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PROCESS-BASED ANALYTICAL ACCOUNTS AND HYBRID COSTING IN FRUIT AND VEGETABLE PROCESSING ENTERPRISES

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Abstract

The paper proposes process-based analytical accounts and a hybrid costing method for fruit and vegetable processing enterprises. Working accounts opened under the synthetic accounts for main production, finished goods, sales revenue and period expenses record raw-material reception, boiling and concentration, aseptic filling and packaging, cold storage, product groups, export sales and laboratory and certification costs separately. Hybrid costing combines process costing for continuous lines with job-order costing for small-batch recipes and ties yield, rework, energy intensity and normative losses to cost centres. The proposals rest on the 2021–2024 statements of three processing enterprises of Uzbekistan and have been adopted by the Chamber of Commerce and Industry of Uzbekistan.

Keywords: Fruit and vegetable processing, analytical accounts, hybrid costing, process costing, normative losses, accounting policy, IAS 2.

Introduction

Deep processing of fruit and vegetables has become a strategic link of the agro-industrial chain of Uzbekistan: raw materials are seasonal and perishable, their quality, natural losses, cold chain and packaging determine both unit cost and selling price, and the share of export products with high value added is expected



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to grow, while financial accounting is being brought into line with international standards under Presidential Resolutions PQ-4611 [1] and PQ-282 [2]. In most processing enterprises, however, information on raw-material reception, technological stages, by-products, natural losses and finished goods is kept in aggregated form, so unit cost, profitability and resource use by process and product segment remain opaque to management and to the auditor.

The accounting of processing enterprises has been studied by Vlasova [5] and Kolesnikova [6] for the fruit and vegetable and fruit and berry subcomplexes and by Dvoretzkaya and Gorlo [7] for industrial processing shops; in Uzbekistan Ibragimov [8] and Avloqulov [9] examined production cost accounting and the accounting of financial results. None of these works offers analytical accounts fitted to the national chart of accounts [4] and to the stages of fruit and vegetable processing, or a costing method that reconciles continuous flows with small-batch orders.

The 2021–2024 statements of "Asian jam" LLC, "Green world-group" LLC and "East agro international" LLC show why this matters. Revenue grew fast – at "Asian jam" LLC from 3.76 to 5.92 trillion UZS, at "Green world-group" LLC from 3.28 to 8.81 trillion UZS – but the gross margin of "Asian jam" LLC fell from 47.9 to 26.6 per cent and its operating margin from 25.8 to –1.2 per cent, and "Green world-group" LLC closed 2024 with an operating margin of –9.9 per cent despite a gross margin of 45.1 per cent. The break-even revenue of the three enterprises rose over 2021–2023 from 2.32 to 4.83, from 2.11 to 4.01 and from 1.82 to 3.13 trillion UZS. The aim of the paper is to propose an accounting structure that makes the sources of such margin erosion visible by process, product and cost driver.



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Materials and methods

The study draws on the Law "On Accounting" [3], the chart of accounts approved as National Accounting Standard No. 21 [4], IAS 2 [10], and the financial statements, accounting policies and production records of the three enterprises for 2021–2024. Grouping, comparison, monographic study, cost-volume-profit analysis, modelling of accounting entries and expert assessment were applied; the enterprises' cost lines were unified into six economic elements so that their shares, growth rates and contribution to total cost change could be compared.

Results and discussion

The first element of the proposal is an accounting policy adapted to the sector, which fixes for each module the parameter to be adjusted, its normative range, the allocation base and the audit evidence (Table 1). Normal losses are set by product group and any excess is written off to period expenses; by-products and returnable waste are credited against the cost of the main product; energy intensity is metered by section; equipment is depreciated by component; revenue is recognised at the risk-transfer point defined by the delivery terms.



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Table 1. Adaptation map of the accounting policy of a fruit and vegetable processing enterprise

Module	Adjusted parameter and normative range	Allocation base and audit evidence
Materials	Normal loss: tomato 4–7 %, apple 2–4 %, apricot and peach 5–8 %	Raw material (kg), batch; batch passport, Brix and pH log
Energy and utilities	Intensity: boiling 0.10–0.25 kWh/kg, cold chain 0.05–0.12 kWh/kg	kWh/kg, steam kg/t; meter reports, heat map
General production	Laboratory, maintenance and logistics: 5–10 % of cost	Number of tests, work orders, tonne-km
Depreciation	Useful life: lines 7–12, energy 10–15, cold storage 12–20, IT 5–8 years	Component accounting; asset register
Joint and by-products	Split-off point or net realisable value, reviewed annually	Sales share or NRV; calculation sheet
Revenue and export	Risk transfer per EXW / FCA / FOB; FX costs 0.5–1.5 % of revenue	Contract, consignment note, certificates, invoices

Source: developed by the author.

The second element is a set of analytical accounts under the synthetic accounts of the national chart (Table 2): main production is split by technological stage, finished goods by product group, revenue by market and period expenses by the services on which the sector depends, each with its own physical unit and evidence source.



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Table 2. Proposed analytical accounts for fruit and vegetable processing enterprises

Synthetic account	Analytical account	Content	Unit and evidence
2010 Main production	2011 Raw-material reception	Raw material delivered, reception losses, tests	t, kg; reception act, laboratory log
	2012 Boiling and concentration	Heat energy, raw-material use, maintenance	kWh, kg; production order, meters
	2013 Aseptic filling and packaging	Containers, labels, sterilisation, labour	units, litres; packaging log, timesheet
	2014 Cold storage	Electricity, refrigeration losses, maintenance	kWh/kg; refrigeration records
2810 Finished goods	2811 Juices; 2812 Purees and pastes; 2813 Dried and frozen products	Cost and yield of each product group	litre, kg; warehouse records
9010 Sales revenue	9011 Domestic sales; 9012 Export sales	Revenue by market and currency	UZS, USD; contracts, customs documents
9410 Period expenses	9411 Laboratory and certification; 9412 Maintenance; 9413 Logistics	Quality control, certification fees, spare parts, transport	UZS, km, hours; protocols, journals

Source: developed by the author.

The third element is hybrid costing. Process costing suits the continuous lines – sterilisation, drying, freezing and aseptic filling – where output passes through successive stages and equivalent units divide costs between finished goods and work in progress, whereas job-order costing suits small-batch special recipes. The



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two are joined in a three-tier structure of centres, cost items and drivers: the centres follow the technological stages and service units, and the drivers are kilograms, litres, units, steam kilograms, kilowatt-hours, machine-hours, tests or batches and pallet-kilometres. Service-centre costs pass to the main processes in proportion to actual physical consumption, joint costs are allocated by net realisable value, normal losses stay in product cost and abnormal losses go to the period result, so that yield, rework share, energy intensity and normative losses are tied to specific cost centres. For tomato paste the resulting cost structure is 68–72 per cent raw material, 8–10 per cent energy, 8–12 per cent labour and 6–10 per cent maintenance and packaging, and the production report always satisfies the equality input costs = finished goods + closing work in progress + (abnormal losses – scrap value).

Applied to the three enterprises, the approach explains the margin dynamics reported above: material yield at "Asian jam" LLC rose from 72.5 to 78.0 per cent and energy intensity fell from 0.83 to 0.76 kWh/kg over 2021–2023, yet the contribution margin narrowed and the break-even point rose because raw-material and energy prices outpaced efficiency gains and selling and "other operating" expenses were not traced to products and channels. The proposed accounts have been adopted by the Chamber of Commerce and Industry of Uzbekistan (certificate No. 01-06-30-3857 of 21 April 2026).

Conclusions

1. Aggregated accounting of production costs in fruit and vegetable processing enterprises hides the stages, products and drivers at which margin is lost; analytical accounts 2011–2014, 2811–2813, 9011–9012 and 9411–9413, each tied to a physical unit and an evidence source, restore this visibility within the national chart of accounts and IAS 2.



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2. Hybrid costing, which combines process costing with equivalent units for continuous lines and job-order costing for small-batch recipes through a three-tier structure of centres, items and drivers, links yield, rework, energy intensity and normative losses to cost centres and yields a reliable unit cost and profitability by product segment.
3. The sector-specific accounting policy – normative loss ranges, energy intensity norms, component depreciation, NRV allocation of joint products and Incoterms-based revenue recognition – turns accounting into an instrument of cost control and audit evidence.

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