They made a big point that the group did not have single family dwellings (when that was not part of the culture in the country where their city was located) or single-person vehicles.*
- *Some of the judges were experienced but some did not seem at all familiar with the scoring sheet and did not ask the kids any questions at the end of their presentations. Our kids had to ask them "Would you like us to tell you about our zoning? Our waste management system?" etc. Our finals round scoring did not include the model scoring, so now we*

*aren't sure what placement we actually deserved (they are checking on this for all finals round teams).*

- After asking for 2 reviews of the rules during the competition I learned that some of the judges had not read the rules, which was disappointing to me. I gave my handbook to a judge who asked for it to make sure he was following the rules. The biggest problem I found was the team who claimed their materials were recycled when they were what they had used on their models for over 8 years (the teacher told me this).*
- I was told that judges would rate the first two deliverables (slideshow and description) by January 1st. This way I could have a basis for deciding which 8 of my 21 teams would be able to go to Regionals. However, they did not share the scores with me until 3 days before the models were due downtown, and this was after much emailing begging and pleading from me. This makes it really hard for families to plan ahead! If they could not follow through on the scoring they should have never committed to it.*
- As a Chicago Public School, our team is at a disadvantage to private schools. Our school is not in session until after Labor Day, and it is difficult to conduct club activities during the school day. Also, students are reluctant to spend time after school and there is little parent involvement. Future City is a fun, hands-on competition, but the time commitment is intensive.*
- As a first time teacher leader, I was not prepared for (therefore my students were not prepared for) the question/answer sessions for the special awards. It would be helpful to inform teacher leaders of that process. My kids handled it well at the competition, however, I felt as if I had not prepared them.*

Parents reported:

- It is disheartening to the students to see projects that win because it appears that lots of professional or adult work went into it.*
- We were very disappointed in the judging this year. Listening to the top 5 presenters, it was obvious that the winning team had more than a little help with this project as they were unable to answer many of the questions. This leads me to believe that the parents did more work than the students. I could be wrong, but it is the impression that was left.*

Mentors reported:

- In my region, for the past four years, the first place team has been the same homeschool group located in the same house address. After 12 years of doing this, I know what the model building skill and critical thinking is of 12-14 year olds. Competing against a team with a model so minutely detailed and a presentation incredibly coached up is*

*disheartening. The comparison is so obvious, yet no one from the judging panel takes action to put a stop to it. I have reason to believe that it could be a case of fraud or deception with adult participation outside of the rules of the FC competition. It seems highly unfair to continue compete against a homeschool operation with unlimited time to devote to winning this at any cost. I am happy for the experiences my teams have had and the many awards they have won, Best Essay, Best use of Engineering, Most Innovative Solution, etc., etc., and all of the third place finishes. I have soured on the judging process and there should be a way to level the playing field to disqualify repeat teams when it looks skeptical.*

- The rule of one-team-per-school into the finals was very discouraging for our students.*
- After reviewing the national competition, the teams who placed high seemed to reuse parts from prior years' models and had significant parental help. The team that won elicited comments "there is no way the kids made that model."*
- It is a great program but I think that some kids are at a disadvantage because the playing fields are not level. Some schools have this program as a course while others are doing on their own time after school and weekends.*
- Specialty schools have distinct advantages over the majority of schools with general educational programs. This is not considered in judging - not a level playing field.*
- The team that has won NC the past 7 years, uses the same model every year. The rules allow for tearing down the model and use the base, then they reuse (recycle) and rebuild the same model from the pieces that they took off. Every year the judges give them a 68-70 for their model.*
- Unfortunately, when it came to judging and the competition, I think our students also learned that a lot about "real world" engineering isn't really very real. There's a lot of gaming the system going on, with incumbent teams whose teachers have been there many years in a row having a strong advantage in the competition. It seemed they'd coached their kids to do things the way the judges would expect or prefer even if they weren't in line with the manual or "specifications" that had been set up for the competition... The unfortunate "real-life" lesson there I guess was knowing and anticipating your judges' (client/selection committee's) biases might be more important to "success" than pursuing what you think the best option is.*
- There seemed to be little appetite among the judges for good city planning and public involvement concepts in conjunction with good engineering... one judge asked a question quite skeptical of my kids' idea to require volunteering in the recycling center as a civic duty much like jury duty to reduce the amount of waste being treated as trash and increase recycling among citizens. This was termed an inconvenience to*

*the citizens. Another asked, "how will you recycle cars?" When they pointed out their city would be walkable and bikeable and have low-emission transit instead of cars, he gave a huff of contempt about that. I'm hoping the apparent biases of many of the local judges (this is Texas after all) won't rub off on their enthusiasm or be as apparent in the national competition. I understand you're working with volunteers at these things, so you take whomever you can get, but this was frustrating for our kids. I hope they'll consider engineering in the future, but this was not an ideal experience for them.*

- *Another thing is that it is not very well advertised. We had never heard of it before last year. I am glad my wife stumbled upon it because my daughter and her team won the competition and had the wonderful experience of going to DC and representing our region. While I am sad that our team did not win this year (they came in 4th), I am glad that new group of kids, parents and mentors get that experience.*

Regional Coordinators reported:

- *...most of the work is done by parents of the students. I am afraid that by introducing harder subjects for the 6-8 graders; we will be actually judging the parents at least for the bulk of the competition (virtual city; City description; Project plan). Is that we want? In questioning the low scores by the judges; a couple of teachers in essence indirectly admitted fixing the essay. I prefer to judge the work of the students and not that of the teachers or parents. I prefer the program be simple but inviting the students to engage in critical thinking.*

## Suggestions for Improvement

Participants expressed a strong desire for Future City to find ways to identify cheating and cases in which parents are doing the work instead of the students. Participants suggested eliminating the rule that allows teams to reuse parts and pieces year after year and to keep a closer eye on which materials are being used and their actual value.

Mentors suggested:

- *I know the program allows re-use to some extent but may be worth considering elimination of re-used models in the future.*

Educators suggested:

- *Do NOT ever allow cheating. What are you teaching our youth?*

- *Physical model budgets should be looked at more closely to ensure \$100 limit is not being exceeded.*
- *Ensure that judged work is not reused from previous years.*
- *Have the expense reports checked. One school seemed to go way over but listed prices that were way undervalued.*
- *I think 3D printing should not be allowed as all schools do not have this expensive technology. It should be about student creativity, not who has the big expense accounts to afford the best materials.*
- *Sure would be nice to separate out parent involvement vs. student team involvement.*

Regional Coordinators suggested:

- *I get complaints by teachers at the competition that the same school wins every year because they use the same model every year tearing down to the base and rebuilding. I believe this rule needs to be changed and everyone start from scratch.*
- *Change the rule of tearing down the model and being able to use the same base and parts. Everyone should have to begin from scratch.*

Participants recommended that more than one team per school should be allowed to participate in the finals.

Mentors suggested:

- *Currently only one team from each school is allowed. Even if the second team is in top 3 in region. Future City should allow them to present on the stage even if they are from same school. In case of same school having 2 top 5, all 6 presenters should be allowed to present on stage. This gives them more opportunities and exposure and it's just what they deserve.*

Participants recommended ensuring that judges and sponsors are not affiliated with any schools as mentors, as this represents a conflict of interest.

Educators suggested:

- *Judges and sponsors should not be affiliated with any school as mentors.*

Participants recommended that Future City look for ways to make the competition fair to teams that do their work only after school (versus as part of a class).

Educators suggested:

- *Find a way to have schools that have limited time and resources also be competitive in the overall competition. We meet weekly for 80 minutes and though my students were fully invested and loved the project, time continued to be a factor in all of our processes.*
- *Have you considered how to make it equitable for students who do all their work AFTER school?*
- *I think for the competition aspect there should be a private school and public school division. It is very difficult for some public schools to be able to compete against Private schools who have MUCH more flexibility.*
- *I would be curious to find out how many teams actually have this competition as a part of the daily curriculum - whether as a class or a STEM project or whatever. Running FC as an after-school program seems to severely limit our time, and we often seem much less prepared than other teams. While I know that the point is not to win, I have had frustrated teams who will complain how "unfair" it is (a typical middle school refrain!) There would never really be a way to separate teams into levels based on the way the program is run at a school, but it would be nice to understand exactly at what levels the different teams are operating.*
- *The competition greatly favors teams that are part of class, in particular a class that has done it in previous years. I wish there was some way to make it more competitive for clubs, homeschoolers, and first year participants.*

One parent suggested:

- *Awards should be awarded by afterschool groups and class led groups. Future City is not fair to All students.*

Participants recommended that Future City find ways to advertise the program to a wider audience and, at the same time, make the competition more accessible to underserved students.

Educators suggested:

- *Develop online resources such as website, Facebook, etc. Get students interested through social media. Make sure schools and organizations know about the project, including homeschool organizations and Boy and Girl Scout troops. Invite cities to make a link to the national and regional websites on city website. Suggest libraries and museums put models on display. Develop regional ambassadors by having winners present to their communities. Though it is a large program, I believe more students could be reached.*



Regional Coordinators suggested:

- *Make it more accessible to lower-income schools.*
- *Find a way to encourage public school teachers to get more involved.*

One judge reported:

- *As a minority I left Future City wishing more minority students had participated in the competition and ways to recruit minorities interest in STEM.*

Participants expressed that the competition judges need to ask better questions, that Future City needs better-trained judges, and that judges should provide feedback to teams so they can learn and improve for next year.

Students reported:

- *Overall I felt unprepared for the actual competition. I enjoyed the actual day but I think that if questions were going to be asked about things specifically other than waste management that I should have known long in advance.*
- *It was really nice, but we would like to have an evaluation given to us to know how we did on the project and what are our strengths and weaknesses are.*

Educators reported:

- *All models should be graded by the same judges and all presentations should be graded by the same judges. We have more team in our school competition than at the regionals and are able to do this in one school day. If you had one set of judges do presentations only and one set of judges walk around the gym and judge the models, the scores would be much more fair. All teams would be exposed to the same inherent evaluation/interpretation of the rubrics and personal bias. That way, there is no question that a top 5 was a top 5, at least according to each year's judges. I would be willing to help in any way to make this change happen. I do like the project, but as a school we have considered not attending regionals in future years due to the unfair judging process, and just stopping at the in-school competition.*
- *It seems like the pairs of judges should be split up throughout the day, and should be assigned to all different schools.*
- *The biggest thing I would change is presenting process of having judges that are separate from the Great Plains Region because I feel it would take the recognition of other teams being there in the past away and make the playing field less bias when it comes to judging.*

- *Many of the questions that special awards judges ask are not always appropriate for the middle school level. If very difficult and specific questions are asked, then they should be provided in advance to students.*
- *I would recommend that all judges are familiar with scoring procedures prior to meeting students.*
- *I would appreciate feedback for my students as to how their deliverables were scored. In education when you provide a rubric and assign scores students expect some sort of number with feedback, especially with a project of this magnitude.*
- *More transparency on grading. What could the students improve on. We had points deducted for grammar. Where were the mistakes? We had not caught any. Some of the numbers seemed arbitrary. I would love to read some of the other students essays and seen their solutions. I wish there were more sharing of ideas and interactions between the teams so they could see how others attacked the problems. We never saw any other teams power point presentations. How are the students to learn if they can't see others ideas?*

Mentors reported:

- *The cost limitation involved in building the models for under \$100 was a start, but I'd like to see some emphasis in the judging on selecting concepts that while futuristic aren't sci-fi. There should be some emphasis on cost - if not quantitative cost estimates of different future technologies (which is hard for even real engineers to do) at least an effort to qualitatively compare the likely cost of different emerging or future technologies relative to each other.*

Regional Coordinators made the following suggestions for improving judging for Future City:

- *Include a Penalties Form for the judging teams to use in reviewing for and assessing penalties.*
- *Create a summary showing all the scoring and deducts on one page would be useful.*
- *Clarify existing rules and guidelines. Some guidelines are really vague and it leaves judges in an unfavorable position on competition day.*
- *Often the students or teachers do not understand why they haven't gotten full points for something. Visual examples will help with this. While some might think that this is 'dumbing down' the instructions, the truth is that most competitors or even teachers have not seen the various levels of success in a concrete fashion. At the very least something like this should go on the website.*

- *Assure that all competition rules are followed and applied evenly to all competing teams.*

Judges offered the following suggestions for enhancing the judging process:

- *A bit more of an overview of the judging process and rubric might be helpful for the presentation judges on the day of the presentation.*
- *Being a first year participant, the judging process seemed extremely confusing. Which web page do I use? Where do I go to get direction? etc. Perhaps a step by step process to explain the requirements and responsibilities would simplify and help first year judges.*
- *A little more time in the morning to go over the rubric and sample questions would be good, plus some time to get familiar with the layout of the event location and where rooms were located.*
- *As a 'first year model judge' I would have appreciated an opportunity to have a better overview of what was 'age appropriate'. Sadly, the first two models presented to my group of judges were significantly more sophisticated and detailed than the last few which were presented. As we had been urged not to give away all the 4's and 5's to the first few, I feel a disservice was done not only to the first models, but also to subsequent groups for whom one felt required to downgrade by comparison with the first few, even while following the rubric as provided. I think emphasis that the rubric can be followed pretty closely would have been better advice.*
- *Allow more time to ask questions to gauge the student's understanding of the Projects.*
- *Allow a Comments section for City Descriptions so that judges can add some notes about why they may have deducted points, etc.*
- *Identify age groups so judges have a better idea of where the students should be knowledge-wise.*
- *Consider supplying a desk clock per team to better track time or encourage judges to bring watches. I ended up using my phone to track time when i needed to but it always feels rude to have a phone out during a presentation.*
- *A parking voucher for judges would be nice.*
- *As a judge of our company's specialty award, I found it very difficult to complete my work of judging all the models based on the organizational structure of the space. This was at the new engineering building on the KU campus and this year, models were positioned on 3 different floors of the building. Also, the models were being moved throughout the morning for both model judging and presentation judging. So as I made my way up and down the stairs to these three rooms, I found many models missing. It was a considerable effort to climb and descend the stairs all morning trying to find certain teams and their models. In years past, the event was at the KU student union where there was adequate space in the ballroom*

*for all the models to be in one place. Even if one was missing during the morning, it was far easier to find it later in the morning. Please move this event back to the union where there was food service for the morning breakfast for the judges, and a much better layout for the event.*

- *Ask teams beforehand what special awards they want to compete for. If there are some they're not interested in, the judges should not try to evaluate them. This would give the teams and the judges a few extra five-minute breaks. This was done once before, and I think it was a good idea.*
- *As a judge of something other than the day of event, it would be nice to receive an update of the results. We may not have been there to judge the presentations but still did our part and would like to know the outcome. A simple email would suffice.*