Needs Assessment

Offshore Wind Turbine

Team 12 Members:

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Problem Statement

From the project description:

"The energy potential of offshore wind farms is much greater than that of land based farms thanks to the reduced surface roughness of the sea. For some states the entire electricity could come from offshore wind farms. With such enormous energy potential, offshore wind turbines will contribute to the national energy security.

Although the floating offshore wind turbine has advantages, the cost is still prohibitive. The most important project objective is to reduce the cost compared to existing ideas. The approach is not limited to innovative design --you may come up with innovative construction method, logistics, or any other approach that you can think of."

The purpose of this project is to expand a future renewable resource in the hopes of making it available for the commercial market. The largest problem facing the current development is expense. If it were able to have grid parity, the benefits from offshore wind power would grow the renewable energy market tremendously. The greatest cost hindrance comes from the transmission lines as well as construction. The overall goal is to modify existing designs to minimize cost, while maximizing output and sustainability with the goal of reaching a levelized cost of electricity with respect to total grid production.

Background

A floating wind turbine is an offshore wind turbine that is attached to a floating structure. The purpose of this concept is to generate electricity where the depth is not feasible for anchoring to the seafloor. Floating wind turbines are ideal for the creation of wind farms because they are mobile and reduce visual pollution. Offshore wind production will have a higher and more predictable wind output, compared to inland. With the continuing innovation of floating wind turbines, there have been three full-scale models that have been developed. The locations of these turbines are in Norway, Portugal and Maine.

Objective

The primary objective of the project is to come up with an innovative way to cut the cost of building an offshore wind turbine compared to its preexisting counterparts by the end of the spring semester, 2014.

The main goals for FALL SEMESTER include:

1. Completion of full design of both structure and turbine
2. Build turbine to sense and turn with wind currents
3. Establish efficient floating/anchoring system
4. Pour concrete for the structure to allow time to set

Methodology

The overall floating wind turbine has been broken down into sub-components to assist in the design process and delegation. The main sub-components are: anchor, structure (floating frame), controls and sensors, blades, and gearbox. The wind sensing control will be developed and refined before implementation on the whole turbine. It will take time to optimize the blade shape and size. Once the group has agreed upon a design for the actual turbine and its loads have been calculated, work will commence on developing the design of the floating structure. Due to limited funding the gearboxes will be made by hand or the one from last year will be reused. Designing all of these sub-components will ensure the bulk of our funding goes to innovative design. Luckily, through professional connections, our group will be able to acquire most of the floating concrete and steel free of charge. Furthermore, throughout the design process, we will be using a local pond to test our prototypes and modify them as necessary.

Expected Results

The expected results of this research project are a scaled, fully functioning floating wind turbine. This turbine should be a scaled down prototype designed to be able to float off shore at great distance from any shore. It should be able to stay afloat, upright, require minimal maintenance, and able to tether in all weather conditions. The turbine should be able to produce enough energy to be a viable commercial power option. This model will generate enough energy to illuminate one LED. It should be designed with the intent of lowering the cost of any and all phases of production, design, transportation, installation, and maintenance. Everything required for complete construction including items such as rotors, blades, base, and gearbox will be designed and fabricated by team personnel.

Constraints

Time Management: The Floating Wind Turbine must be designed, built and tested before the last week of the spring semester (as of now April 25th 2014). Time management will be necessary in order to batch and cure the concrete foundation, build the steel structure and manufacture the blades and gears before the project deadline. Proper scheduling will be essential to the overall success of the Floating Wind Turbine.

Budget: As of now our budget is 2,000 dollars that is being supplied by Dr. Jung's research grant. Supplies will also be donated from Florida Rock and Cives Steel which will alleviate some of the financial burden from acquiring materials. Blades, gears, motors and sensors will be restricted to the 2,000 dollar budget. The team will track expenditures in order to stay on budget and provide a quality product with a marginal cost.

Team members: The team consists of seven members from three disciplines of engineering. There are three mechanical, three civil and one electrical engineering majors assigned to this project. It is imperative that the three disciplines communicate and schedule effectively amongst each other to make the Floating Wind Turbine a reality. Due to differing schedules, the team must overcome scheduling conflicts and resolve a meeting time once a week that can accommodate the team. This is critical to meet objectives and benchmarks determined by faculty and the team members.

In order to overcome scheduling conflicts, much of the work will be broken into task that will completed remotely by the team members. Proper file organization will minimize confusion and ease collaboration of report writing. Drop box and the File Exchange in the EEL4911 Blackboard Course site will be utilized to share, retain and organize documents.

Task will be tracked and benchmarks will be set using a Gantt Chart created in Microsoft Project. The specified timeline will be utilized to track progress, goals, due dates. This timeline will govern the progression of the project.

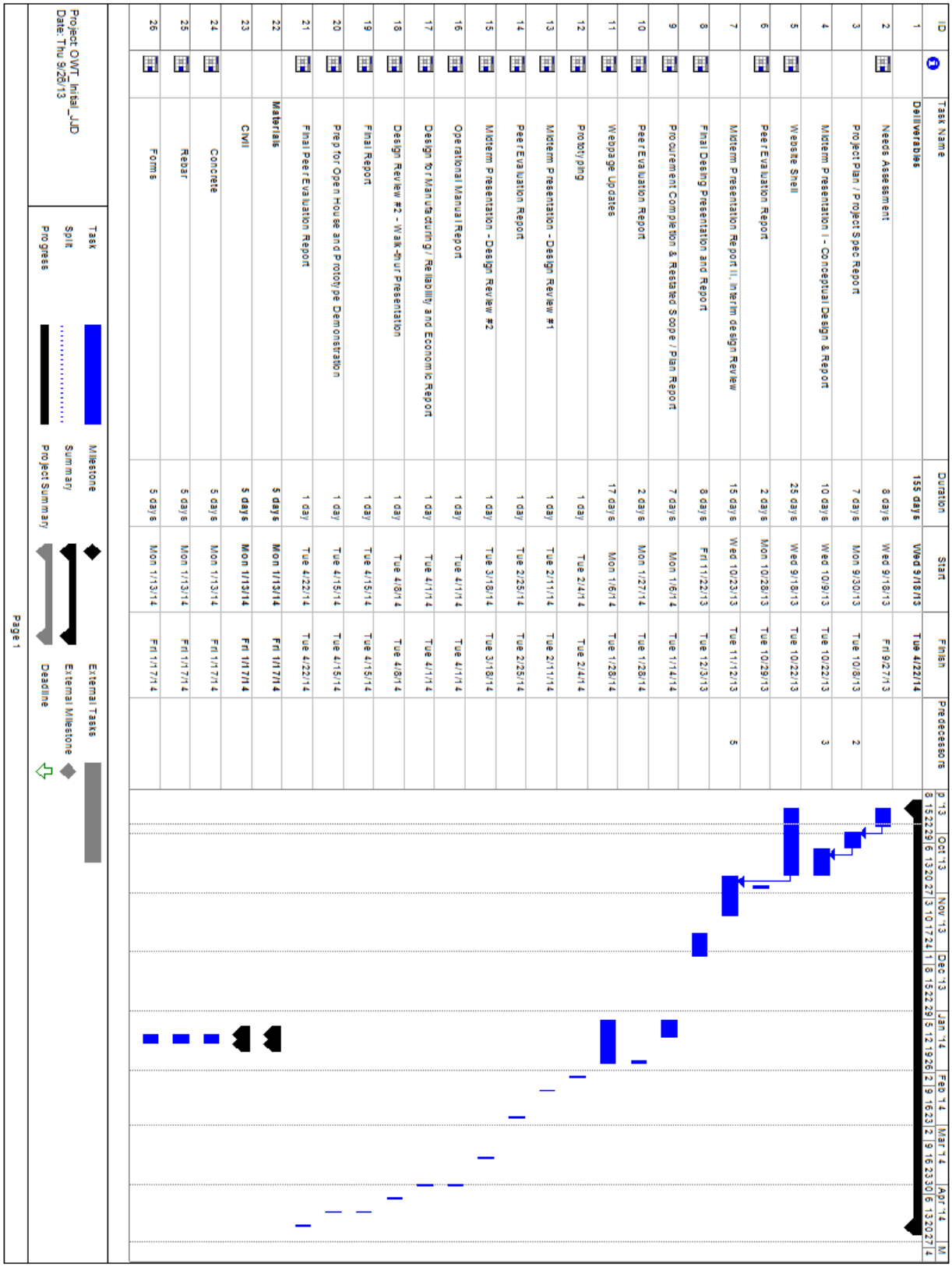
Design Requirements

The most important task that our team needs to achieve is innovating a new idea that will provide cost reductions of offshore wind turbines compared to what is already in the field. Elements such as logistics and constructive methods might be solutions to this difficult task. Along with this, structure stability is another major concern. Our turbine must be able to withstand loading conditions presented by varying climate conditions such as average ocean waves and powerful winds. Finally, the offshore wind turbine must be able to light a LED.

Mechanical/Prototype Requirements:

1) Budget - $2000
2) Height of Water – “Deep Water”
    a. Required to float and stay in one location
3) Expected Size of Prototype
    a. Approximately 1m x 1m x 2m
4) Key Components
    a. Rotor (Constructed by the team)
        i. Direct Drive vs. Gear Box
        ii. Cost Effective
    b. Low-Voltage DC Generator (purchase required)
    c. Optional: commercially available blades
5) Significance of a Stable Floating Platform
    a. Sensors/controllers
    b. Anchors are not required
6) Testing Sites
    a. FSU swimming pool
    b. Local pond

Gantt Chart


Project OWT_Initial_JJD
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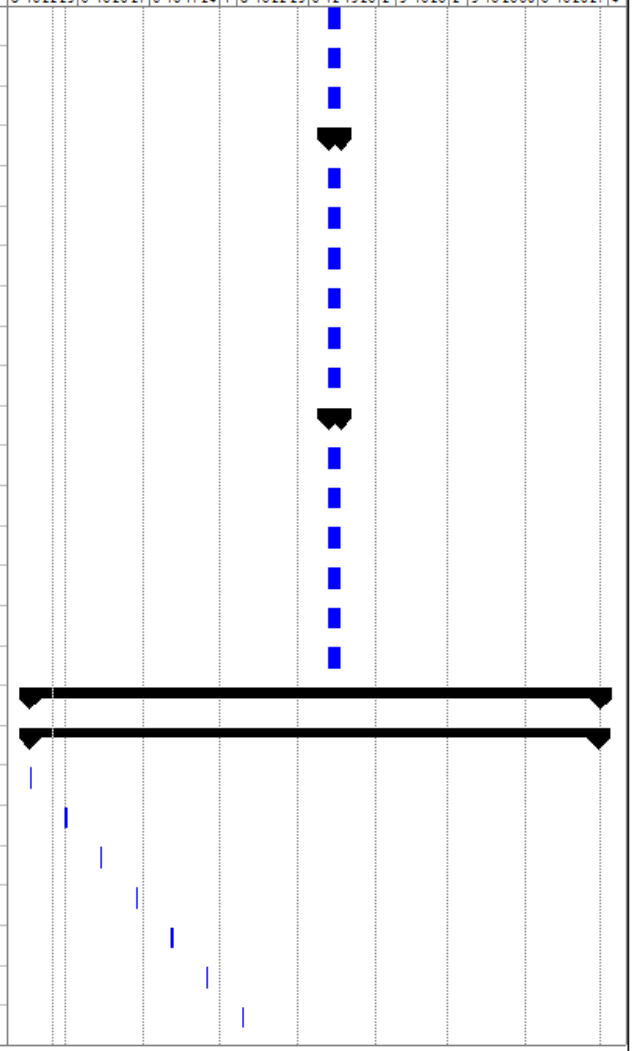
ID	Task Name	Duration	Start	Finish	Predecessors
27	Steel / Aluminu	5 days	Mon 1/13/14	Fri 1/17/14	
28	Small Tools	5 days	Mon 1/13/14	Fri 1/17/14	
29	Small Parts	5 days	Mon 1/13/14	Fri 1/17/14	
30	**Electrical**	**5 days**	**Mon 1/13/14**	**Fri 1/17/14**	
31	DC Motor / Generator	5 days	Mon 1/13/14	Fri 1/17/14	
32	Anemometer	5 days	Mon 1/13/14	Fri 1/17/14	
33	Wire	5 days	Mon 1/13/14	Fri 1/17/14	
34	Servos	5 days	Mon 1/13/14	Fri 1/17/14	
35	Small Tools	5 days	Mon 1/13/14	Fri 1/17/14	
36	Small Parts	5 days	Mon 1/13/14	Fri 1/17/14	
37	**Mechanical**	**5 days**	**Mon 1/13/14**	**Fri 1/17/14**	
38	Gears / Gearbox	5 days	Mon 1/13/14	Fri 1/17/14	
39	Nacel	5 days	Mon 1/13/14	Fri 1/17/14	
40	Hub	5 days	Mon 1/13/14	Fri 1/17/14	
41	Blades	5 days	Mon 1/13/14	Fri 1/17/14	
42	Small Tools	5 days	Mon 1/13/14	Fri 1/17/14	
43	Small Parts	5 days	Mon 1/13/14	Fri 1/17/14	
44	**Meetings**	**162 days**	**Tue 9/17/13**	**Wed 4/30/14**	
45	**Staff, B210, 4-4:15p**	**161 days**	**Tue 9/17/13**	**Tue 4/29/14**	
46	1	1 day	Tue 9/17/13	Tue 9/17/13	
47	2	1 day	Tue 10/1/13	Tue 10/1/13	
48	3	1 day	Tue 10/15/13	Tue 10/15/13	
49	4	1 day	Tue 10/29/13	Tue 10/29/13	
50	5	1 day	Tue 11/12/13	Tue 11/12/13	
51	6	1 day	Tue 11/26/13	Tue 11/26/13	
52	7	1 day	Tue 12/10/13	Tue 12/10/13	



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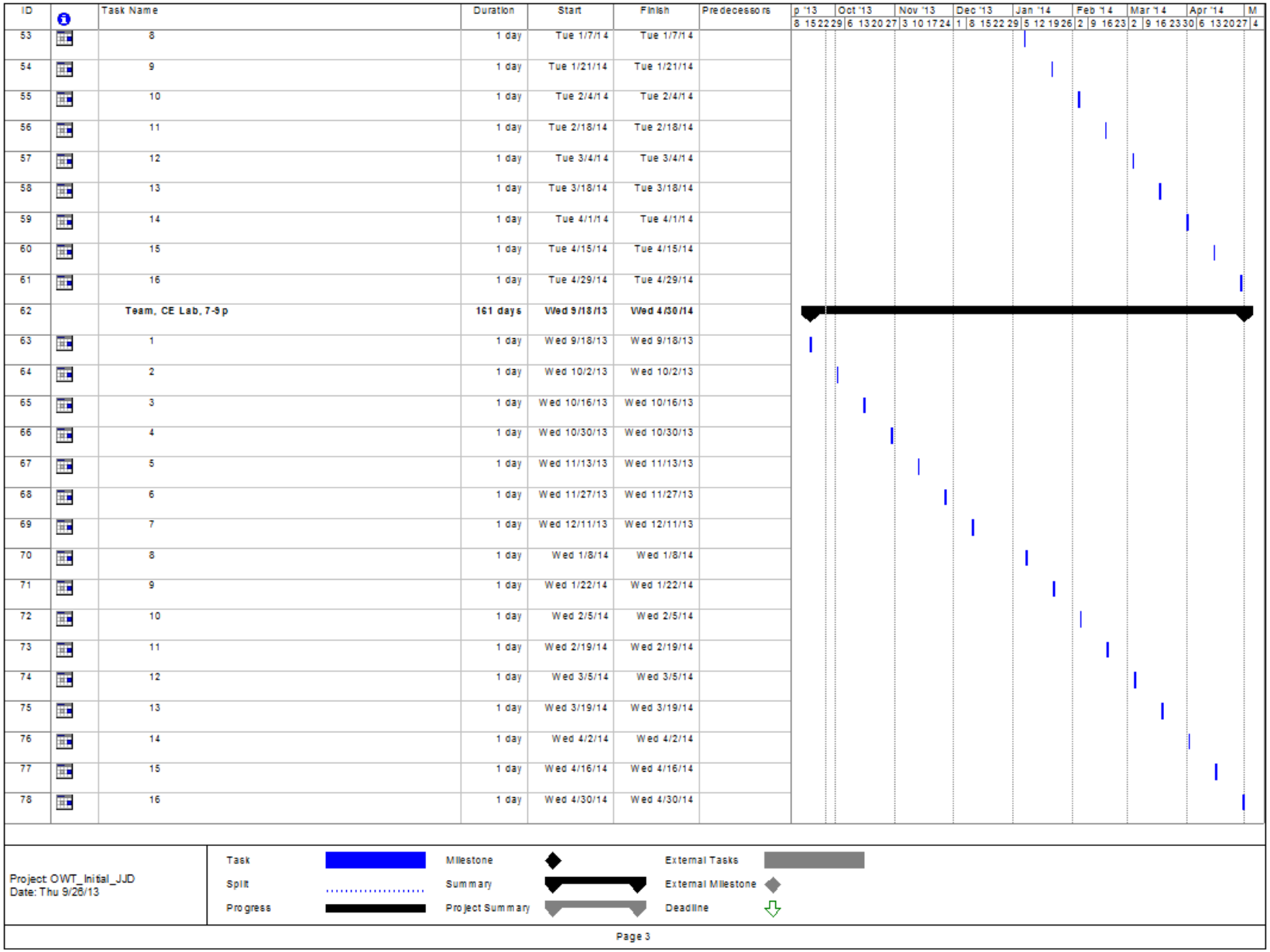

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53	8	1 day	Tue 1/7/14	Tue 1/7/14	
54	9	1 day	Tue 1/21/14	Tue 1/21/14	
55	10	1 day	Tue 2/4/14	Tue 2/4/14	
56	11	1 day	Tue 2/18/14	Tue 2/18/14	
57	12	1 day	Tue 3/4/14	Tue 3/4/14	
58	13	1 day	Tue 3/18/14	Tue 3/18/14	
59	14	1 day	Tue 4/1/14	Tue 4/1/14	
60	15	1 day	Tue 4/15/14	Tue 4/15/14	
61	16	1 day	Tue 4/29/14	Tue 4/29/14	
62	**Team, CE Lab, 7-9p**	**161 days**	**Wed 9/18/13**	**Wed 4/30/14**	
63	1	1 day	Wed 9/18/13	Wed 9/18/13	
64	2	1 day	Wed 10/2/13	Wed 10/2/13	
65	3	1 day	Wed 10/16/13	Wed 10/16/13	
66	4	1 day	Wed 10/30/13	Wed 10/30/13	
67	5	1 day	Wed 11/13/13	Wed 11/13/13	
68	6	1 day	Wed 11/27/13	Wed 11/27/13	
69	7	1 day	Wed 12/11/13	Wed 12/11/13	
70	8	1 day	Wed 1/8/14	Wed 1/8/14	
71	9	1 day	Wed 1/22/14	Wed 1/22/14	
72	10	1 day	Wed 2/5/14	Wed 2/5/14	
73	11	1 day	Wed 2/19/14	Wed 2/19/14	
74	12	1 day	Wed 3/5/14	Wed 3/5/14	
75	13	1 day	Wed 3/19/14	Wed 3/19/14	
76	14	1 day	Wed 4/2/14	Wed 4/2/14	
77	15	1 day	Wed 4/16/14	Wed 4/16/14	
78	16	1 day	Wed 4/30/14	Wed 4/30/14	

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