University of Toronto
Faculty of Applied Science and Engineering
APS111 & APS113 Engineering Strategies and Practice
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Midterm Examination
October 27, 2016

This is a 70 minute midterm with **39** questions and 16 pages. It is a multiple choice midterm and is closed book. No aids are permitted. Read each question thoroughly and provide the answer on the answer sheet. Be sure to fill out the answer sheet clearly with no overlaps. Fill out the answer sheet using a pencil. Erase any errors completely. Provide only 1 answer per question and each correct answer is worth 1 mark. There is no deduction for wrong answers. Select the answer that best satisfies the question. You are not required to hand in the exam question booklet. You may tear off the appendix to ease the answering of questions.

1. When working on the description of the service environment, you are in:
   a. The concept space
   b. The solution space
   c. The problem space
   d. The implementation space

2. The phases of a design project (defining the problem, conceptual design, etc) are:
   a. The same for every project both in phase type and duration.
   b. Generally the same for every project, but often differ in duration.
   c. Different in every project, but the duration of each phase is usually the same.
   d. Mostly unnecessary; most projects do not have these phases.

3. A design project initiated by a company that employs its own engineers to work on the design is called:
   a. An in-house project
   b. An internal project
   c. A consulting project
   d. A contracted project

4. A public bidding system with clear, firm deadlines is used to:
   a. Penalize companies that take too long preparing a proposal.
   b. Ensure that the project can start on time.
   c. Minimize the number of proposals so it is easier to pick a contractor.
   d. Create a fair process so every company bidding has an equal opportunity.

5. “A set of measurable characteristics that a design solution needs to fulfill to address a design problem” describes:
   a. An Implementation Plan
   b. A Request for Proposals (RFP)
   c. A Conceptual Design Specification (CDS)
   d. Detailed Requirements

6. The three most common sources for constraints in a design problem are:
   a. Government, the client, and stakeholder interests.
   b. Government, the design brief, and codes.
   c. The client, regulations, and users.
   d. The design brief, users and operators, and regulations.

7. Suppose your design team is tasked with designing a new, portable device to tell time (e.g. something like a wrist watch). If you apply the black box method to this design problem, which of the following would be outputs:
   a. A strap to hold the device to the user’s wrist, and the correct time of day.
   b. The user, and the correct time of day.
   c. Initial time setting accurate for the user’s location (i.e. time zone), and the user.
   d. A visual indication of the time (e.g. written numbers), and a strap to hold the device to the user’s wrist.

8. The field of human-centered design has evolved over the last few decades. Current trends in this field include increasingly taking into account in the design process:
   a. The user’s emotional needs.
   b. Environmental issues.
   c. The user’s physical measurements, i.e. anthropometric data.
   d. The stakeholder’s interests.

9. In moving from ideation to detailed design, the design team must discard a large number of potential designs. The basis for deciding which design ideas to keep, and which to discard, is which design ideas best:
   a. Fit the top objective of the project.
   b. Meet all of the constraints.
   c. Fulfill the stakeholder interests.
   d. Fit the requirements.

10. Which of the following is **TRUE** for standards?
   a. A standard never relies on, or references other standards.
   b. All standards are written in SI units, which is a global requirement.
   c. You must reference and use applicable standards in requirements.
   d. Use of standards is voluntary, not mandatory.

11. The graphical decision matrix method is used to:
    a. Eliminate ideas that do not meet the top objectives for the project.
    b. Eliminate ideas that do not meet the constraints for the project.
    c. Identify ideas that best meet the functional requirements for the project.
    d. Identify ideas that best meet the stakeholder interests for the project.

12. Support for a claim is considered both **TRUE** and **Valid** when:
    a. The premises are true and link evidence to the claim in a way that stands up to reasonable analysis.
    b. The evidence really exists and comes from a high quality, valid reference source.
    c. The idea is truly valuable and people agree with it, without even having to see evidence – for example, common knowledge.
    d. The premises are true and the support for the claim comes from a person believed to be a valid expert.

13. What are the three necessary parts for a complete claim?
    a. Subject, Verb and Predicate
    b. Fact, Opinion and Claim
    c. Statement, Explanation and Evidence
    d. Grammar, Spelling and Syntax

14. Critical thinking means:
    a. Having opinions based only on your own experience and values.
    b. Having ideas that are entirely free from bias and value-laden language.
    c. Having unique ideas that you can convince others to accept as valid.
    d. Having the ability to criticize other people's ideas from your own perspective.

15. Which of the following statements is **TRUE**?
    a. Because bias is the same as prejudice, you must work to get rid of all bias in yourself.
    b. No one is entirely free of bias since everyone has a frame of reference.
    c. Because of bias, all engineering decisions must inevitably be subjective.
    d. To have good judgement, you must never make a decision that agrees with your bias.

16. Engineers are constrained by the communication practices of science. This means that:
    a. They only write lab reports.
    b. Never use any form of argument.
    c. They use arguments based on evidence and logic.
    d. They must use the appropriate jargon, no matter the audience.

17. Plain language is language in which:
    a. One thing is compared with another using the words “like” or “as” – for example, “the pepper was as hot as fire.”
    b. The explicit meaning has far more effect than the implied meaning – for example, “the pepper was hot because it contained a high level of an ingredient known as capsaicin.”
    c. The words are user-friendly, enabling the reader to easily see what is meant – for example, “the car burned up the road.”
    d. What is said is plain and has no extra description in the form of adjectives or adverbs – for example, “a pepper.”

18. Why are tables typically used in engineering?
    a. To organize information.
    b. To communicate relationships between parts of a system.
    c. To give the reader a visual understanding of the data.
    d. To enhance the visual appeal of a document.

19. In preparing Project Requirements, an engineer asks and answers a series of questions, including:
    a. What is the best solution for the problem at hand?
    b. Do my alternatives give value to the client, by representing unique trade-offs?
    c. What do I know and what do I not know about the problem at hand?
    d. What are the final costs, who will pay them and when?

Questions 20 to 22 pertain to the Team situation described in the following paragraph

Fiona, Garrett and Hattie are working on a design team together. They have not worked together before on a project.

20. After talking for a while, they decide that it would be useful to develop a set of team beliefs. These include the shared goals of the project, and a preliminary timeline for completing some of the major deliverables for the project. This phase of teaming is called:
    a. Forming
    b. Storming
    c. Norming
    d. Performing

21. In discussing how they will work together, the team decides that they will use voting to make decisions. What else should they add to this decision to make voting a more effective means of decision making?
    a. They should add a rule that all votes should be unanimous because with only three people on the team it would be better if everyone agreed on every decision.
    b. They should add a rule that all votes should be recorded in their engineering notebooks. This will ensure that they have an accurate record of every decision and who voted for what.
    c. They should add a rule that everyone should have a chance to express their opinion before the vote. This will ensure that they have adequately discussed the options before voting.
    d. They should add a rule that everyone must vote on every decision. Otherwise they could have a tie which would stop them from moving forward on the project.

22. Fiona, Garett and Hattie found that developing their team beliefs was relatively easy. They all agreed on the purpose and goals of the project. They also all seem to have a similar commitment to completing the project successfully. This means that:
    a. It is unlikely that conflicts or disagreements will arise during the course of the project because the team shares the same beliefs.
    b. It is unlikely that conflicts and disagreements will arise because the team is so small – only three people.
    c. It is likely that conflicts and disagreements will arise during the project, and they can use their shared beliefs to address these issues.
    d. It is likely the conflicts and disagreements will arise, so shared beliefs are not very helpful.

Questions 23 to 39 pertain to the Case Study - Chewing Gum Anti-Theft Solution located in the appendix of this booklet.

23. The functional basis for this case study can best be described as
    a. Maintaining mass and controlling transport of mass
    b. Combining mass and optimizing transformation of energy
    c. Separating information and controlling mass location
    d. Sensing information and preventing energy storage

24. One of the most important objectives in this design problem is;
    a. Should require no modification to packaging processes.
    b. Must be food safe.
    c. Should utilize AM or RFID tags which are used in many other similar products.
    d. Should not negatively impact product or package shelf life.

25. One of the other objectives in this problem is “should be very low cost”. Given that a typical package of chewing gum costs about $1.00, what would be an appropriate objective goal for this requirement?
    a. More than $1.00 per package of gum that the system protects.
    b. More than 10 cents per package of gum that the system protects.
    c. Less than $1.00 per package of gum that the system protects.
    d. Less than 10 cents per package of gum that the system protects.

26. For the objective “should be very low cost”, which of the following would be an appropriate metric?
    a. Weigh the package of gum before and after the solution has been applied.
    b. Calculate the cost of a package of gum before and after the solution has been applied.
    c. Calculate the cost of manufacturing AM or RFID tags and putting them into the packaging.
    d. Measure the number of chewing gum thefts before and after the solution has been applied.

27. If the primary market for the system is North America, then the service environment description for this design should include
    a. Average wind speed, and average outdoor temperature.
    b. Typical lighting conditions in a store, and information about shelving systems used in stores.
    c. The typical floor plan of a store, and information about the building materials used in the store construction.
    d. Information about the habits of squirrels, birds and other animals that are common in the North American environment.

28. The client for this design is Mondelez, the manufacturer of the chewing gum product. Which of the following row would be the best choice for expressing a stakeholder and their interest in your Project Requirements document?

	Stakeholder	Interest
a.	The design team	economic and ethical interest
b.	Users	economic and social interest
c.	environmental groups, such as the Sierra Club	legal and economic interest
d.	Law enforcement agencies	legal and social interest

29. Which of the following would be the best choice for a benchmarking activity for this design problem?
    a. Observing the current manufacturing process for the chewing gum by visiting the gum factory.
    b. Watching video tape surveillance from stores that carry consumer products.
    c. Observing a user buying a package of gum and noting the steps they follow.
    d. Analyzing the anti-theft strategies used in other products such as shampoo.

30. Which of the following is an example of task analysis for this design problem?
    a. Observing the current manufacturing process for the chewing gum by visiting the gum factory.
    b. Watching video tape surveillance from stores that carry consumer products.
    c. Observing a user buying a package of gum and noting the steps they follow.
    d. Analyzing the anti-theft strategies used in other products such as shampoo.

31. One of the requirements identified for this product is “must not increase the environmental impact relative to the existing product”. This means that a solution with more environmental impact than the current product:
    a. Would be fine to propose.
    b. Is not preferred, but may be acceptable given other considerations.
    c. Is acceptable if it meets government regulations for environmental impact.
    d. Is not acceptable.

32. Suppose your design team uses decomposition to generate solution ideas for this design problem. One activity that would be part of this process would be:
    a. Brainstorming solution ideas for that would meet the requirements.
    b. Combining ideas using a morphological chart.
    c. Brainstorming ideas for the use of RFID tags in the product packaging.
    d. Looking at biological systems for inspiration.

33. Your team uses a pairwise comparison to prioritize the objectives and finds that one of the objectives, “allows the production machinery to run at current speeds”, gets a score of zero. This means that the team should
    a. Discard this objective and not use it for comparing alternatives later.
    b. Set this objective aside for now and only use it later if it is needed.
    c. Continue to use the objective in the alternative selection process.
    d. Prioritize this objective because it becomes the most important consideration in selecting an alternative.

34. Suppose your design team comes up with two solutions:
    - A low cost way to add a physical lock, so the gum cannot be accessed without a code.
    - A shelving system that allows the customer to only take one item at a time, instead of quickly dumping a whole shelf of goods into a bag.

In developing a solution to propose, the team puts these ideas together and proposes a shelf that has a code lock on it and only dispenses one item at a time. The customer buys a code, and then goes and gets their gum. This is an example of using:

a. Brainstorming
b. Decomposition
c. SCAMPER
d. Design by analogy

35. The users and operators for this design do **NOT** include
    a. People shopping at stores that carry chewing gum.
    b. People buying chewing gum.
    c. Store clerks who put products onto store shelves.
    d. Cashiers at stores that carry the chewing gum.

A team working on the Mondelez project has written the following Problem Statement:

> *Mondelez Corporation has tasked our design team with finding a solution to the problem of chewing gum theft in newer, larger, modern stores that are the main distribution channels for their famous product, Trident gum. These stores are limiting shelf space and restricting display or thinking of encasing the product in acrylic boxes so that people cannot get to it easily enough to steal it. Therefore, the stores have a gap in display spaces that are resistant to theft but enable legitimate shoppers to easily select the product they want and purchase it. A solution must be low-cost and food safe.*

36. Which of the following statements demonstrates the communication values of this course?
    a. This is a well written Problem Statement which has no grammatical errors.
    b. This Problem Statement does a poor job because it does not add any new information to the Client Statement.
    c. This Problem Statement does a good job of confirming the information in the Client Statement.
    d. This Problem Statement does a poor job of predicting what the solution could be.

37. The Mondelez International Inc. fact sheet states “Our dream is to create delicious moments of joy in everything that we do.” This statement is an example of:
    a. Evidence for the claim that Mondelez’s interest is creating joy.
    b. A constraint from the client that the design shall be joyful.
    c. Figurative language used for marketing.
    d. A description of the “gap” in the current snacks market.

38. A design team is referencing the Mondelez fact sheet. The correct way to format the reference as an online source, according to the IEEE standard, is:
    a. No author. (No date) 2016 Fact Sheet. [PDF] Available: http://www.mondelezinternational.com/~/media/mondelezcorporate/Uploads/downloads/mondelez_intl_fact_sheet.pdf
    b. “2016 Fact Sheet.” *Mondelez Corporation,* http://www.mondelezinternational.com/~/media/mondelezcorporate/Uploads/downloads/mondelez_intl_fact_sheet.pdf. Accessed 17 Oct. 2016.
    c. Fact sheet. http://www.mondelezinternational.com/~/media/mondelezcorporate/Uploads/downloads/mondelez_intl_fact_sheet.pdf
    d. Mondelēz. (2016) Mondelēz International Corporate Factsheet 2016 Fact Sheet. [Online] Available: http://www.mondelezinternational.com/~/media/mondelezcorporate/Uploads/downloads/mondelez_intl_fact_sheet.pdf

39. For this project, use of the Wikipedia article on chewing gum is
    a. Strictly forbidden – use of Wikipedia is considered an academic misconduct at university.
    b. A good place to start – but you should go on to more detailed and specific sources.
    c. Very useful because you need at least three references for every sentence in the assignment.
    d. A poor place to start since the focus of the design is the packaging rather than the gum itself.

End of questions that pertain to the Case Study – Chewing Gum Anti-Theft Solution located in the appendix of this booklet.

There are no questions beyond this point

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Appendix A: Case Study – Chewing Gum Anti-Theft Solution[1]

There are no questions in this appendix. You may detach this appendix for ease of answering the questions that pertain to the Case Study.

Client: Mondelēz International
Their company manifesto can be found at:
http://www.mondelezinternational.com/about-us/our-dream-belief-and-values
Mondelēz brands include Oreos, Cadbury, Triscuits, Toblerone, and others
See the posted corporate fact sheet for more information

Description

The client is looking for a low cost solution to reduce, or eliminate, the theft of chewing gum from stores. The solution must allow the gum to be displayed prominently on existing shelving units and give the retailer confidence that the product will not be stolen.

Background

Trident gum currently holds a leadership position many global markets. Consumer research shows it is considered one of the most beloved brands.

The newer, larger, modern stores that have developed are one of the main distribution channels for Trident, but theft has become a problem. As a result, some of the key accounts are limiting shelf space and restricting display to isolated locations. This results in lost sales.

Other products with a similar issue, such as batteries, sunscreen, shampoo and even nursing products. These products have moved to encasing the product in acrylic boxes or adding acousto-magnetic or radio frequency tags to the products.

Mondelez is looking for a low cost solution to reduce or eliminate the theft of chewing gum from stores. The solution must allow the gum to be displayed prominently and give the retailer confidence that the product will not be stolen.

Key Success Criteria

The proposed technology should:

- Not impact product or package quality, safety or functionality
- Be very low cost
- Should not negatively impact product or package shelf life
- Must be food safe
- Enable production machinery that manufactures the gum and packaging to run at current speeds

[1] Adapted from NineSigma Request Number N645136

- Should require minimum modification to packaging processes
- Must not increase the environmental impact relative to the existing product
- If an AM or RF solution, it must work with existing AM or RF control systems for alarm and deactivation

Possible Approaches

Possible approaches include, but are not limited to:

- Modifications to packaging materials that reduce theft
- Low cost AM or RF packaging inclusions
- New technologies compatible with existing systems

Appendix B – Mondelēz Fact Sheet

2016 Fact Sheet

Mondelēz International
the power of big. and small.

Unleashing a Global Snacking Powerhouse

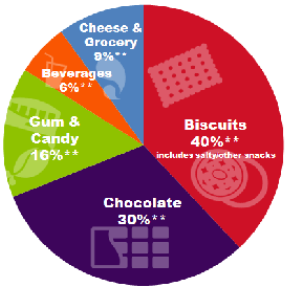
Mondelēz International, Inc. (NASDAQ: MDLZ) is one of the world's largest snacks companies, with 2015 net revenues of approximately $30 billion.

Our dream is to create delicious moments of joy in everything we do. Nearly 100,000 employees support this dream by manufacturing and marketing delicious food and beverage products for consumers in approximately 165 countries around the world.

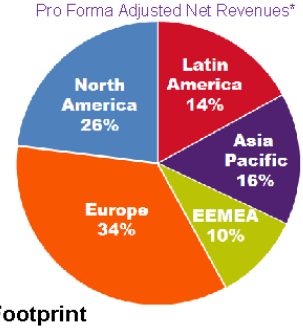
We are the world's pre-eminent maker of snacks, with leading market shares in every category in which we compete. Mondelēz International holds the No. 1 position globally in Biscuits, Chocolate and Candy as well as the No. 2 position in Gum. (source: Euromonitor)

About 85 percent of our annual revenue is generated in fast-growing snacks categories, and nearly 75 percent of our sales come from outside of North America (see pie charts at right).

Sales by Category
Percentage of 2015
Pro Forma Adjusted Net Revenues*



Sales by Geography
Percentage of 2015
Pro Forma Adjusted Net Revenues*



* Pro Forma Adjusted Net Revenues exclude Venezuela operations. See GAAP to Non-GAAP reconciliations under Events & Webcasts tab of the investors' section of our website at http://bit.ly/1KYhs2E.

** Does not foot to 100% due to rounding.

Significant Competitive Advantages

At Mondelēz International, we have all the ingredients in place to deliver sustainable, profitable growth.

- **Focused Snacks Portfolio**
- **Leading Snack Shares**
- **Favorite Snack Brands**
- **Advantage Geographic Footprint**
- **Strong Routes to Market**
- **World-Class Talent & Capabilities**

Because of our advantaged platform, we're one of the few industry players positioned to deliver strong sales and profitability growth over the long term. We're focused on accelerating our core business, addressing key consumer trends and further developing sales and distribution capabilities.

A Portfolio of the World's Favorite Brands

Our portfolio features seven billion-dollar brands: *Cadbury*, *Cadbury Dairy Milk* and *Milka* chocolate; *LU*, *Nabisco* and *Oreo* biscuits; and *Trident* gum.

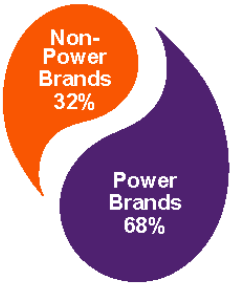
In addition, our portfolio includes another 44 brands that each generate annual revenues of more than $100 million.

2016 Fact Sheet

Mondelēz International
the power of big. and small.

Our Categories & Power Brands

In 2015, our Power Brands, which represent nearly 70 percent of our Pro Forma Adjusted Net Revenues*, continued to drive our top line and grew at a rate more than twice that of the total company.



* Pro Forma Adjusted Net Revenues exclude Venezuela operations. See GAAP to Non-GAAP reconciliations under Events & Webcasts tab of the investors' section of our website at http://bit.ly/1KYhs2E.

Our Strategies

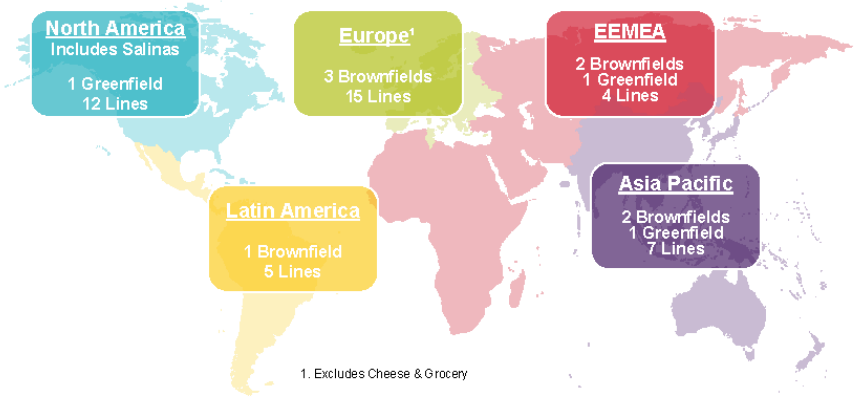
As a global snacks powerhouse, we leverage our competitive advantages to achieve two primary goals: deliver top-tier financial performance and be a great place to work.

We plan to achieve these goals by executing the following five strategies:

- Unleash the Power of Our People
- Transform Snacking
- Revolutionize Selling
- Drive Efficiency to Fuel Growth
- Protect the Well-Being of Our Planet

Continued Investments to Fuel Growth

We continue to invest in our Power Brands, innovation platforms, technologies and infrastructure to drive growth over the long-term. Since 2012, we've invested more than $1.5 billion in new or existing manufacturing sites to better meet our growth needs.



1. Excludes Cheese & Grocery

2016 Fact Sheet

Mondelēz International
the power of big. and small.

the call for well-being

The growth of our business is directly linked to the well-being of the people who make and enjoy our products and the communities we serve. As the world's largest snack company, we want to help people lead healthier lives and support their quest for well-being. Our Call For Well-being focuses on four areas that are critical to the world and where we can make the greatest impact:

- ***Well-being Choices:*** We intend to be the global leader in well-being snacks, with 50 percent of our portfolio in the Well-being space by 2020. To achieve our goal, we will simplify and improve the ingredient and nutritional profile of our current portfolio by reducing sodium and saturated fats by 10 percent; increasing whole grains by 25 percent; and looking to remove artificial colors and flavors in key brands. Secondly, we will expand the Well-being options within our portfolio. By 2020, we'll deliver 25 percent of our revenue from our Better Choice products; increasing the availability of portion control options by 25 percent; as well as expand our offering of products that meet consumers lifestyle needs. We plan to focus 70 percent of our new product development efforts on Well-Being platforms. Finally, we will continue to inspire consumers to snack mindfully and put calories on the front of packaging globally by the end of 2016 to help them make informed choices.

- ***Sustainability***: Our ability to create delicious tasting snacks starts with the community of farmers who grow our ingredients. We aim to create a sustainable cocoa supply by transforming the lives of smallholder cocoa farmers and communities at scale and will continue to invest and expand our signature Cocoa Life program to empower 200,000 cocoa farmers in six key origins. At the end of 2015, 21 percent of our cocoa was sustainably sourced through Cocoa Life. We also partnered with over 2,000 European wheat farmers to better preserve the environment and local biodiversity through Harmony, our European wheat-sourcing program, which now covers 75% of our biscuits sold in Western Europe. Our new Sustainability 2020 targets build on the reductions achieved in 2015 and place us at the forefront in the fight against climate change. Specifically, by 2020, we will reduce our absolute CO_2 emissions from manufacturing by 15 percent; reduce deforestation within our agricultural supply chain; and focus our water-reduction efforts in high-priority locations, reducing our usage by 10 percent. We will also eliminate 65,000 tons of packaging material and reduce total manufacturing waste by 20 percent.

- ***Safety:*** By the end of 2015, all of our internal manufacturing facilities achieved third-party food safety certification. And we continue to improve employee safety performance in all areas of the business year over year.

- ***Communities:*** We're investing $50 million in community partnerships over the next several years to support healthy lifestyle programs that will reach more than 1 million children and families across 14 countries. The programs are focused on nutrition education, active play and access to fresh foods, and align with the UN's Sustainable Development Goals of addressing malnutrition and promoting good health and well-being. To measure progress, we teamed up with the Yale School of Public Health to develop common KPIs for all programs. Our learnings are published in the Food & Nutrition Bulletin available to public health professionals in over 125 countries.

We recognize we don't have all the answers to these global societal challenges. But through our Call for Well-being, we're partnering with experts to bring together powerful ideas and help execute solutions at the local level. Check out our progress in the Well-Being section of our website.

2016 Fact Sheet

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facebook.com/mondelezinternational

twitter.com/MDLZ

www.linkedin.com/company/mondelezinternational

www.youtube.com/mdlz

Listed on the NASDAQ Global Select Market Ticker: MDLZ

Member of Standard & Poor's 500, NASDAQ-100 Indices and Dow Jones Sustainability Index

www.mondelezinternational.com

This fact sheet contains a number of forward-looking statements. Words, and variations of words, such as "will," "intend," "plan," "position," "target" and similar expressions are intended to identify our forward-looking statements, including, but not limited to, statements about: our financial performance, including our sales and profitability growth; our Well-being portfolio and goals; and our 2020 sustainability targets. These forward-looking statements are subject to a number of risks and uncertainties, many of which are beyond our control, which could cause our actual results to differ materially from those indicated in our forward-looking statements. Such factors include, but are not limited to, risks from operating globally including in emerging markets; changes in currency exchange rates, controls and restrictions; continued volatility of commodity and other input costs; weakness in economic conditions; weakness in consumer spending; pricing actions; unanticipated disruptions to our business; competition; our global workforce; the restructuring program and our other transformation initiatives not yielding the anticipated benefits; changes in the assumptions on which the restructuring program is based; and tax law changes. Please also see our risk factors, as they may be amended from time to time, set forth in our filings with the SEC, including our most recently filed Annual Report on Form 10-K. Mondelēz International disclaims and does not undertake any obligation to update or revise any forward-looking statement in this fact sheet, except as required by applicable law or regulation.