To: EGR Corporation
From: I.M. Engineer and U.B. Designer: Jennifer Ha, Drew Hottenstein, Madison Jaffrey
Subject: Request for Design Analysis and Benchmarking Services
Date: January 30, 2022

Proposal Evaluation Board:
The purpose of this memo is to provide a response to your recent request for an analysis of market-leading products to help guide future product positioning, design, and manufacturing planning for an upcoming contract in the small appliance marketplace.

Executive Summary

This report aims to compare the RCA Digital Alarm Clock (**Figure 1**) and the Northwest Flying Alarm Clock (**Figure 2**) in terms of design and manufacturing costs. The RCA Digital Alarm Clock is considered to be a relatively standard alarm clock among industry standards, while the Northwest Flying Alarm Clock represents what might be considered a more lucrative but fun purchase for the user.

Figure 1: Put together RCA Digital Alarm Clock front view

Figure 2: Put together Northwest Flying Alarm Clock front view

We analyzed the various clocks through reverse engineering. Through close examination and comparison of the two clocks, we show that the flying clock has a more complex and unique design than the simple RCA clock and that it is cheaper to manufacture. The uniqueness implies that while the clock may appeal to a more niche

audience, it could lead to higher profit margins. The simple RCA clock has worse margins but will appeal to a broader audience, thus leading to greater quantities sold.

Description of Approach

The first step we took in approaching this project was examining the clocks. After making sure both the RCA Digital Alarm Clock and the Flying Alarm Clock worked, we began examining them. At this point we divided tasks. Madison Jaffrey took apart both clocks, documenting the whole process with photos of each part and where each part went. Using the images, all three team members worked to identify the various components within both clocks. Following this, Jennifer Ha began creating exploded diagrams in order to show the inner workings of each clock and label the different parts for future reference. At this point, Drew Hottenstien and Madison Jaffrey both created a Costed Bill of Materials and Structured Assembly Diagram for the different clocks which allowed us to analyze and present our findings.

Analysis of Findings

Through reverse engineering the clocks, and a variety of methods described above, we found key differences between the RCA Digital Alarm Clock and the Northwest Flying Alarm Clock. Both clocks offer key features that may appeal to users in different ways. The RCA clock has the capacity to be plugged in for easy bedside access but can also run on a battery due to the extension cord (**Figure 3**, #21) and the nine volt battery connector (**Figure 3**, #6) placed at the back of the clock. The Flying Clock on the other hand, may appeal to an audience looking for a more engaging way to wake up in the morning. The foam ball and the propeller (**Figure 4**, #1, 2) work together in such a way that the user has to get out of bed to turn off the alarm and snooze it. The battery component (**Figure 4**, #8) also allows the user to place it anywhere in a room, making the movement aspect of the alarm clock more adjustable.

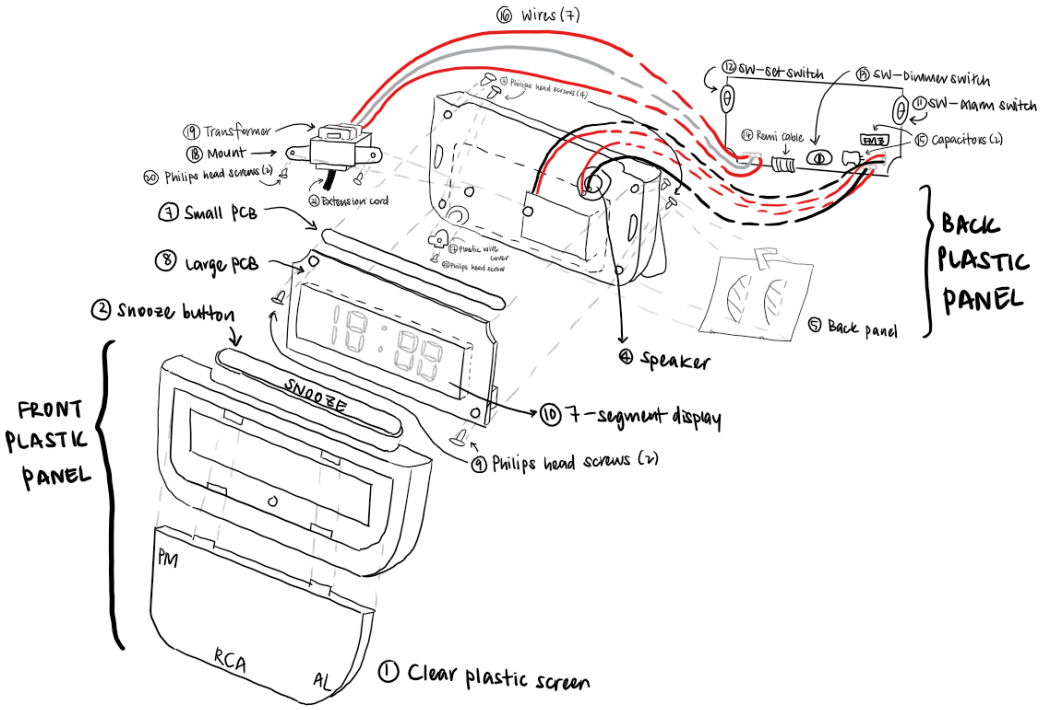

Figure 3: Exploded diagram of RCA clock

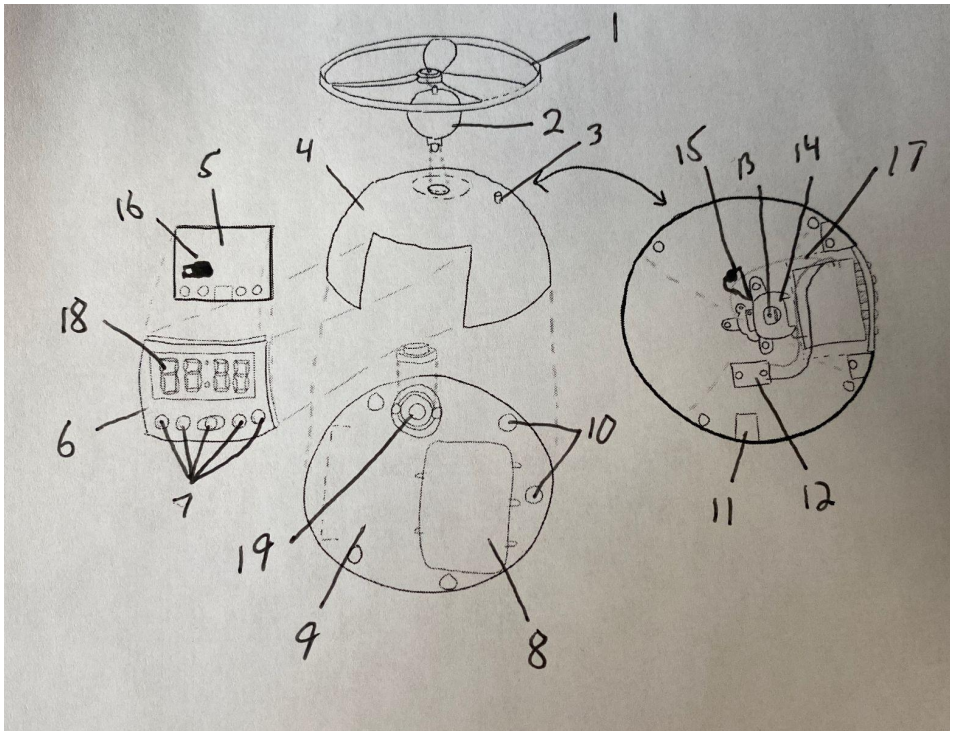

Figure 4: Exploded diagram of flying clock

Despite their differences in features, both the RCA clock (**Figure 5**) and the flying clock (**Figure 6**) have similar manufacturing costs. We assumed that due to mass production seen in small appliance markets, that material costs would be 50% less than what was listed for smaller orders. The Flying Alarm Clock often goes for a higher retail price which creates a larger profit margin for the manufacturer. The difference in profit between the two clocks appears to be $13.24 in favor of the flying alarm clock.

	Cost per Unit	Units	Total
1 g of plastic	$ 0.04	80	$ 3.20
Philips head screw	$ 0.07	9	$ 0.63
Speaker	$ 0.20	1	$ 0.20
Mount	$ 1.06	1	$ 1.06
Transformer	$ 1.00	1	$ 1.00
Capacitors	$ 0.73	2	$ 1.46
Remi Cable	$ 0.20	1	$ 0.20
Wires	$ 0.03	7	$ 0.21
Large PCB	$ 4.00	1	$ 4.00
Small PCB	$ 0.60	1	$ 0.60
Nine volt battery connecter	$ 1.15	1	$ 1.15
7 Segment Display	$ 3.30	1	$ 3.30
	Total Cost:		$ 17.01
	Cost with a 50% discount		$ 8.51

Figure 5: The RCA Alarm Clock bill of costs shows the total costs to be around $17.01 or $8.51 if a 50% discount is given. With a retail cost of $12.99, the profit (when using the discounted price) is $4.48

	Cost per Unit	Units	Total
1 g of black plastic	$0.04	140	$5.60
8 ohm 0.25W speaker	$1.75	1	$1.75
DC motor	$1.95	1	$1.95
DC barrel jack	$1.25	1	$1.25
Ceramic Capacitor	$0.10	1	$0.10
Pushbutton	$0.30	4	$1.20
3-position slide switch	$0.93	1	$0.93
4 bit 7 segment display	$1.80	1	$1.80
Aluminum electrolytic capacitor	$0.04	1	$0.04
Wires	$0.01	14	$0.14
PCB	$0.90	1	$0.90
Propeller	$0.80	1	$0.80
Foam Ball	$0.07	1	$0.07
	Total Cost:		$16.53
	Cost with a 50% Discount:		$8.27

Figure 6: The Flying Alarm Clock bill of costs shows the total costs to be around $16.53 or $8.27 if a 50% discount is given. With a retail cost of $25.99, the profit (when using the discounted price) is $17.72

The final component of our analysis involves the complexity of the clocks themselves. The RCA clock technically has more parts that have to be put together as can be seen in it's structured assembly (**Figure 7**) in comparison to the Flying Clock structured assembly. When physically taking apart the two clocks however the flying clock is much more complex and difficult to work with. The RCA Alarm Clock only has nine screws total, while the Flying clock quickly surpasses that number simply by

opening the chassis. The cramped space inside the clock requires careful placement of parts for everything to fit and a longer period of time to screw everything in. Time taken to build the two clocks in a manufacturing setting is not something that we can quantify, however based on observations, the Flying Clock is more likely to take longer to be manufactured even by a machine rather than hand production.

<table>
<tr><td rowspan="22">Complete Alarm Clock</td><td>Front Plastic Panel</td><td colspan="3">1. Clear Plastic Screen</td></tr>
<tr><td rowspan="21">Back Plastic Panel</td><td colspan="3">2. Snooze Button</td></tr>
<tr><td colspan="3">3. Philips Head Screws (4)</td></tr>
<tr><td colspan="3">4. Speaker (welded in)</td></tr>
<tr><td colspan="3">5. Back Panel (Battery Cover)</td></tr>
<tr><td colspan="3">6. Nine volt battery connecter</td></tr>
<tr><td colspan="3">7. Small PCB</td></tr>
<tr><td rowspan="8">8. Large PCB</td><td rowspan="2">Front Section</td><td>9. Philips head screws (2)</td></tr>
<tr><td>10. 7-segment display</td></tr>
<tr><td rowspan="6">Back Section</td><td>11. SW- Alarm Switch</td></tr>
<tr><td>12. SW - Set Switch</td></tr>
<tr><td>13. SW - Dimmer Switch</td></tr>
<tr><td>14. Remi Cable</td></tr>
<tr><td>15. Capacitors (2)</td></tr>
<tr><td>16. Wires (7)</td></tr>
<tr><td rowspan="4">17. Plastic Wire Cover</td><td rowspan="2">18. Mount</td><td>19. Transformer</td></tr>
<tr><td>20. Philips head screws (2)</td></tr>
<tr><td colspan="2">21. Extension Cord</td></tr>
<tr><td colspan="2">22. Philips head screw</td></tr>
</table>

Figure 7: Structured assembly of RCA clock

<table>
<tr><td rowspan="15">Complete Alarm Clock</td><td colspan="4">1. Propeller</td></tr>
<tr><td colspan="4">2. Foam Ball</td></tr>
<tr><td rowspan="7">Base of Clock</td><td rowspan="3">6. Display Assembly</td><td rowspan="2">5. Display PCB</td><td>16. Capacitor</td></tr>
<tr><td>18. Seven segment display</td></tr>
<tr><td colspan="2">7. Buttons and Switch</td></tr>
<tr><td rowspan="5">4. Top Plastic Panel</td><td colspan="2">14. Motor Mount</td></tr>
<tr><td rowspan="2">13. DC Motor</td><td>17. Wires</td></tr>
<tr><td>15. Ceramic Capacitor</td></tr>
<tr><td colspan="2">11. DC Barrel Jack</td></tr>
<tr><td>3. Test Button</td><td>12. Test Button PCB</td></tr>
<tr><td rowspan="3">9. Bottom Plastic Panel</td><td colspan="2">8. Battery Compartment</td></tr>
<tr><td colspan="2">10. Philip Head Screws</td></tr>
<tr><td colspan="2">19. Speaker</td></tr>
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Figure 8: Structured assembly of flying clock

Summary and Conclusions

Both the RCA Digital Alarm Clock and the Northwest Flying Alarm Clock demonstrate different aspects of the small appliances market, especially within the clock market. The RCA clock is what would be considered a more standard clock. It's margin of profit is not as large but it's a relatively stable product that's easy to manufacture and has a steady demand due to its simplicity. An appliance like the Northwest Flying Alarm Clock might appeal in a contract where you're looking to take a high reward risk. This particular clock is more complex meaning manufacturing time will take longer, and due to its unique design has a smaller niche audience. However, since manufacturing costs

are similar to the RCA clock and it’s marketable at a higher price, the profit margin is a lot larger. When looking at future product positioning, design, and manufacturing the RCA clock is a good reference for a baseline appliance while the flying alarm clock shows the benefits and risks in releasing something innovative into the market. Depending on the type of contract EGR cooperation is hoping to sign, both clocks help set a good baseline for types of products as well as types of competition one might see within the lucrative and exciting small appliance market.